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Application of Fuzzy Analytic Hierarchy Process (FAHP) In Choosing a Comprehensive University for Medical Course

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Abstract: The Malaysian education system offers a wide range of courses to school leavers in public and private universities. Medical course is one of the courses chosen by outstanding students. Several universities across the country offer such courses. This study is going to determine the most favorable comprehensive universities in Malaysia that offer medical courses and examine the ranking of criteria that have an impact on choosing universities. Specifically, this study applied fuzzy triangular numbers (TFN) and fuzzy analytic hierarchy process (FAHP) to multi-criteria decision-making (MCDM). A set of questionnaires was distributed to the students of matriculation session 2020/2021 which were from Module 1. Responses were analyzed using Microsoft Excel based on FAHP Chang's model. FAHP shows the first rank university having the highest total weight vector. Universiti Malaysia Sabah (UMS) got the first rank based on the criteria chosen.

Keywords: Fuzzy analytic hierarchy process, Local universities, Matriculation student, Triangular fuzzy number Multi-criteria decision making

1 Introduction

Throughout the years, Malaysia has developed many public and private universities offering a wide variety of courses. Medical course is one of the most popular courses among students. From the 20 public universities, 11 universities offer Bachelor of Medicine and Surgery (MBBS), and all comprehensive universities offer this course. Considering the wide range of medical courses offered by universities, students should take into account a few criteria before choosing a university. These situations cause some fuzziness for students in the order to make a decision.

Pursuing studies at the tertiary level is students' choice to get a better qualification for career life. As technologies developed, there are many universities built to cope with the technological development demand, and education has been looked upon as a benchmark of one's achievement. Some factors to be considered in choosing universities are ranking, intermediate language, location, fees, and facility.

In this research, three criteria or factors were included which were the reputation of the institution, quality of facilities, and location of the universities. For the alternatives, four universities involved were Universiti Teknologi MARA (UiTM), Universiti Islam Antarabangsa Malaysia (UIA), Universiti Malaysia Sabah (UMS), and Universiti Malaysia Sarawak (UNIMAS). All the universities listed above are comprehensive universities in Malaysia. A group of students were selected from Pahang Matriculation College session 2020/2021 specifically to be the decision maker, and those who are in module 1 and module 3 were chosen as our respondents. For Matriculation programme, students who enrolled in science courses are divided into 3 modules which is module 1 consists of students who are taking both biology and physics subjects, module 2 consists of students who are taking only physics subject and module 3 consists of students who are taking biology subject only.

First and foremost, one of the best ways to determine the complex criteria is by using Analytical Hierarchy Process (AHP). The AHP is a structured technique for organizing and analyzing complex decisions that involve subjective judgments. AHP is used by listing some criteria and weighted them methodically according to their significance. Using an analytical method is the most preferred solution to obtain the best decision. It is because there are two types of variables that exist which are quantitative variable and qualitative variable. The respondents will choose and rate the most preferred choices [1]. Besides effectively dealing with qualitative and quantitative data, AHP is also easy to understand.

According to [2], fuzzy set is a theory in dealing with human thought's ambiguity and obscurity, whereby the theory was based on the rationality of uncertainty. The fuzzy set can be explained as a scale of zero to one, a class of objects with a membership function that represented uncertainty and vagueness in mathematical terms. According to Zadeh's concept, fuzzy set theory handles groups of data that ambiguously defined bound.

Definition 1: Fuzzy Subset [3]
Let E be a set with finite or infinite. Let A be a set contained in E. Then the set of ordered pairs $\left(x,\mu_A(x)\right)$ gives the fuzzy subset A of E, where x is an element in E and $\mu_A(x)$ is the degree of membership of x in E.

Definition 2: Fuzzy Number [3]
A fuzzy number is a generalization of a regular, real number. It refers to a connected set of possible values, where each possible value has its own weight between 0 to 1. Thus, a fuzzy number is a special case of a convex, normalized fuzzy set of the real line.

Definition 3: Triangular Fuzzy Number [3]
A fuzzy number $\tilde{A}=(a,b,c)$ is called triangular fuzzy number if its membership function is given by

$$\mu_{\tilde{A}}(x)=\begin{cases} 0 & ,x<a \\ \dfrac{x-a}{b-a} & ,a\le x\le b \\ \dfrac{c-x}{c-b} & ,b\le x\le c \\ 0 & ,x>c \end{cases} \quad . \tag{1}$$

Fuzzy AHP is an extension of the classical AHP method when there is fuzziness in making a decision. In solving real-world problems, the analysis method is strong and needs to extend crisp theory over the fuzzy techniques. To obtain more accurately measured parameters and variables, it requires some extension in the process for the case study [4]. Because of the confusion in the mind of the decision-makers, as it has been observed in recent years, the decision-making process should be integrated with the probable deviations [5].

Fuzzy AHP can be considered as one of the capable methodology for multi-criteria decision making (MCDM) since the consolidation between the fuzzy set theory and AHP have more application instead of the classical one. Fuzzy AHP provides a hierarchical structure, pairwise comparison, reduces inconsistency, fuzzy weight calculation, and generates ranking. Before proceeding to analyze the judgments, the process starts by building a hierarchy structure [1]. There are three levels in hierarchical system, and each level serves a different purpose. The structure is built from the first level to the second level and the third level. The pairwise comparison carried out by Fuzzy AHP using the fuzzy linguistic preference scale which ranged from 1 to 9. For the case of simplicity, the pairwise comparison matrix replaces the reciprocal fuzzy numbers with individual triangular fuzzy numbers (TFNs) [6].

Based on [7], the AHP is extensively used and evolved by T. L. Saaty in 1977 to derive ratio-scale priorities from pairwise comparison matrices. AHP is used to analyse the relative weights to be assigned to different criteria and alternatives, and the decision made [8]. According to [9], AHP is used in the HR selection process includes aspects such as personality tests, interviews, and participation in the contestants' curriculum vitae. Some data derived from decision-makers' subjective and individual judgments are arbitrary, and this is emphasised as a flaw when employing AHP [10]. The AHP is a regularly utilised MCDM method that has solved numerous real problems. The AHP is a regularly utilised MCDM method that has solved numerous real problems [11].

According to studies, the factors that influence students' decisions about which universities to attend range from one student to the next, however, there are some similarities [12]. The availability of appropriate programmes and financial aid, such as scholarships, were some of the deciding factors in how students choose a university [13]. Institutional variables include prestige, location, research programmes, educational facilities, tuition costs, career opportunities, and the availability of institutional subsidies. In terms of marketing or communication methods, advertising, college tours, institutional leaders visiting high schools, and job fairs are some of the variables influencing students' decisions to study at which universities [14]. Several studies have found that a range of elements connected to students' personal and individual characteristics, the role of others, students' expectations about relevance and costs, as well as institutional features, impact students' decisions to attend a university for research [15]. According to [16], it also mentions lecturers' experience, range of courses offered, and travel comfort as some of the predictors of the preferences of students to select a specific university to study at. In his study, [17] also cited that marketing, in particularly the marketing mix, had a major impact on how students choose to study at colleges, they found that the desire to simply acquire a degree was the primary determinant.

Based on [18], it was found that access to learning facilities such as information communication technologies (ICT), cultural diversity, international partnerships, institutional social life, and requirements for admission, flexible modes of study, and campus attractiveness had a significant impact on how students make their choices about which university to study at. The higher education environment is today confronted with the twin issues of fewer students eligible for government funding and fierce competition among colleges for these students [19]. Literature suggests that any misinformed option might fully destroy the life of students. According to [20] and [21], their study discovered that parents have a significant influence on how students (their children) choose a university to attend.

2 Methodology

This study employs the FAHP Chang's extent analysis method. Steps 1 – 6 below show the detailed steps of Chang's extent analysis method.

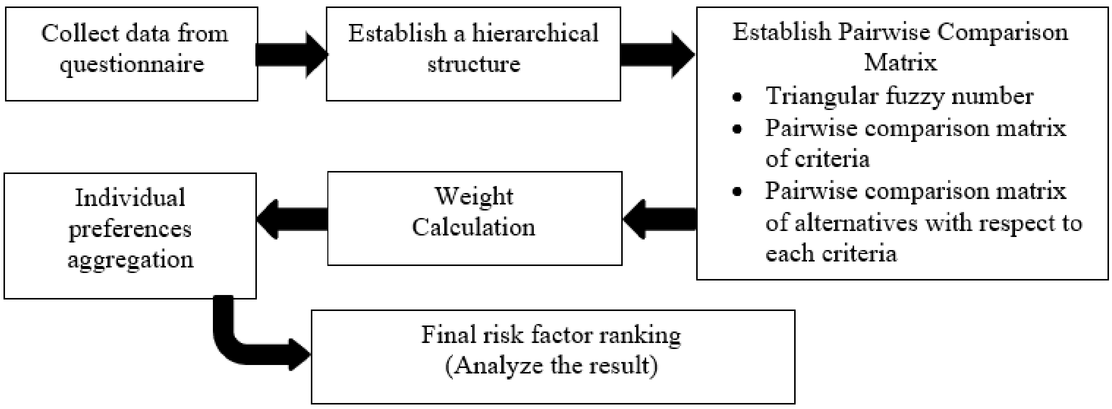


Figure 1: The Flowchart of FAHP Method

Step 1: Data Collection from Questionnaire

Four decision makers were Matriculation Programme students from Pahang Matriculation College session 2020/2021. Students who take biology subject will be chosen as the respondents. At the matriculation college, only Module 1 and Module 3 students take biology subjects. Each respondent will be asked to answer the given questionnaire. Based on the scope, we can see that this research placed a constraint on the sample size to be used. This research is also only limited to Module 1 and Module 3 of Malaysia Matriculation Programme. The data collected from the questionnaire were analysed using Chang's extent analysis method.

Step 2: Establish a Hierarchical Structure

There are three levels in the hierarchical structure. Top-level, second-level, and third-level which represent goal, criteria, and alternative, respectively.

Step 3: Establish Pairwise Comparison Matrix

The importance of each criterion and alternative was determined by creating the fuzzy pairwise comparison matrix. The semantic description was used in this study to allow the respondents to express their opinion and judgments fully. The triangular fuzzy number (TFN) was used to express semantic judgment value.

Construct a fuzzy decision matrix, $\tilde{A}_t$:

$$\tilde{A}_t = \left\{\tilde{d}_{ijt}\right\} = \begin{bmatrix} \tilde{d}_{11t} & \cdots & \tilde{d}_{1nt} \\ \vdots & \ddots & \vdots \\ \tilde{d}_{n1t} & \cdots & \tilde{d}_{nnt} \end{bmatrix} \quad (2)$$

For more than one decision maker, $\tilde{d}_{ijt} = \dfrac{\sum_{i=1}^{t} \tilde{d}_{ijt}}{t}$ (3)

Then, compute the average fuzzy decision matrix, $\tilde{A}$:

$$\tilde{A} = \left\{\tilde{d}_{ij}\right\} = \begin{bmatrix} \tilde{d}_{11} & \cdots & \tilde{d}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{d}_{n1} & \cdots & \tilde{d}_{nn} \end{bmatrix} \quad (4)$$

where

$\tilde{A}_t$: Fuzzy pairwise comparison matrix in t^{th} period.

$\tilde{d}_{ijt}$: Fuzzy triangular number which represents the decision maker's preference of criterion *j* in t^{th} period as $\tilde{d}_{ijt} = \left(l_{ijt}, m_{ijt}, u_{ijt}\right)$. While criterion j over criterion i in t^{th} period as $\dfrac{1}{\tilde{d}_{ijt}} = \left(\dfrac{1}{l_{ijt}}, \dfrac{1}{m_{ijt}}, \dfrac{1}{u_{ijt}}\right)$.

$\tilde{A}$: Average fuzzy pairwise comparison matrix in t^{th} period.

Step 4: Weight Calculation

The crisp weight from fuzzified pairwise comparison was determined by calculating the value of fuzzy synthetic extent with respect to t^{th} alternative as follows:

$$s_i = \sum_{j=1}^{n} \tilde{d}_{ij} \left[\sum_{i=1}^{n} \sum_{i=1}^{n} \tilde{d}_{ij} \right]^{-1} \quad (5)$$

where

$$\sum_{j=1}^{n} \tilde{d}_{ij} = \left(\sum_{j=1}^{n} l_j , \sum_{j=1}^{n} m_j , \sum_{j=1}^{n} u_j \right)$$

and

$$\left[\sum_{i=1}^{n} \sum_{i=1}^{n} \tilde{d}_{ij} \right]^{-1} = \left(\frac{1}{\sum_{j=1}^{n} l_j}, \frac{1}{\sum_{j=1}^{n} m_j}, \frac{1}{\sum_{j=1}^{n} u_j} \right)$$

Step 5: Individual Preferences Aggregation

The degree of possibility can be calculated as follows:

Let $M_1 = (l_1, m_1, u_1)$ be the first triangular fuzzy number and $M_2 = (l_2, m_2, u_2)$ be the second triangular fuzzy number.

If $(M_2 \geq M_1)$ then $V(M_2 \geq M_1) = \sup_{y \geq x} \left[\min\left(\mu_{M1}(x)\right), \min\left(\mu_{M2}(y)\right) \right]$

$$V(S_2 \geq S_1) = \begin{cases} 1 if m_2 \geq m_1 \\ 0 if l_1 \geq u_2 \\ \frac{(l_1 - u_2)}{(m_2 - u_2) - (m_1 - l_1)}, otherwise \end{cases}$$

$$V(S \geq S_1, S_2, ..., S_k) = \min V(S \geq S_i);\ i = 1, 2, ..., k \tag{6}$$

$$d'(A_i) = \min V(S_i \geq S_k);\ i, k = 1, 2, ..., n;\ k \neq i$$

$$W' = \left[d'(A_1), d'(A_2), d'(A_3) \right]^T \tag{7}$$

The minimum of these possibilities was used as the overall score for each factor. Then these scores were normalized to get the overall weight, W.

Step 6: Final Risk Factor Ranking (Analyse the Result)

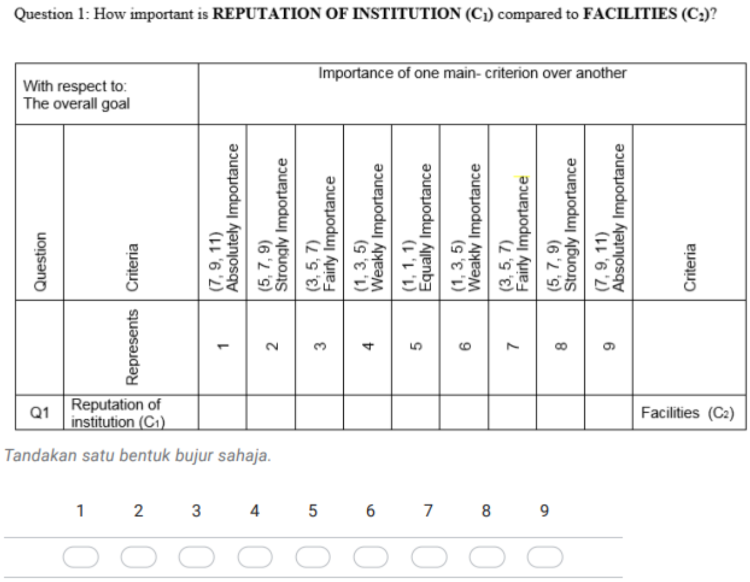
The ranking was implemented based on the overall weight value. Overall weight value was obtained by multiplying the weight vector of the criteria with the weight vector of the alternatives. The alternatives, ranked by using total weight, will be used to rank the alternatives. The largest weight will be the highest ranking, while the smallest weight will be the lowest ranking. The ranking of the alternatives helps students to determine the most favourable comprehensive university in medical courses.

3 Implementation

The FAHP methodology to rank the best comprehensive university for medicine courses is based on Chang's analysis method. Below is an explanation of each of the steps in detail.

Step 1: Data Collection from Questionnaire

A set of questionnaires containing 2 parts and 21 questions were constructed. The first part is about the comparison of the main criteria and has 3 questions. The second part is about the comparison of the alternatives with respect to each criterion and has 18 questions. The questionnaire was distributed to 4 respondents. All of the respondents were from Pahang Matriculation College session 2020/2021 Module 1 and Module 3 (Science Stream) students.


Question 1: How important is **REPUTATION OF INSTITUTION (C_1)** compared to **FACILITIES (C_2)**?

With respect to: The overall goal		Importance of one main- criterion over another									
Question	Criteria	(7, 9, 11) Absolutely Importance	(5, 7, 9) Strongly Importance	(3, 5, 7) Fairly Importance	(1, 3, 5) Weakly Importance	(1, 1, 1) Equally Importance	(1, 3, 5) Weakly Importance	(3, 5, 7) Fairly Importance	(5, 7, 9) Strongly Importance	(7, 9, 11) Absolutely Importance	Criteria
	Represents	1	2	3	4	5	6	7	8	9	
Q1	Reputation of institution (C_1)										Facilities (C_2)

Tandakan satu bentuk bujur sahaja.

1 2 3 4 5 6 7 8 9

Figure 2: Sample of Questionnaire

Step 2: Establish a Hierarchical Structure

A hierarchical structure with 3 levels was constructed. The top level, second level, and third level, respectively, represent the goal, criteria, and alternative of the project. Figure 3 below shows the hierarchical structure.

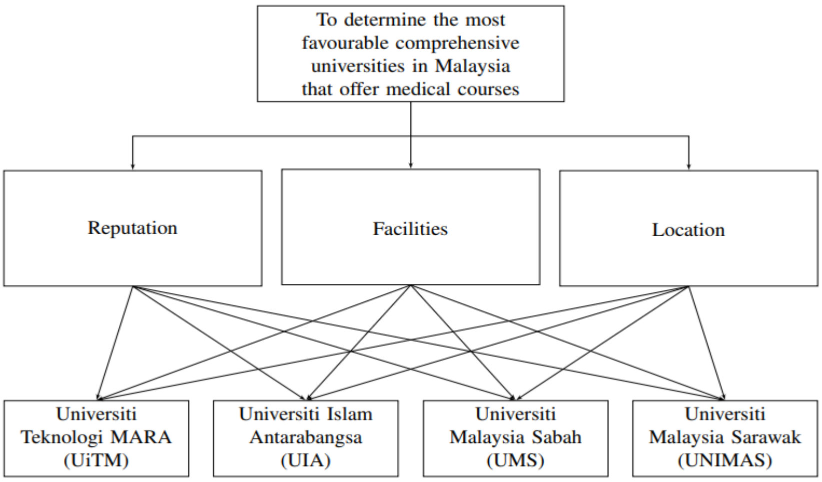


Figure 3: The Hierarchical Structure.

Step 3: Establish Pairwise Comparison Matrix

The fuzzy pairwise comparison matrix was created in this step. All the calculations in each step were calculated using Microsoft Excel. Each of the results of the comparison was represented by a triangular fuzzy number and its inverse. Table 1 below shows the linguistic terms as in [22]

Table 1: The Linguistic Terms

Linguistic Terms	**TFNs**	**Inverse TFNs**
Equally Importance	(1,1,1)	(1,1,1)
Weakly Importance	(1,3,5)	(1/5,1/3,1)
Fairly Importance	(3,5,7)	(1/7,1/5,1/3)
Strongly Importance	(5,7,9)	(1/9,1/7,1/5)
Absolutely Importance	(7,9,11)	(1/11,1/9,1/7)

A pairwise comparison matrix was generated from the questionnaire that was answered by the decision-maker. To generate pairwise comparison, the answers from the questionnaire were transformed into a TFN from Table 1 using equations (2) and (3).

Table 2: Fuzzified Pairwise Comparison Matrix

	C1			**C2**			**C3**		
DM1									
C1	1	1	1	5	7	9	7	9	11
C2	0.1111	0.1429	0.2	1	1	1	1	1	1
C3	0.0909	0.1111	01429	1	1	1	1	1	1
DM2									
C1	1	1	1	0.1111	0.1429	0.2	0.1111	0.1429	0.2
C2	5	7	9	1	1	1	0.1429	0.2	0.3333
C3	5	7	9	3	5	7	1	1	1
DM3									
C1	1	1	1	0.1429	0.2	0.3333	0.1111	0.1429	0.2
C2	3	5	7	1	1	1	0.1429	0.2	0.3333
C3	5	7	9	3	5	7	1	1	1
DM4									
C1	1	1	1	1	1	1	1	1	1
C2	1	1	1	1	1	1	1	1	1
C3	1	1	1	1	1	1	1	1	1

The average matrix of the comparison of main criteria is represented in Table 3.

Table 3: Average Fuzzified Comparison of Main Criteria

	C1			**C2**			**C3**		
C1	1	1	1	1.5635	2.0857	2.6333	2.0556	2.5714	3.1000
C2	2.2778	3.2857	4.3000	1	1	1	0.5714	0.6000	0.6667
C3	2.7727	3.7778	4.7857	2	3	4	1	1	1

The average matrix for the comparison of alternatives with respect to the main criteria is shown in Table 4.

Table 4: Average Fuzzified Matrix for Comparison of Alternatives Respect to the Main Criteria

		A1			**A2**			**A3**			**A4**		
C1	A1	1	1	1	1.0857	1.6333	2.3333	1.2857	1.8	2.3333	1.0778	1.619	2.3
	A2	1	2	3	1	1	1	2	2	3	2	2	3
	A3	1	2	2	1	2	3	1	1	1	2	2	3
	A4	2	3	4	2	3	4	2	2	3	1	1	1
C2	A1	1	1	1	0.5714	1.1	1.6667	1.0778	1.6190	2.3	0.3778	0.9524	1.8
	A2	2	3	4	1	1	1	2	3	3	2	3	4
	A3	2	3	4	2	3	4	1	1	1	2	2	3
	A4	2	3	5	2	2	3	2	3	5	1	1	1
C3	A1	1	1	1	1.5857	2.1333	2.8333	1.2778	1.7857	2.3	1.7778	2.2857	2.8
	A2	1	2	3	1	1	1	2	3	3	1	2	3
	A3	2	2	3	2	3	4	1	1	1	2	3	4
	A4	2	2	3	2	3	4	1	2	2	1	1	1

Step 4: Weight Calculation

Crisp weight from fuzzified pairwise comparison was determined by calculating the value of fuzzy synthetic extent with respect to i^{th} alternative. Table 5 below shows the value of synthetic extent with respect to the i^{th} alternatives for each criterion using equation (4).

Table 5: Result of Synthetic Extent with Respect to the *i* th Alternatives

		a	***b***	***c***	$\sum_{j=1}^{n}\tilde{d}_{ij}$	***l***	***m***	***u***	S_i
C1	A1	4.4492	6.0524	7.9667	(4.4495, 6.0524, 7.9667)	0.1147	0.2028	0.3692	(0.1147, 0.2028, 0.3692)
	A2	5.4492	7.5524	9.9667	(5.4492, 7.5524, 9.9667)	0.1404	0.253	0.4618	(0.1404, 0.2530, 0.4618)
	A3	5.3413	7.3714	9.4333	(5.3413, 7.3714, 9.4333)	0.1377	0.247	0.4371	(0.1377, 0.247, 0.4371)
	A4	6.3413	8.8714	11.4333	(6.3413, 8.8714, 11.4333)	0.1634	0.2972	0.5298	(0.1634, 0.2972, 0.5298)
	Total	21.581	29.8476	38.8					
	$(a,b,c)^{-1}$	0.0258	0.0335	0.0463					
C2	A1	3.0270	4.6714	6.7667	(3.027, 4.6714, 6.7667)	0.0679	0.1411	0.2975	(0.0679, 0.1411, 0.2975)
	A2	6.6413	6.6413	11.9333	(6.6413, 9.2048, 11.9334)	0.1490	0.2779	0.5246	(0.1490, 0.2779, 0.5246)
	A3	6.9299	9.5111	12.2857	(6.9299, 9.5111, 12.2857)	0.1555	0.2872	0.5401	(0.1555, 0.2872, 0.5401)
	A4	6.1505	9.7302	13.5857	(6.1505, 9.7302, 13.5857)	0.1380	0.2938	0.5972	(0.138, 0.2938, 0.5972)
	Total	22.7486	33.1175	44.5714					
	$(a,b,c)^{-1}$	0.0224	0.0302	0.0440					
C3	A1	5.6413	7.2048	8.9333	(5.6413, 7.2048, 8.9333)	0.1342	0.2187	0.3685	(0.1342, 0.2187, 0.3685)
	A2	5.6190	8.1571	10.7333	(5.619, 8.1571, 10.7333)	0.1337	0.2477	0.4428	(0.1337, 0.2477, 0.4428)
	A3	7.3442	9.8778	12.4524	(7.3442, 9.8778, 12.4524)	0.1747	0.2999	0.5137	(0.1747, 0.2999, 0.5137)
	A4	5.6362	7.6968	9.9190	(5.6362, 7.6968, 9.9190)	0.1341	0.2337	0.4092	(0.1341, 0.2337, 0.4092)
	Total	24.2407	32.9365	42.0381					
	$(a,b,c)^{-1}$	0.0238	0.0238	0.0413					

Step 5: Individual Preferences Aggregation
The fuzzy triangular weights' crisp weight was determined to comply with the FAHP by using the fuzzy number comparison. Using the given equation, a pairwise comparison with the other fuzzy weights was conducted to determine the degree of possibility. Table 6 below shows the result of the degree of possibility for each criterion using equations (5) and (6).

Table 6: Degree of Possibility of Alternatives with Respect to Criteria

		C1	**C2**	**C3**
S_1	$V(S_1 \geq S_2)$	0.8199	0.5203	0.8904
	$V(S_1 \geq S_3)$	0.8397	0.4928	0.7049
	$V(S_1 \geq S_4)$	0.6853	0.5107	0.9401
S_2	$V(S_2 \geq S_1)$	1	1	1
	$V(S_2 \geq S_3)$	1	0.9756	0.8369
	$V(S_2 \geq S_4)$	0.8710	0.9606	1
S_3	$V(S_3 \geq S_1)$	1	1	1
	$V(S_3 \geq S_2)$	0.9800	1	1
	$V(S_3 \geq S_4)$	0.8449	0.9838	1
S_4	$V(S_4 \geq S_1)$	1	1	1
	$V(S_4 \geq S_2)$	1	1	0.9517
	$V(S_4 \geq S_3)$	1	1	0.7798

The above table is calculated manually since it just compares the value using the given equation. All the chosen minimum degrees of possibility normalized using the given equation. Table 7 below shows the result of normalized weight for each criterion.

Table 7: Normalized Weight of Alternative with Respect to Criteria

Criteria		W'	**Normalized Weight, W**
C1	$V(S_1 \geq S_2, S_3, S_4)$	0.6853	0.2015
	$V(S_2 \geq S_1, S_3, S_4)$	0.8710	0.2561
	$V(S_3 \geq S_1, S_2, S_4)$	0.8449	0.2484
	$V(S_4 \geq S_1, S_2, S_3)$	1	0.2940
	Total	**3.4012**	
C2	$V(S_1 \geq S_2, S_3, S_4)$	0.4928	0.1434
	$V(S_2 \geq S_1, S_3, S_4)$	0.9606	0.2795
	$V(S_3 \geq S_1, S_2, S_4)$	0.9838	0.2862
	$V(S_4 \geq S_1, S_2, S_3)$	1	0.2909
	Total	**3.4372**	
C3	$V(S_1 \geq S_2, S_3, S_4)$	0.7049	0.2122
	$V(S_2 \geq S_1, S_3, S_4)$	0.8369	0.2520
	$V(S_3 \geq S_1, S_2, S_4)$	1	0.3011
	$V(S_4 \geq S_1, S_2, S_3)$	0.7798	0.2348
	Total	**3.3216**	

Step 6: Final Risk Factors Ranking

In the last step, the risk factors ranking was done. The weight vector of criteria and the normalized weight of each alternative were multiplied to get the overall weight. The largest weight would be the highest-ranking, while the smallest weight would be the lowest ranking. Table 8 below shows the ranking of the university according to its weight.

Table 8: Weight Table for Risk Factors

Criteria	Weight of Criteria	Weight of A1	A1 UiTM	Weight of A2	A2 UIA	Weight of A3	A3 UMS	Weight of A4	A4 UNIMAS
C1	0.3017	0.2015	0.0608	0.2561	0.0773	0.2484	0.0750	0.2940	0.2348
C2	0.3017	0.1434	0.0337	0.2795	0.0656	0.2862	0.0672	0.2909	0.0683
C3	0.4634	0.2122	0.0983	0.2795	0.0656	0.3011	0.1395	0.2348	0.1088
TOTAL			0.1928		0.2597		0.2817		0.2658
RANK			**4**		**3**		**1**		**2**

4 Results and Discussion

The total weight vectors calculated were summarized in a table and arranged according to their total weight vectors in a descending order. Table 9 below shows the arrangement of alternatives based on ranking.

Table 9: Arrangement of Alternatives Based on Ranking

Alternatives		Total Weight Vectors	Rank
A3	UMS	0.2817	1
A3	UNIMAS	0.2658	2
A2	UIA	0.2597	3
A1	UiTM	0.1928	4

The table shows the weight vector for each alternative. Based on the findings, four students had answered the questionnaire prepared according to their preference. The total weight vectors were calculated from the data obtained for each respondent. The results indicate that the ranking of the universities starting from the most preferred universities were UMS, UNIMAS, UIA, and UiTM. The total weight vectors for each university were 0.2817, 0.2658, 0.2597, and 0.1928, respectively.

5 Conclusion and Recommendations

Making decisions is so important and common in our daily lives. The results show the candidates' preference according to three criteria in choosing a comprehensive university for medical courses. It has a disadvantage, however, that the person whose opinion is used as data must have a solid understanding of the medical courses in charge of the decision-making process. In such a situation, in addition to respondents who are studying at the same educational level, it is also vital to collect important information from respondents who are studying the same course, which is module 1 (science stream) as a prerequisite for pursuing a medical course. Overall, the findings revealed the favoured comprehensive universities' overall ranking by summing up the total weight vectors for each university. The universities were ranked based on their total weight vectors. The higher the total weight vectors, the higher the rank of the university. It is shown by the application in definite cases that the FAHP Chang's method is easy and effective. The methodology can be used by students since it is a method that allows the evaluation of the criteria level and also to see whether the comprehensive university is preferred and suitable for what they need and expect. The FAHP Chang's method will ease the respondents in choosing the university based on their preferences according to all criteria or factors.

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