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APPLICATION OF THE FUZZY TOPSIS METHOD FOR LECTURER CERTIFICATION ASSESSMENT

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ABSTRACT

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Lecturer Certification (Serdos) is the method of granting educational certificates to lecturers as a formal verification of the speaker's recognition as an expert at a higher level of teaching. In Lecturer Certification, there is an Assessment of Lecturers' Self-Statements in Higher Education Tridharma Performance (PDD-UKTPT), which is divided into three Assessment Elements, namely Teaching, Research and Publication of Scientific Work and Community Service (PkM). The study focuses on teaching assessment. Sam Ratulangi University is one of the Universities Organizing Educator Certification for Lecturers (PTPS) in 2023. The Lecturer Certification assessment at Sam Ratulangi University does not describe the specific assessment range or include the importance weight of each criterion. Thus, this research aims to apply the Fuzzy TOPSIS method as an alternative in the assessment, which determines the importance and weight of each criterion and provides a description of the specific assessment range for each criterion to overcome uncertainty in the evaluation to provide clear guidelines for Serdos assessors in conducting the assessment. The research results regarding lecturer suitability decisions in assessing the Teaching Element. Therefore, it is found that Fuzzy TOPSIS can be used as an assessment method in Lecturer Certification, and it is better suited to handle the uncertainty issues often encountered in lecturer certification assessments. The result of this study provides an excellent accuracy of 100% compared with the manual method.

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1. INTRODUCTION

Lecturer Certification (Serdos) is the process of granting educational certificates to Concerned Lecturers (DYS) as formal proof of recognition of lecturers as professionals at the higher education level [1]. One of the Serdos assessments is the Assessment of Lecturers' Self-Statement in the Tridarma of Higher Education Performance (PDD-UKTPT) assessment, which has three assessment elements, namely the Teaching Element, the Research and Publication of Scientific Work Element, and the Community Service Element. Sam Ratulangi University is one of the universities included in PTPS in 2023. Universities Providing Educator Certification for Lecturers (PTPS) is tasked with assessing lecturer portfolios proposed by Proposing Universities (PTU).

In the Serdos assessment, the PDD-UKTPT Sam Ratulangi University section has an assessment interval of 1-7. Still, it does not have a specific description of the assessment range and does not include the importance weight of each assessment criterion. Therefore, this research aims to apply the Fuzzy TOPSIS method as an alternative method in assessing Serdos using Python [2], which determines the importance weight of each assessment criterion in order to adjust the influence of each assessment criterion. The Python libraries used are Pandas, NumPy, Scikit-fuzzy, and Matplotlib, and the Google Colab platform is used to run the Python code. In addition, this research method provides a more specific distribution of assessment ranges, where the assessments are similar and take into account variations in grades in assessing lecturer abilities.

The Order of Preference by Similarity (TOPSIS) method was applied to select priority areas with the most stunting cases in the Sigi Regency in Central Sulawesi Province [3]. On the other hand, the fuzzy method was widely used. In [4], fuzzy mamdani is used to determine the maturity level of crystal guava, while [5] selects candidates eligible to receive Social Assistance from the Government.

TOPSIS is also combined with other methods. Study [6] combined TOPSIS with SAW to choose the potential plasma donor candidate. Meanwhile, fuzzy is also widely combined with different techniques to solve many problems. In [7][8], it combines fuzzy mamdani with back-propagation neural networks to sort out and select the most deserving candidates to receive "bidikmisi" scholarships for economically weak communities in Indonesia.

Fuzzy TOPSIS is a method of FMADM (fuzzy multi-attribution decision-making) that finds optimal choices among several options with specific criteria [9]. Fuzzy TOPSIS has the advantage of handling the uncertainty of data subjectivity through the use of fuzzy numbers and linguistic evaluation, as well as being flexible in dealing with the complexity of assessment [10][11][12].

Several studies use the fuzzy TOPSIS method, which applied the fuzzy analytical hierarchy process (fuzzy AHP) and fuzzy TOPSIS methods to assess lecturer performance in Vietnam. The results obtained were 12 lecturers and nine sub-criteria, and those who got the highest scores were lecturers 8 and 12 [13]. There was also research, which applied the Fuzzy TOPSIS method to find a method for developing sustainable software in the industrial era 5.0. The results obtained contained 4 criteria and 5 alternatives, and the Agile Method obtained the highest sustainability performance [14]. The research uses the Fuzzy TOPSIS method as a Decision Support System for the Selection of Outstanding Students. There were 4 alternative students, and Student B got the highest score [15]. There is research using Fuzzy TOPSIS in recruiting managers in a company. The results show that Candidate A1 has the highest value [16]. The research uses the fuzzy TOPSIS method as a decision support system to determine outstanding employees in the Batu City population and civil registration service. The results show that the first alternative with a value of 1 occupies a position as an exceptional employee [17]. There is research using Fuzzy TOPSIS to determine the best cycling athletes. The results obtained by ID16 are the best cycling athletes [18].

2. RESEARCH METHOD

The research stage begins with a literature study of previous research on the Fuzzy TOPSIS method and Lecturer Certification Assessment. The type of data used is secondary data. The data source of this study is the 2023 Lecturer Certification Assessment Results Document at Sam Ratulangi University in the PDD-UKTPT section. This research began in December 2023 and continued until June 2024, and the research was conducted at the researcher's residence. The data collection technique is done by collecting documents on the results of the Lecturer Certification Assessment and interviews with the Lecturer Certification Coordinator of Sam Ratulangi University. Data analysis uses the Fuzzy TOPSIS method. Analyze the results by comparing the results of the Fuzzy TOPSIS calculation with the manual calculation of Serdos UNSRAT and count the accuracy. Figure 1 describes the research steps.

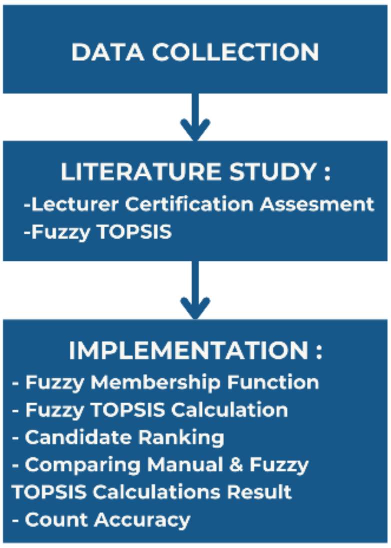

Figure 1. Research Model Diagram

3. RESULT AND DISCUSSION

Based on the data from the five criteria Teaching Elements, the first step is to divide each criterion into domains, the universe of conversations, linguistic variables, and TFN values.

3.1 Criteria Domain

Table 1 explains the elaboration of the domains of criteria 1 to 5 along with the universe of speech, linguistic variables, and their TFN values [19].

Table 1. Criteria Domain

Criteria	Domain	Universe of Conversations	Linguistic Variables	TFN
Mastery of Material (C1)	1.0-4.5	1.0-7.1	Not Mastered (NM)	(1,1,3)
	4.0-6.5		Mastered (M)	(3,5,7)
	5.6-7.1		Very Masterful (VM)	(7,9,9)
Suitability of the Material Delivered with Learning Achievements (C2)	1.0-4.5	1.0-7.1	Not Appropriate (NO)	(1,1,3)
	4.0-6.5		Appropriate (AP)	(3,5,7)
	5.6-7.1		Very Appropriate (VA)	(7,9,9)
Interaction in the Learning Process (C3)	1.0-4.5	1.0-7.1	Passive (P)	(1,1,3)
	4.0-6.5		Medium (M)	(3,5,7)
	5.6-7.1		Active (A)	(7,9,9)
Learning Achievement Assessment (C4)	1.0-4.5	1.0-7.1	Bad (B)	(1,1,3)
	4.0-6.5		Medium (MD)	(3,5,7)
	5.6-7.1		Good (G)	(7,9,9)
Creativity in Delivering Material (C5)	1.0-4.5	1.0-7.1	Not Creative (NC)	(1,1,3)
	4.0-6.5		Creative (C)	(3,5,7)
	5.6-7.1		Very Creative (VC)	(7,9,9)

3.2 Output Variable

Table 2 explains the output variable named "Result" which has 3 linguistic variables, namely "Not Worthy", "Worthy" and "Very Worthy"[19].

Table 2. Output Variable

Output Variable	Domain	Universe of Conversations	Linguistic Variables
Result	0 - 0.45	0 - 1.1	Not Worthy
	0.40 - 0.80		Worthy
	0.75 - 1.1		Very Worthy

3.3 Fuzzy Membership Function

This stage determines the membership function for criteria 1 to criteria 5 using a triangular curve representation [11][20], [21][13].

$$\mu[x] = \begin{cases} 0, x \leq a \ or \ x \geq c \\ \frac{x-a}{b-a}, a < x < b \\ 1, x = b \\ \frac{c-x}{c-b}, b < x < c \end{cases} \quad (1)$$

Criterion 1. Mastery of the Material

Figure 1 displays the graph of **Criterion 1**, which has 3 Linguistic Variables, namely "Not Mastering", which has a domain of 1.0-4.5; "Mastering", which has a domain of 4.0-6.5; and "Very Mastery", which has a domain of 5.6-7.1.

$$\mu \text{ Not Mastered } (x) = \begin{cases} 0, x \leq 1.0 \ or \ x \geq 4.5 \\ \frac{x-1.0}{2.8-1.0}, 1.0 < x < 2.8 \\ 1, x = b \\ \frac{4.5-x}{4.5-2.8}, 2.8 < x < 4.5 \end{cases}$$

$$\mu \text{ Mastered } (x) \begin{cases} 0, \text{if } x \leq 4.0 \ or \ x \geq 6.5 \\ \frac{x-4.0}{5.3-4.0}, 4.0 < x < 5.3 \\ 1, x = b \\ \frac{6.5-x}{6.5-5.3}, 5.3 < x < 6.5 \end{cases}$$

$$\mu \text{ Very Mastery } (x) \begin{cases} 0, x \leq 5.6 \ or \ x \geq 7.1 \\ \frac{x-5.6}{6.4-5.6}, 5.6 < x < 6.4 \\ 1, x = b \\ \frac{7.1-x}{7.1-6.4}, 6.4 < x < 7.1 \end{cases}$$

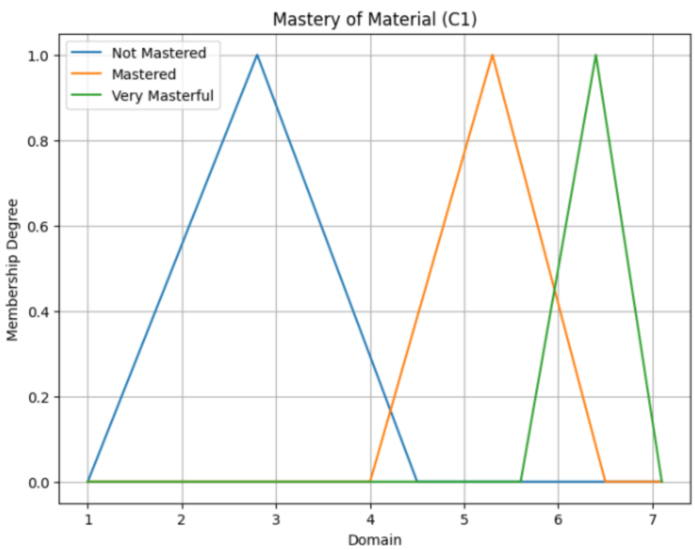

Figure 2. C1 Membership Function Curve

Criterion 2. Suitability of the Material Delivered with Learning Outcomes

Figure 2 displays the graph of **Criterion 2**, which has 3 Linguistic Variables, namely "Not Appropriate", which has a domain of 1.0-4.5; "Appropriate", which has a domain of 4.0-6.5; and "Very Appropriate", which has a domain of 5.6-7.1.

$$\mu \text{ Not Appropriate } (x) = \begin{cases} 0, x \leq 1.0 \text{ } or \text{ } x \geq 4.5 \\ \frac{x-1.0}{2.8-1.0}, 1.0 < x < 2.8 \\ 1, x = b \\ \frac{4.5-x}{4.5-2.8}, 2.8 < x < 4.5 \end{cases}$$

$$\mu \text{ Appropriate } (x) \begin{cases} 0, \text{if } x \leq 4.0 \text{ } or \text{ } x \geq 6.5 \\ \frac{x-4.0}{5.3-4.0}, 4.0 < x < 5.3 \\ 1, x = b \\ \frac{6.5-x}{6.5-5.3}, 5.3 < x < 6.5 \end{cases}$$

$$\mu \text{ Very Appropriate } (x) \begin{cases} 0, x \leq 5.6 \text{ } or \text{ } x \geq 7.1 \\ \frac{x-5.6}{6.4-5.6}, 5.6 < x < 6.4 \\ 1, x = b \\ \frac{7.1-x}{7.1-6.4}, 6.4 < x < 7.1 \end{cases}$$

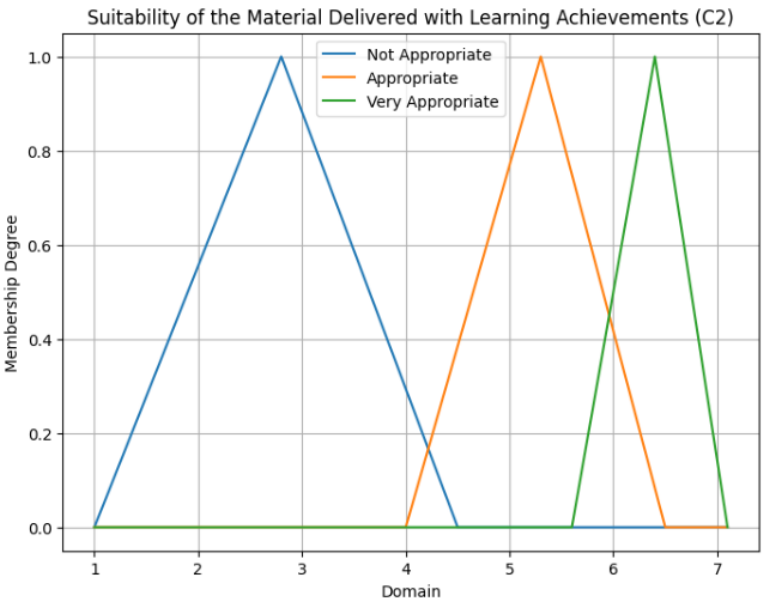

Figure 3. C2 Membership Function Curve

Criterion 3. Interaction in the Learning Process

Figure 3 displays the graph of **Criterion 3** that has 3 Linguistic Variables, namely "Passive", which has a domain of 1.0-4.5; "Medium", which has a domain of 4.0-6.5; and "Active", which has a domain of 5.6-7.1.

$$\mu \text{ Passive } (x) = \begin{cases} 0, x \leq 1.0 \text{ } or \text{ } x \geq 4.5 \\ \frac{x-1.0}{2.8-1.0}, 1.0 < x < 2.8 \\ 1, x = b \\ \frac{4.5-x}{4.5-2.8}, 2.8 < x < 4.5 \end{cases}$$

$$\mu \text{ Medium } (x) \begin{cases} 0, if\ x \leq 4.0\ or\ x \geq 6.5 \\ \frac{x-4.0}{5.3-4.0}, 4.0 < x < 5.3 \\ 1, x = b \\ \frac{6.5-x}{6.5-5.3}, 5.3 < x < 6.5 \end{cases}$$

$$\mu \text{ Active } (x) \begin{cases} 0, x \leq 5.6\ or\ x \geq 7.1 \\ \frac{x-5.6}{6.4-5.6}, 5.6 < x < 6.4 \\ 1, x = b \\ \frac{7.1-x}{7.1-6.4}, 6.4 < x < 7.1 \end{cases}$$

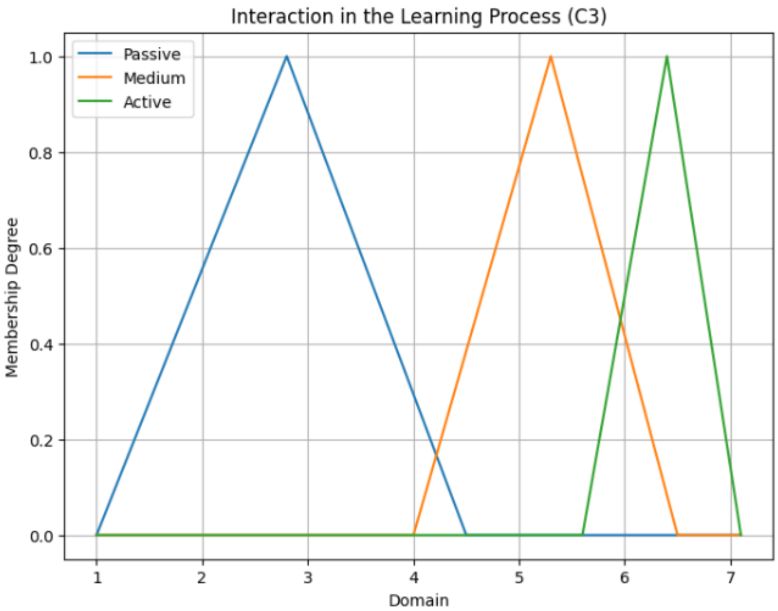

Figure 4. C3 Membership Function Curve

Criterion 4. Learning Outcome Assessment

Figure 4 displays the graph of **Criterion 4** that has 3 Linguistic Variables, namely "Bad", which has a domain of 1.0-4.5; "Medium", which has a domain of 4.0-6.5; and "Good", which has a domain of 5.6-7.1.

$$\mu \text{ Bad } (x) = \begin{cases} 0, x \leq 1.0\ or\ x \geq 4.5 \\ \frac{x-1.0}{2.8-1.0}, 1.0 < x < 2.8 \\ 1, x = b \\ \frac{4.5-x}{4.5-2.8}, 2.8 < x < 4.5 \end{cases}$$

$$\mu \text{ Medium } (x) \begin{cases} 0, \text{if } x \leq 4.0\ or\ x \geq 6.5 \\ \frac{x-4.0}{5.3-4.0}, 4.0 < x < 5.3 \\ 1, x = b \\ \frac{6.5-x}{6.5-5.3}, 5.3 < x < 6.5 \end{cases}$$

$$\mu \text{ Good } (x) \begin{cases} 0, x \leq 5.6\ or\ x \geq 7.1 \\ \frac{x-5.6}{6.4-5.6}, 5.6 < x < 6.4 \\ 1, x = b \\ \frac{7.1-x}{7.1-6.4}, 6.4 < x < 7.1 \end{cases}$$

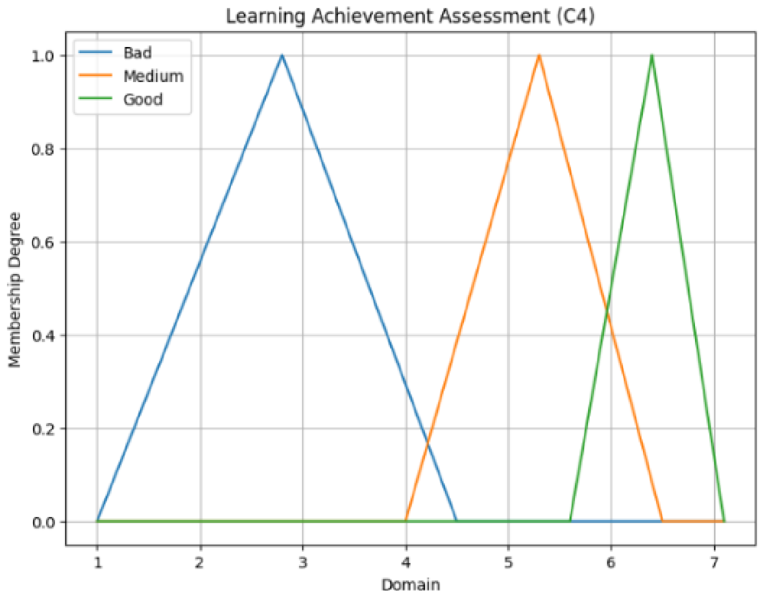

Figure 5. C4 Membership Function Curve

Criterion 5. Creativity in Delivering Material

Figure 5 shows a graph of **Criterion 5** which has 3 Linguistic Variables, namely "Not Creative" which has a domain of 1.0-4.5; "Creative", which has a domain of 4.0-6.5; and "Very Creative", which has a domain of 5.6-7.1.

$$\mu \text{ Not Creative } (x) = \begin{cases} 0, x \leq 1.0 \; or \; x \geq 4.5 \\ \frac{x-1.0}{2.8-1.0}, 1.0 < x < 2.8 \\ 1, x = b \\ \frac{4.5-x}{4.5-2.8}, 2.8 < x < 4.5 \end{cases}$$

$$\mu \text{ Creative } (x) \begin{cases} 0, if \; x \leq 4.0 \; or \; x \geq 6.5 \\ \frac{x-4.0}{5.3-4.0}, 4.0 < x < 5.3 \\ 1, x = b \\ \frac{6.5-x}{6.5-5.3}, 5.3 < x < 6.5 \end{cases}$$

$$\mu \text{ Very Creative } (x) \begin{cases} 0, x \leq 5.6 \; or \; x \geq 7.1 \\ \frac{x-5.6}{6.4-5.6}, 5.6 < x < 6.4 \\ 1, x = b \\ \frac{7.1-x}{7.1-6.4}, 6.4 < x < 7.1 \end{cases}$$

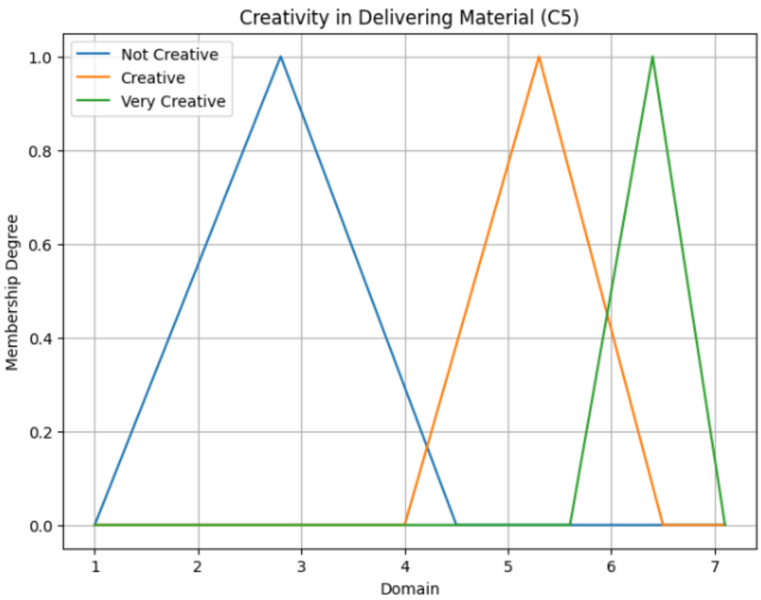

Figure 6. C5 Membership Function Curve

Output. Result

Figure 6 displays a graph of Results that have 3 Linguistic Variables, namely "Not Worthy", which has a domain of 0-0.45; "Worthy", which has a domain of 0.40-0.80; and "Very Worthy", which has a domain of 0.75-1.1.

$$\mu \text{ Not Worthy } (x) = \begin{cases} 0, if\ x \le 0\ or\ x \ge 0.45 \\ \frac{(x-0)}{(0.23-0)}, if\ 0 < x < 0.23 \\ 1, if\ x = b \\ \frac{(0.45-x)}{(0.45-0.23)}, if\ 0.23 < x < 0.45 \end{cases}$$

$$\mu \text{ Worthy } (x) \begin{cases} 0, if\ x \le 0.40\ or\ x \ge 0.80 \\ \frac{x-0.40}{0.60-0.40}, if\ 0.40 < x < 0.60 \\ 1, if\ x = b \\ \frac{0.80-x}{0.80-0.60}, if\ 0.60 < x < 0.80 \end{cases}$$

$$\mu \text{ Very Worthy } (x) \begin{cases} 0, if\ x \le 0.75\ or\ x \ge 1.1 \\ \frac{(x-0.75)}{(0.93-0.75)}, if\ 0.75 < x < 0.93 \\ 1, if\ x = b \\ \frac{(1.1-x)}{(1.1-0.93)}, if\ 0.93 < x < 1.1 \end{cases}$$

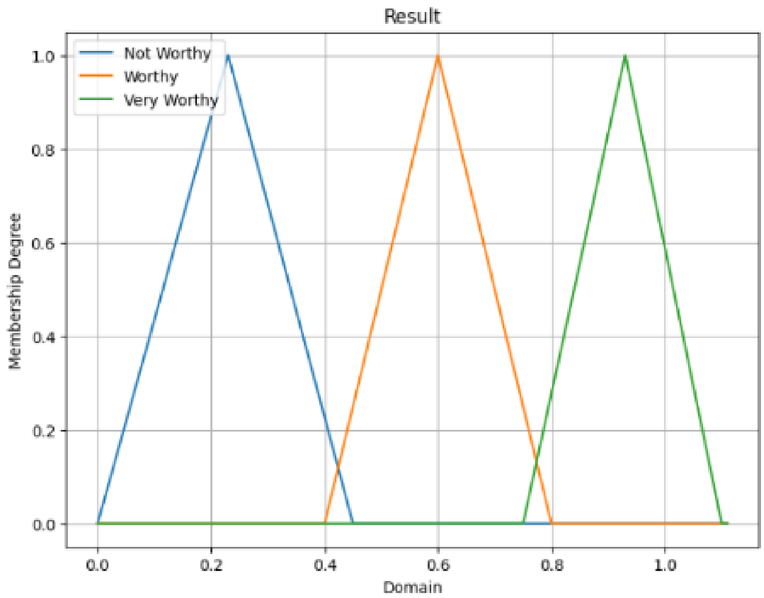

Figure 7. Output Membership Function Curve

3.4 Determining Linguistic Variables

Table 3 explains the determination of linguistic variables that are determined based on the division of criteria domains in Table 1 [19].

Table 3. Linguistic Variables

Alternative	Lecturer	C1	C1.1	C2	C2.1	C3	C3.1	C4	C4.1	C5	C5.1
A1	Lecturer 1	VM	VM	VA	VA	A	A	G	M	VC	C
A2	Lecturer 2	VM	VM	VA	VA	A	A	G	G	VC	VC
A3	Lecturer 3	VM	VM	VA	VA	A	A	M	M	VC	VC
A4	Lecturer 4	VM	VM	VA	VA	A	M	M	G	VC	C
A5	Lecturer 5	M	M	VA	A	M	A	M	B	C	C
A6	Lecturer 6	VM	M	A	NO	A	M	M	M	C	C
A7	Lecturer 7	VM	VM	VA	A	A	M	G	M	VC	VC
A8	Lecturer 8	VM	VM	A	VA	M	M	G	G	VC	VC
A9	Lecturer 9	VM	M	A	VA	M	M	M	M	C	C
A10	Lecturer 10	M	VM	A	VA	A	A	M	M	C	C
A11	Lecturer 11	VM	VM	VA	VA	A	A	G	G	VC	VC
A12	Lecturer 12	VM	VM	VA	VA	A	A	G	G	VC	C
A13	Lecturer 13	VM	M	VA	A	M	P	G	M	C	NC
A14	Lecturer 14	VM	VM	VA	VA	A	A	G	M	VC	VC
A15	Lecturer 15	VM	VM	A	VA	M	M	M	M	C	C
A16	Lecturer 16	VM	VM	A	VA	M	M	M	G	C	C
A17	Lecturer 17	M	M	A	A	A	A	M	M	C	NC
A18	Lecturer 18	VM	VM	VA	A	A	M	G	G	VC	C
A19	Lecturer 19	VM	VM	VA	VA	A	A	G	G	VC	VC
A20	Lecturer 20	M	VM	A	VA	M	A	M	G	NC	C
A21	Lecturer 21	VM	VM	VA	VA	A	A	G	G	VC	VC
A22	Lecturer 22	VM	VM	VA	VA	A	A	G	G	VC	VC
A23	Lecturer 23	M	VM	A	VA	A	A	B	M	C	C
A24	Lecturer 24	VM	VM	VA	VA	A	A	G	G	VC	VC
A25	Lecturer 25	VM	VM	A	A	A	M	M	M	C	VC
A26	Lecturer 26	VM	VM	VA	VA	M	A	G	G	VC	VC
A27	Lecturer 27	VM	VM	A	VA	M	A	M	G	C	VC
A28	Lecturer 28	VM	M	A	A	A	A	M	M	C	C
A29	Lecturer 29	VM	M	VA	VA	A	A	G	M	VC	C
A30	Lecturer 30	NM	NM	NO	NO	P	P	B	B	NC	NC
A31	Lecturer 31	VM	VM	VA	VA	A	A	G	G	VC	VC
A32	Lecturer 32	VM	VM	VA	VA	A	A	M	G	VC	C

3.5 Determining the TFN Value

Table 4 explain the determination of the TFN value follows the distribution of TFN values in Table 1 [19].

Table 4. TFN Values

Alternative	Lecturer	C1	C1.1	C2	C2.1	C3	C3.1	C4	C4.1	C5	C5.1
A1	Lecturer 1	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)
A2	Lecturer 2	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A3	Lecturer 3	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(3, 5, 7)	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)
A4	Lecturer 4	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(3, 5, 7	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)	(3, 5, 7)
A5	Lecturer 5	(3, 5, 7)	(3, 5, 7	(7, 9, 9)	(3, 5, 7	(3, 5, 7	(7, 9, 9	(3, 5, 7)	(1, 1, 3)	(3, 5, 7)	(3, 5, 7)
A6	Lecturer 6	(7, 9, 9)	(3, 5, 7	(3, 5, 7)	(1, 1, 3	(7, 9, 9	(3, 5, 7	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A7	Lecturer 7	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(3, 5, 7	(7, 9, 9	(3, 5, 7	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)
A8	Lecturer 8	(7, 9, 9)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(3, 5, 7	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A9	Lecturer 9	(7, 9, 9)	(3, 5, 7	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(3, 5, 7	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A10	Lecturer 10	(3, 5, 7)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A11	Lecturer 11	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A12	Lecturer 12	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 5, 7)
A13	Lecturer 13	(7, 9, 9)	(3, 5, 7	(7, 9, 9)	(3, 5, 7	(3, 5, 7	(1, 1, 3	(7, 9, 9)	(3, 5, 7)	(3, 5, 7)	(1, 1, 3)
A14	Lecturer 14	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)
A15	Lecturer 15	(7, 9, 9)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(3, 5, 7	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A16	Lecturer 16	(7, 9, 9)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(3, 5, 7	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)	(3, 5, 7)
A17	Lecturer 17	(3, 5, 7)	(3, 5, 7	(3, 5, 7)	(3, 5, 7	(7, 9, 9	(7, 9, 9	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(1, 1, 3)
A18	Lecturer 18	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(3, 5, 7	(7, 9, 9	(3, 5, 7	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 5, 7)
A19	Lecturer 19	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A20	Lecturer 20	(3, 5, 7)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(7, 9, 9	(3, 5, 7)	(7, 9, 9)	(1, 1, 3)	(3, 5, 7)
A21	Lecturer 21	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A22	Lecturer 22	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A23	Lecturer 23	(3, 5, 7)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(1, 1, 3)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A24	Lecturer 24	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A25	Lecturer 25	(7, 9, 9)	(7, 9, 9	(3, 5, 7)	(3, 5, 7	(7, 9, 9	(3, 5, 7	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(7, 9, 9)
A26	Lecturer 26	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(3, 5, 7	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A27	Lecturer 27	(7, 9, 9)	(7, 9, 9	(3, 5, 7)	(7, 9, 9	(3, 5, 7	(7, 9, 9	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)
A28	Lecturer 28	(7, 9, 9)	(3, 5, 7	(3, 5, 7)	(3, 5, 7	(7, 9, 9	(7, 9, 9	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A29	Lecturer 29	(7, 9, 9)	(3, 5, 7	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)
A30	Lecturer 30	(1, 1, 3)	(1, 1, 3	(1, 1, 3)	(1, 1, 3	(1, 1, 3	(1, 1, 3	(1, 1, 3)	(1, 1, 3)	(1, 1, 3)	(1, 1, 3)
A31	Lecturer 31	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A32	Lecturer 32	(7, 9, 9)	(7, 9, 9	(7, 9, 9)	(7, 9, 9	(7, 9, 9	(7, 9, 9	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)	(3, 5, 7)

3.6 Determining Aggregated Fuzzy

Table 5 explain the Aggregated Fuzzy Determination using the following formula [19]:

$$a_{ij} = \min_{k}\{a_{ij}^{k}\}, b_{ij} = \frac{1}{K}\sum_{k=1}^{K} b_{ij}^{k}, c_{ij} = \max_{k}\{c_{ij}^{k}\} \quad (2)$$

Table 5. Aggregated Fuzzy

Alternative	Lecturer	C1	C2	C3	C4	C5
A1	Lecturer 1	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)
A2	Lecturer 2	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A3	Lecturer 3	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 5, 7)	(7, 9, 9)
A4	Lecturer 4	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)
A5	Lecturer 5	(3, 5, 7)	(3, 7, 9)	(3, 7, 9)	(1, 3, 7)	(3, 5, 7)
A6	Lecturer 6	(3, 7, 9)	(1, 3, 7)	(3, 7, 9)	(3, 5, 7)	(3, 5, 7)
A7	Lecturer 7	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)	(7, 9, 9)
A8	Lecturer 8	(7, 9, 9)	(3, 7, 9)	(3, 5, 7)	(7, 9, 9)	(7, 9, 9)
A9	Lecturer 9	(3, 7, 9)	(3, 7, 9)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A10	Lecturer 10	(3, 7, 9)	(3, 7, 9)	(7, 9, 9)	(3, 5, 7)	(3, 5, 7)
A11	Lecturer 11	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A12	Lecturer 12	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)
A13	Lecturer 13	(3, 7, 9)	(3, 7, 9)	(1, 3, 7)	(3, 7, 9)	(1, 3, 7)
A14	Lecturer 14	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(7, 9, 9)
A15	Lecturer 15	(7, 9, 9)	(3, 7, 9)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)
A16	Lecturer 16	(7, 9, 9)	(3, 7, 9)	(3, 5, 7)	(3, 7, 9)	(3, 5, 7)

Alternative	Lecturer	C1	C2	C3	C4	C5
A17	Lecturer 17	(3, 5, 7)	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)	(1, 3, 7)
A18	Lecturer 18	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)	(7, 9, 9)	(3, 7, 9)
A19	Lecturer 19	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A20	Lecturer 20	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)	(1, 3, 7)
A21	Lecturer 21	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A22	Lecturer 22	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A23	Lecturer 23	(3, 7, 9)	(3, 7, 9)	(7, 9, 9)	(1, 3, 7)	(3, 5, 7)
A24	Lecturer 24	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A25	Lecturer 25	(7, 9, 9)	(3, 5, 7)	(3, 7, 9)	(3, 5, 7)	(3, 7, 9)
A26	Lecturer 26	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(7, 9, 9)	(7, 9, 9)
A27	Lecturer 27	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)	(3, 7, 9)
A28	Lecturer 28	(3, 7, 9)	(3, 5, 7)	(7, 9, 9)	(3, 5, 7)	(3, 5, 7)
A29	Lecturer 29	(3, 7, 9)	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)
A30	Lecturer 30	(1, 1, 3)	(1, 1, 3)	(1, 1, 3)	(1, 1, 3)	(1, 1, 3)
A31	Lecturer 31	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)
A32	Lecturer 32	(7, 9, 9)	(7, 9, 9)	(7, 9, 9)	(3, 7, 9)	(3, 7, 9)

3.7 Determining Normalized Fuzzy Decision Matrix ($\tilde{r}_{ij}$)

Table 6 explain the determination of the Normalized Fuzzy Decision Matrix using the following formula [19]:

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}\right), \left(\frac{b_{ij}}{c_j^*}\right), \left(\frac{c_{ij}}{c_j^*}\right)\ dan\ c_j^* = \max_i\{c_{ij}\}\ (benefit\ criteria) \tag{3}$$

Table 6. Normalized Fuzzy Decision Matrix

Alternative	Lecturer	C1	C2	C3	C4	C5
A1	Lecturer 1	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)
A2	Lecturer 2	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A3	Lecturer 3	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.333, 0.556, 0.778)	(0.7778, 1, 1)
A4	Lecturer 4	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.333, 0.7778, 1)	(0.3333, 0.7778, 1)
A5	Lecturer 5	(0.3333, 0.5556, 0.7778)	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.111, 0.333, 0.778)	(0.3333, 0.5556, 0.7778)
A6	Lecturer 6	(0.3333, 0.7778, 1)	(0.111, 0.3333, 0.778)	(0.333, 0.778, 1)	(0.333, 0.556, 0.778)	(0.333, 0.556, 0.7778)
A7	Lecturer 7	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.333, 0.7778, 1)	(0.3333, 0.7778, 1)	(0.7778, 1, 1)
A8	Lecturer 8	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.333, 0.556, 0.778)	(0.7778, 1, 1)	(0.7778, 1, 1)
A9	Lecturer 9	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)	(0.333, 0.556, 0.778)	(0.333, 0.556, 0.778)	(0.3333, 0.5556, 0.7778)
A10	Lecturer 10	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)	(0.7778, 1, 1)	(0.333, 0.556, 0.778)	(0.3333, 0.5556, 0.7778)
A11	Lecturer 11	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A12	Lecturer 12	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.3333, 0.7778, 1)
A13	Lecturer 13	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.111, 0.333, 0.778)	(0.33, 0.7778, 1)	(0.111, 0.333, 0.78)
A14	Lecturer 14	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.77778, 1, 1)
A15	Lecturer 15	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.333, 0.556, 0.778)	(0.3333, 0.5556, 0.7778)	(0.3333, 0.5556, 0.7778)
A16	Lecturer 16	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.333, 0.556, 0.778)	(0.3333, 0.778, 1)	(0.3333, 0.556, 0.7778)
A17	Lecturer 17	(0.3333, 0.5556, 0.7778)	(0.333, 0.556, 0.778)	(0.7778, 1, 1)	(0.3333, 0.5556, 0.7778)	(0.1111, 0.3333, 0.7778)
A18	Lecturer 18	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.7778, 1, 1)	(0.333, 0.778, 1)
A19	Lecturer 19	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A20	Lecturer 20	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.3333, 0.7778, 1)	(0.1111, 0.3333, 0.7778)
A21	Lecturer 21	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A22	Lecturer 22	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A23	Lecturer 23	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.7778, 1, 1)	(0.1111, 0.3333, 0.7778)	(0.3333, 0.5556, 0.7778)
A24	Lecturer 24	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A25	Lecturer 25	(0.7778, 1, 1)	(0.333, 0.556, 0.778)	(0.333, 0.778, 1)	(0.3333, 0.5556, 0.7778)	(0.3333, 0.7778, 1)
A26	Lecturer 26	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.333, 0.778, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A27	Lecturer 27	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)
A28	Lecturer 28	(0.3333, 0.7778, 1)	(0.333, 0.556, 0.778)	(0.7778, 1, 1)	(0.3333, 0.5556, 0.7778)	(0.3333, 0.5556, 0.7778)
A29	Lecturer 29	(0.3333, 0.7778, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.333, 0.778, 1)
A30	Lecturer 30	(0.1111, 0.1111, 0.3333)	(0.1111, 0.111, 0.333)	(0.1111, 0.111, 0.333)	(0.1111, 0.1111, 0.3333)	(0.1111, 0.1111, 0.3333)
A31	Lecturer 31	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)
A32	Lecturer 32	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.7778, 1, 1)	(0.3333, 0.7778, 1)	(0.3333, 0.7778, 1)

3.8 Determining a Weighted Normalized Fuzzy Decision Matrix ($\tilde{v}_{ij}$)

Table 7 explain the determination of the Weighted Normalized Fuzzy Decision Matrix using the following formula [19]:

$$\tilde{v}_{ij} = \tilde{r}_{ij} x\, w_j \tag{4}$$

Table 7. Weighted Normalized Fuzzy Decision Matrix

Alter-native	Lecturer	C1	C2	C3	C4	C5
A1	Lecturer 1	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.3333, 0.7778, 3)	(0.3333, 0.7778, 3)
A2	Lecturer 2	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A3	Lecturer 3	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.3333, 0.5556, 2.3334)	(0.7778, 1, 3)
A4	Lecturer 4	(5.4446, 9, 9)	(2.3334, 5, 7)	(0.9999, 3.889, 7)	(0.3333, 0.7778, 3)	(0.3333, 0.7778, 3)
A5	Lecturer 5	(2.3331, 5.0004, 7.0002)	(0.9999, 3.889, 7)	(0.9999, 3.889, 7)	(0.1111, 0.3333, 2.3334)	(0.3333, 0.5556, 2.3334)
A6	Lecturer 6	(2.3331, 7.0002, 9)	(0.3333, 1.6665, 5.4446)	(0.9999, 3.889, 7)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.5556, 2.3334)
A7	Lecturer 7	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 3.889, 7)	(0.3333, 0.7778, 3)	(0.7778, 1, 3)
A8	Lecturer 8	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 2.778, 5.4446)	(0.7778, 1, 3)	(0.7778, 1, 3)
A9	Lecturer 9	(2.3331, 7.0002, 9)	(0.9999, 3.889, 7)	(0.9999, 2.778, 5.4446)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.5556, 2.3334)
A10	Lecturer 10	(2.3331, 7.0002, 9)	(0.9999, 3.889, 7)	(2.3334, 5, 7)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.5556, 2.3334)
A11	Lecturer 11	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A12	Lecturer 12	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.3333, 0.7778, 3)
A13	Lecturer 13	(2.3331, 7.0002, 9)	(0.9999, 3.889, 7)	(0.3333, 1.6665, 5.4446)	(0.3333, 0.7778, 3)	(0.1111, 0.3333, 2.3334)
A14	Lecturer 14	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.3333, 0.7778, 3)	(0.7778, 1, 3)
A15	Lecturer 15	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 2.778, 5.4446)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.5556, 2.3334)
A16	Lecturer 16	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 2.778, 5.4446)	(0.3333, 0.7778, 3)	(0.3333, 0.5556, 2.3334)
A17	Lecturer 17	(2.3331, 5.0004, 7.0002)	(0.9999, 2.778, 5.4446)	(2.3334, 5, 7)	(0.3333, 0.5556, 2.3334)	(0.1111, 0.3333, 2.3334)
A18	Lecturer 18	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 3.889, 7)	(0.7778, 1, 3)	(0.3333, 0.7778, 3)
A19	Lecturer 19	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A20	Lecturer 20	(2.3331, 7.0002, 9)	(0.9999, 3.889, 7)	(0.9999, 3.889, 7)	(0.3333, 0.7778, 3)	(0.1111, 0.3333, 2.3334)
A21	Lecturer 21	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A22	Lecturer 22	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A23	Lecturer 23	(2.3331, 7.0002, 9)	(0.9999, 3.889, 7)	(2.3334, 5, 7)	(0.1111, 0.3333, 2.3334)	(0.3333, 0.5556, 2.3334)
A24	Lecturer 24	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A25	Lecturer 25	(5.4446, 9, 9)	(0.9999, 2.778, 5.4446)	(0.9999, 3.889, 7)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.7778, 3)
A26	Lecturer 26	(5.4446, 9, 9)	(2.3334, 5, 7)	(0.9999, 3.889, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A27	Lecturer 27	(5.4446, 9, 9)	(0.9999, 3.889, 7)	(0.9999, 3.889, 7)	(0.3333, 0.7778, 3)	(0.3333, 0.7778, 3)
A28	Lecturer 28	(2.3331, 7.0002, 9)	(0.9999, 2.778, 5.4446)	(2.3334, 5, 7)	(0.3333, 0.5556, 2.3334)	(0.3333, 0.5556, 2.3334)
A29	Lecturer 29	(2.3331, 7.0002, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.3333, 0.7778, 3)	(0.3333, 0.7778, 3)
A30	Lecturer 30	(0.7777, 0.9999, 2.9997)	(0.3333, 0.5555, 2.3331)	(0.3333, 0.5555, 2.3331)	(0.1111, 0.1111, 0.9999)	(0.1111, 0.1111, 0.9999)
A31	Lecturer 31	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.7778, 1, 3)	(0.7778, 1, 3)
A32	Lecturer 32	(5.4446, 9, 9)	(2.3334, 5, 7)	(2.3334, 5, 7)	(0.3333, 0.7778, 3)	(0.3333, 0.7778, 3)

3.9 Determining Positive (A^*) and Negative (A^-) Fuzzy Ideal Solutions

Table 8 explain the determining Fuzzy Positive and Negative Ideal Solutions using the following formula [19]:

$$A^* = (\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*) \quad (5)$$

$$A^- = (\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-) \quad (6)$$

Table 8. Positive and Negative Fuzzy Ideal Solutions

Criteria	FPIS	FNIS
C1	[5.4446, 9, 9]	[0.7777, 0.9999, 2.9997]
C2	[2.3334, 5, 7]	[0.3333, 0.5555, 2.3331]
C3	[2.3334, 5, 7]	[0.3333, 0.5555, 2.3331]
C4	[0.7778, 1, 3]	[0.1111, 0.1111, 0.9999]
C5	[0.7778, 1, 3]	[0.1111, 0.1111, 0.9999]

3.10 Determining Alternative Distances to Positive (d_i^*) and Negative (d_i^-) Fuzzy Ideal Solutions

Table 9 and Table 10 explain the determining Distances to Positive and Negative Ideal Solutions using the following formula [19]:

$$d_i^* = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^*) \quad (7)$$

$$d_i^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^-) \quad (8)$$

$$d(\tilde{x}, \tilde{y}) = \sqrt{\frac{1}{3}[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2]} \quad (9)$$

Table 9. Alternative Distance to Posititve Ideal Solution

Alternative	Lecturer	Distance FPISC1	Distance FPIS C2	Distance FPIS C3	Distance FPIS C4	Distance FPIS C5	di*
A1	Lecturer 1	0	0	0	0.2869	0.2869	0.5738
A2	Lecturer 2	0	0	0	0	0	0
A3	Lecturer 3	0	0	0	0.529	0	0.529
A4	Lecturer 4	0	0	1.0021	0.2869	0.2869	1.5759
A5	Lecturer 5	3.1452	1.0021	1.0021	0.6667	0.529	6.3451
A6	Lecturer 6	2.1355	2.4174	1.0021	0.529	0.529	6.613
A7	Lecturer 7	0	1.0021	1.0021	0.2869	0	2.2911
A8	Lecturer 8	0	1.0021	1.745	0	0	2.7471
A9	Lecturer 9	2.1355	1.0021	1.745	0.529	0.529	5.9406
A10	Lecturer 10	2.1355	1.0021	0	0.529	0.529	4.1956
A11	Lecturer 11	0	0	0	0	0	0
A12	Lecturer 12	0	0	0	0	0.2869	0.2869
A13	Lecturer 13	2.1355	1.0021	2.4174	0.2869	0.6667	6.5086
A14	Lecturer 14	0	0	0	0.2869	0	0.2869
A15	Lecturer 15	0	1.0021	1.745	0.529	0.529	3.8051
A16	Lecturer 16	0	1.0021	1.745	0.2869	0.529	3.563
A17	Lecturer 17	3.1452	1.745	0	0.529	0.6667	6.0859
A18	Lecturer 18	0	1.0021	1.0021	0	0.2869	2.2911
A19	Lecturer 19	0	0	0	0	0	0
A20	Lecturer 20	2.1355	1.0021	1.0021	0.2869	0.6667	5.0933
A21	Lecturer 21	0	0	0	0	0	0
A22	Lecturer 22	0	0	0	0	0	0
A23	Lecturer 23	2.1355	1.0021	0	0.6667	0.529	4.3333
A24	Lecturer 24	0	0	0	0	0	0
A25	Lecturer 25	0	1.745	1.0021	0.529	0.2869	3.563
A26	Lecturer 26	0	0	1.0021	0	0	1.0021
A27	Lecturer 27	0	1.0021	1.0021	0.2869	0.2869	2.578
A28	Lecturer 28	2.1355	1.745	0	0.529	0.529	4.9385
A29	Lecturer 29	2.1355	0	0	0.2869	0.2869	2.7093
A30	Lecturer 30	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A31	Lecturer 31	0	0	0	0	0	0
A32	Lecturer 32	0	0	0	0.2869	0.2869	0.5738

Table 10. Alternative Distance to Negative Ideal Solution

Alternative	Lecturer	Distance FNIS C1	Distance FNIS C2	Distance FNIS C3	Distance FNIS C4	Distance FNIS C5	di-
A1	Lecturer 1	6.3714	3.8959	3.8959	1.224	1.224	16.6112
A2	Lecturer 2	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A3	Lecturer 3	6.3714	3.8959	3.8959	0.8216	1.321	16.3058
A4	Lecturer 4	6.3714	3.8959	3.3335	1.224	1.224	16.0488
A5	Lecturer 5	3.3876	3.3335	3.3335	0.7805	0.8216	11.6567
A6	Lecturer 6	4.9808	1.9075	3.3335	0.8216	0.8216	11.865
A7	Lecturer 7	6.3714	3.3335	3.3335	1.224	1.321	15.5834
A8	Lecturer 8	6.3714	3.3335	2.2409	1.321	1.321	14.5878
A9	Lecturer 9	4.9808	3.3335	2.2409	0.8216	0.8216	12.1984
A10	Lecturer 10	4.9808	3.3335	3.8959	0.8216	0.8216	13.8534
A11	Lecturer 11	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A12	Lecturer 12	6.3714	3.8959	3.8959	1.321	1.224	16.7082
A13	Lecturer 13	4.9808	3.3335	1.9075	1.224	0.7805	12.2263
A14	Lecturer 14	6.3714	3.8959	3.8959	1.224	1.321	16.7082
A15	Lecturer 15	6.3714	3.3335	2.2409	0.8216	0.8216	13.589
A16	Lecturer 16	6.3714	3.3335	2.2409	1.224	0.8216	13.9914
A17	Lecturer 17	3.3876	2.2409	3.8959	0.8216	0.7805	11.1265
A18	Lecturer 18	6.3714	3.3335	3.3335	1.321	1.224	15.5834
A19	Lecturer 19	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A20	Lecturer 20	4.9808	3.3335	3.3335	1.224	0.7805	13.6523
A21	Lecturer 21	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A22	Lecturer 22	6.3714	3.8959	3.8959	1.321	1.321	16.8052

Alternative	Lecturer	Distance FNIS C1	Distance FNIS C2	Distance FNIS C3	Distance FNIS C4	Distance FNIS C5	di-
A23	Lecturer 23	4.9808	3.3335	3.8959	0.7805	0.8216	13.8123
A24	Lecturer 24	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A25	Lecturer 25	6.3714	2.2409	3.3335	0.8216	1.224	13.9914
A26	Lecturer 26	6.3714	3.8959	3.3335	1.321	1.321	16.2428
A27	Lecturer 27	6.3714	3.3335	3.3335	1.224	1.224	15.4864
A28	Lecturer 28	4.9808	2.2409	3.8959	0.8216	0.8216	12.7608
A29	Lecturer 29	4.9808	3.8959	3.8959	1.224	1.224	15.2206
A30	Lecturer 30	0	0	0	0	0	0
A31	Lecturer 31	6.3714	3.8959	3.8959	1.321	1.321	16.8052
A32	Lecturer 32	6.3714	3.8959	3.8959	1.224	1.224	16.6112

3.11 Determining Closeness Coefficient (*CCi*)

Table 11 explain the determination of the Closeness Coefficient using the following formula [19]:

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*} \tag{10}$$

Table 11. Closeness Coefficient

Alternative	Lecturer	CCi
A1	Lecturer 1	0.9666
A2	Lecturer 2	1
A3	Lecturer 3	0.9686
A4	Lecturer 4	0.9106
A5	Lecturer 5	0.6475
A6	Lecturer 6	0.6337
A7	Lecturer 7	0.8718
A8	Lecturer 8	0.8415
A9	Lecturer 9	0.6725
A10	Lecturer 10	0.7675
A11	Lecturer 11	1,00
A12	Lecturer 12	0.9831
A13	Lecturer 13	0.6526
A14	Lecturer 14	0.9831
A15	Lecturer 15	0.7812
A16	Lecturer 16	0.7970
A17	Lecturer 17	0.6464
A18	Lecturer 18	0.8718
A19	Lecturer 19	1
A20	Lecturer 20	0.7283
A21	Lecturer 21	1
A22	Lecturer 22	1
A23	Lecturer 23	0.7612
A24	Lecturer 24	1
A25	Lecturer 25	0.7970
A26	Lecturer 26	0.9419
A27	Lecturer 27	0.8573
A28	Lecturer 28	0.7210
A29	Lecturer 29	0.8489
A30	Lecturer 30	0
A31	Lecturer 31	1
A32	Lecturer 32	0.9666

3.12 Determining the Sequence of Closeness Coefficient Values

In Table 12, shows the order of Closeness coefficients from highest to lowest.

Table 12. Order of Closeness Coefficient Values

Alternative	CCi
A31	1.0
A24	1.0
A22	1.0
A21	1.0
A19	1.0
A2	1.0
A11	1.0
A12	0.9831
A14	0.9831
A3	0.9686
A1	0.9666
A32	0.9666
A26	0.9419
A4	0.9106
A18	0.8718
A7	0.8718
A27	0.8573
A29	0.8489
A8	0.8415
A16	0.797
A25	0.797
A15	0.7812
A10	0.7675
A23	0.7612
A20	0.7283
A28	0.721
A9	0.6725
A13	0.6526
A5	0.6475
A17	0.6464
A6	0.6421
A30	0.0

3.13 Analysis of Results

In the results analysis section, we conducted validity and reliability testing. We compared the results of the manual calculation decision and the Fuzzy TOPSIS calculation to assess the validity. Judging from the results of the comparison of the two methods in **Table 13**, it shows that the Fuzzy TOPSIS method has an accuracy of 100% because it has the same decision results as manual calculations, namely 31 lecturers are declared "Passed" and 1 lecturer is declared "Not Passed", namely A30.

$$\text{Accuracy} = \frac{\text{Same Decision Results}}{\text{Total of Data}} x\ 100\% = \frac{32}{32} x\ 100\% = \ 100\%$$

For reliability analysis, the Fuzzy TOPSIS method provides more precise results. Judging from **Table 13**, the results of the manual calculation for A1 and A18 produce the same value, which is 5.9. However, when using the Fuzzy TOPSIS method, the values obtained varied, namely 0.9666 for A1 and 0.8718 for A18.

Table 13. Comparison of Calculation Results

2023 UNSRAT Serdos Manual Calculation Results				Fuzzy TOPSIS Calculation Results		
Rank	**Alternative**	**Final score**	**Decision Results**	**Alternative**	**Closeness Coefficient (CC_i)**	**Decision Results**
1	A11	7	Passed	A31	1.0	Very Worthy
2	A19	7	Passed	A24	1.0	Very Worthy
3	A31	6.5	Passed	A22	1.0	Very Worthy
4	A12	6.3	Passed	A21	1.0	Very Worthy
5	A21	6.3	Passed	A19	1.0	Very Worthy

2023 UNSRAT Serdos Manual Calculation Results				**Fuzzy TOPSIS Calculation Results**		
Rank	**Alternative**	**Final score**	**Decision Results**	**Alternative**	**Closeness Coefficient (CC_i)**	**Decision Results**
6	A22	6.3	Passed	A2	1.0	Very Worthy
7	A2	6.2	Passed	A11	1.0	Very Worthy
8	A14	6.2	Passed	A12	0.9831	Very Worthy
9	A24	6.1	Passed	A14	0.9831	Very Worthy
10	A26	6.1	Passed	A3	0.9686	Very Worthy
11	A1	5.9	Passed	A1	0.9666	Very Worthy
12	A18	5.9	Passed	A32	0.9666	Very Worthy
13	A3	5.8	Passed	A26	0.9419	Very Worthy
14	A32	5.8	Passed	A4	0.9106	Very Worthy
15	A4	5.7	Passed	A18	0.8718	Very Worthy
16	A7	5.7	Passed	A7	0.8718	Very Worthy
17	A8	5.7	Passed	A27	0.8573	Very Worthy
18	A27	5.7	Passed	A29	0.8489	Very Worthy
19	A29	5.7	Passed	A8	0.8415	Very Worthy
20	A10	5.4	Passed	A16	0.797	Very Worthy
21	A16	5.4	Passed	A25	0.797	Very Worthy
22	A25	5.4	Passed	A15	0.7812	Very Worthy
23	A15	5.3	Passed	A10	0.7675	Very Worthy
24	A20	5.3	Passed	A23	0.7612	Very Worthy
25	A23	5.3	Passed	A20	0.7283	Very Worthy
26	A28	5.3	Passed	A28	0.721	Very Worthy
27	A9	5.2	Passed	A9	0.6725	Very Worthy
28	A5	5.1	Passed	A13	0.6526	Very Worthy
29	A6	5.1	Passed	A5	0.6475	Worthy
30	A13	5.1	Passed	A17	0.6464	Worthy
31	A17	5.1	Passed	A6	0.6421	Worthy
32	A30	4	Not Passed	A30	0.0	Not Worthy

Table 13 shows that there is a difference between fuzzy and manual ranking. For example, A11 gets 1st rank in Manual calculation, but in the Fuzzy TOPSIS, it gets 7th. It means that the weighted rule in TOPSIS methods influences the final score.

4. CONCLUSIONS

Based on the results of the research, the Fuzzy TOPSIS Method in the assessment of Lecturer Certification at Sam Ratulangi University, which focuses on the Assessment of Teaching Elements with 5 criteria, provides a specific assessment range so that it can handle the problem of uncertainty that is widely encountered in the Assessment of Lecturer Certification.

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