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Analysis Of Student Sentiment On Lecturers Teaching Using The Fuzzy Tsukamoto Method

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Keywords

Fuzzy Tsukamoto
Student Sentimen on
Lecturer

Abstract. Analysis of student sentiment on lecturer teaching performance This study aims to analyze student sentiment on lecturer teaching performance in a good university. The method used in this research is sentiment analysis using the Fuzzy Tsukamoto Method. The data were obtained from the results of a questionnaire conducted on students regarding the teaching performance of lecturers in the last semester. The data is then processed and analyzed using a classification algorithm to classify student sentiment into positive, negative, or neutral towards lecturer teaching performance. is student sentiment towards lecturers, from the teaching quality testing data = 2 positive words (8), Material Availability = 2 neutral words (7), Student and lecturer interaction = 1 negative word (4), Lecturer Feedback Quality = 2 negative word (3) from the input the output result is a value of 3 and is in the negative set, so the result of the test is negative sentiment

1. INTRODUCTION

Sentiment analysis is a rapidly growing field of study in recent years. The main background of sentiment analysis is the need to understand and analyze human opinions and opinions which are increasing, especially in today's digital era, technology also plays an important role in the growth of sentiment analysis. The availability of big data and increasingly sophisticated natural language processing technologies have made sentiment analysis even easier to perform. Machine learning and artificial intelligence also help increase the accuracy of sentiment analysis by recognizing patterns in data and making more accurate predictions. STMIK Pelita Nusantara is a good education in the field of informatics and computers, STMIK Pelita Nusantara always uses the PPEPP mode of Determination, Implementation, Evaluation, Control and Improvement of Higher Education Standards so that it can achieve the vision and mission of STMIK Pelita Nusantara to become a superior good university. The problem in this study is that the management has not analyzed the sentiments in the teaching questionnaire comments on the evaluation of lecturer teaching performance which is always carried out at the end of each semester, so that the data obtained on the lecturer teaching performance evaluation is only numbers to get a rating of very Enough, Adequate, enough or less, In the world of education, sentiment analysis is used to understand how students respond to teaching from lecturers. By analyzing sentiment, management can identify students' problems and needs, so that the evaluation results of lecturer teaching performance are obtained accurately. One method that can help to analyze sentiment is with fuzzy logic, Fuzzy logic is a mathematical technique that can be used to map numerical values into linguistic values that can be interpreted by humans. Fuzzy logic was introduced by Lofti Zadeh in 1965 as a tool for dealing with uncertainty in data processing. This method is very useful in the field of artificial intelligence, automatic control, and decision making. One of the methods in the fuzzy inference system is the Fuzzy Tsukamoto. Fuzzy Tsukamoto is a method that has a tolerance for data and is very flexible. The advantages of the Tsukamoto method are that it is intuitive and can provide responses based on information that is qualitative, inaccurate, and ambiguous.

2. METHOD

Fuzzy

Fuzzy set theory is used as a mathematical framework to deal with problems of uncertainty, ambiguity or can be used for lack of information. In everyday life, the lack of information is found in many areas of life. In general, Fuzzy logic is a method of "counting" with variable words (linguistic variables), instead of counting with numbers. Indeed, the words used in Fuzzy are not as precise as numbers, but the words used are closer to human intuition, such as the words "feel", "approximately", "more or less", and so on. In accordance with the development of human intellect, Fuzzy logic has become popular for use in research, because of its ability to bridge machine language which is

completely precise with human language which tends to be imprecise. Usually termed the word significant (significance). Vague logic or Fuzzy logic can be considered as an approach to mapping an input or input space into an output or output space (Setiawan et al., n.d. 2018)

Fuzzy Tsukamoto

In the Tsukamoto Method, each consequence of a rule in the form of IF-Then must be represented by a Fuzzy set with a monotonous membership function. As a result, the output of the inference results from each rule is given crisply (crisp) based on the α-predicate (fire strength). The final result is obtained using a weighted average (Salendah et al., 2022)

Tsukamoto's Fuzzy Method is an extension of monotone reasoning. In the Tsukamoto method, each consequence of a rule in the form of IF-THEN must be represented in a Fuzzy set with a monotone membership function. The resulting value at the consequence of each Fuzzy rule is a crisp value obtained based on the fire strength in its antecedent. The system output is generated from the weighted average concept of the output of each Fuzzy rule. An illustration of the Tsukamoto method Fuzzy system can be seen in Figure 2.1.

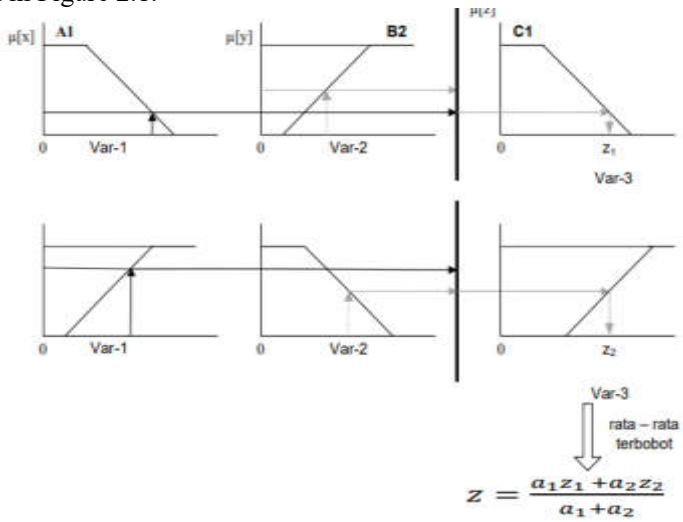

Figure 1 Defuzzification of the Tsukamoto Model
Source :(Ismi & Wahyu, 2020)

In the Tsukamoto method, the implications of each rule are in the form of "Causal"/"Input-Output" implications where there must be a relationship between the antecedent and the consequence. Each rule is represented using Fuzzy sets, with a monotonous membership function. Then to determine the firm result (Crisp Solution) the affirmation formula (defuzification) is used which is called the "Center Average Deffuzzifier Method". In the Tsukamoto method, each consequence of a rule in the form of IF- THEN must be represented by a Fuzzy set with a monotonous membership function. As a result, the output of the inference results from each is given firmly (crips) based on the α-predicate (fire strength). The final result is obtained using a weighted average. In general, the form of the Tsukamoto Fuzzy model is: IF(X IS A) and (Y IS B) Then (Z IS C) [3] Where A, B, and C are Fuzzy sets. Suppose we know the following 2 rules. IF (x is A1) AND (y is B1) THEN (z is C1) IF (x is A2) AND (y is B2) THEN (z is C2) In his inference, the Tsukamoto method uses the following steps

1. *Fuzzy*fiction
2. Formation of knowledge base*Fuzzy* (Rule in form*IF…THEN*)
3. Inference Engine Using the MIN implication function to get the value of α-predicate (a1, a2, a3 …an)
4. Of*Fuzzy* Fication Using the Average method (*Average*) (Ismi & Wahyu, 2020)

(Perwira & Kartika Lubis, 2021) During the rule evaluation process in the inference engine, the Fuzzy Tsukamoto method uses the MIN implication function to obtain the α-predicate value of each

rule (α1, α2, α3,... αn). Each α predicate value is used to calculate the crisp inference results for each rule (z1, z2, z3,.... zn). The deFuzzification process in the Tsukamoto method uses the average method with the following formula

With $= \frac{\sum \alpha 1\, Z1}{\sum \alpha 1} = \frac{\sum \alpha 1\, Z1}{\sum \alpha 1}$

……
……..……(1)

Diagram Fishbone

The first step is making a fishbone to find out the root cause of the problem, the following is a fishbone diagram for this research

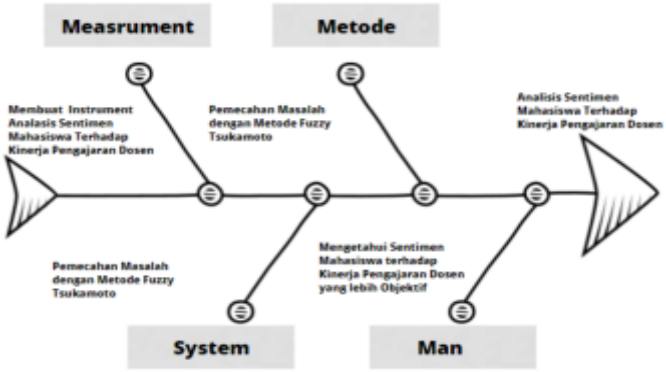

Figure 2 Fishbone Diagram

3. RESULTS AND DISCUSSION

Data

The topics that will be discussed in the physics science learning application of straight motion kinematics include Motion, Distance and Displacement, Speed and Velocity, Acceleration and Progress, Regular Straight Motion, Regular Changing Straight Motion, and Free Fall Motion.

Sentiment refers to the feelings, emotions or attitudes that arise in responding to or evaluating a situation, object or experience. Sentiment can be positive, negative, or neutral, depending on how one interprets and feels something. Sentiments are often reflected in words, facial expressions, behavior and even actions.

In sentiment analysis, we try to identify and quantify the feelings or emotions present in a particular text, conversation or context. It can be used in various contexts, such as social media analysis to understand public opinion on a topic, product review analysis to assess customer satisfaction, or even in everyday communication to express one's feelings and views.

Sentiments are often divided into three main categories:
Positive: Refers to feelings such as happiness, joy, love, and contentment.
Negative: Refers to feelings such as anger, disappointment, fear, and sadness.
Neutral: Refers to feelings that do not have a strong emotional charge, or it could refer to factual descriptions without emotional judgment.

Examples of positive sentiment words
Happiness: Happy, cheerful, elated, delighted, enthusiastic.
Love: Love, affection, affection, caring.
Satisfaction: Satisfied, satisfied, satisfied, proud.
Hope: Hoping, optimistic, passionate, confident.
Tranquility: Calm, peaceful, relaxed, comfortable.
Success: Success, achievement, accomplishment, luck.
Grateful: Thankful, thankful, appreciative.

Togetherness: Together, united, good relations, mutual support.
Creativity: Creative, innovative, brilliant ideas, productive.
Courage: Brave, confident, overcoming obstacles, fighting.

Examples of negative sentiment words
Anger: Angry, irritated, furious, negative emotions.
Disappointment: Disappointed, frustrated, feeling neglected, hope dashed.
Dissatisfaction: Dissatisfied, unhappy, feeling cheated.
Sad: Sad, depressed, empty, heartbroken.
Worry: Anxious, worried, restless, afraid.
Despair: Despair, hopelessness, feeling of having no way out.
Hate: Hate, dislike, feel unsuited.
Guilt: Feeling guilty, blaming yourself.
Not Confident: Not confident, feeling inferior, doubtful.
Alienation: Feeling isolated, lonely, no support.

Teaching Quality:
Fuzzy Sets: Less, Enough, Good,
Linguistic Example: "Less", "Enough", "Good"
Material Availability and Clarification:
Fuzzy Sets: Less, Enough, Good,
Linguistic Example: " Less ", "Enough","Good"
Lecturer-Student Interaction:
Fuzzy Sets: Less, Enough, Good,
Linguistic Example: " Less ", "Enough","Good"
Quality of Lecturer Feedback:
Fuzzy Sets: Less, Enough, Good,
Linguistic Example: " Less ", "Enough","Good"
Student sentiment towards lecturers:
Fuzzy Sets: Less, Enough, Good,
Linguistic Example: " Less ", "Enough","Good"

The data to be processed to determine the determination of Sentiment for the lecturer's assessment with the Quality of Assessment and Examination: with the Tsukamoto fuzzy consists of 4 input variables and 1 output. The following variable and domain data can be seen in table 4.2 below.

Table 1. Variable Set and DomainNo

	Variable	Collection	Mark	Domain
1	Teaching Quality	Negative (linear Down)	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	3-5
		Neutral	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	3-5-10

		Positive	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	5 – 10
2	Material Availability	Negative (linear Down)	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	3-5
		Neutral	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	3-5-10
		Positive	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	5 – 10
3	Student and Lecturer Interaction	Negative (linear Down)	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	3-5
		Neutral	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	3-5-10
		Positive	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	5 – 10
4	Quality of Lecturer Feedback	Negative (linear Down)	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	3-5

		Neutral	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	3-5-10
		Positive	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	5 – 10
5	Student Sentiment	Negative (linear Down)	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	3-5
		Neutral	Membership Functions: Triangle Range: 3 - 7 Peak: 5 (neutral) Value 0 at 3, increase linearly to 1 at 5, and decrease linearly to 0 at 7 The value seen from the number of neutral words 1 is worth 5, 2 is worth 6 more than 2 is worth 7	3-5-10
		Positive	Range: 0 - 5 Peak: 0 (Negative) Value 1 on 0, The value is seen from the number of negative words if 1 is worth 4, more than 1 is worth 3	5 – 10

Fuzzy Analysis Tsukamoto

The steps for determining the Sentiment of Assessment of the Lecturer of the Fuzzy Tsukomoto Method are as follows:

a. *Fuzzyfics*

Fuzzyfics aims to transform assertive input data into*fuzzy.* In this study used 4 input variables and 1 output variable,

1. Teaching Quality

The content consists of 3 collections*fuzzy* that is:

a. Negative = [0-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

The teaching quality membership function is presented in Figure 3

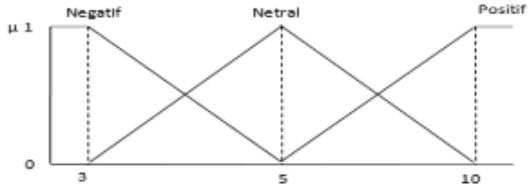

Figure 3. Membership Function Teacher Quality

In Figure 3 above it can be seen that the membership function uses a decreasing linear representative, the membership function simply uses a triangular curve and the good membership function uses an ascending linear representative.

The following is the formula for the Teaching Quality Membership Function

$$\mu\text{Teacher Quality}[x]\begin{cases}1, = & x \leq 3\\ 0 \leq x \leq 50 = & \frac{5-x}{50-3},\\ 0, = & x \geq 50\end{cases}$$

$$\mu\text{Teacher Quality }[x]\begin{cases}1, = x = b\\ 0 \leq x \leq 50 = \frac{x-3}{5-3},\\ b \leq x \leq c = \frac{5-x}{10-50},\\ 0, = x > 10 \mid \mid x < 3\end{cases}$$

$$\mu\text{Teacher Quality}[x]\begin{cases}1, & x \geq 5\\ 50 \leq x \leq 100 = & \frac{x-5}{10-5},\\ 0, & x \leq 5\end{cases}$$

2 . Material Availability Variable

Material Availability Variable consists of 3 sets*fuzzy* that is:

a. Negative = [0-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

The membership function of Material Availability is presented in Figure 4.2

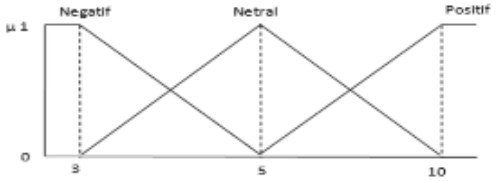

Figure 4. Membership Function Material Availability

In Figure 4 above it can be seen that the membership function uses a decreasing linear representative, the membership function simply uses a triangular curve and the good membership function uses an ascending linear representation.

The following is the formula for the Material Availability Function

$$\mu\text{Material Availability }[x]\begin{cases}1, = & x \leq 3\\ 0 \leq x \leq 50 = & \frac{5-x}{50-3},\\ 0, = & x \geq 50\end{cases}$$

$$\mu\text{Material Availability }\ [x]\begin{cases}1, = x = b\\ 0 \leq x \leq 50 = \frac{x-3}{5-3},\\ b \leq x \leq c = \frac{5-x}{10-50},\\ 0, = x > 10 \mid \mid x < 3\end{cases}$$

$$\mu\text{Material Availability }[x]\begin{cases}1, & x \geq 5\\ 50 \leq x \leq 100 = & \frac{x-5}{10-5},\\ 0, & x \leq 5\end{cases}$$

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3. Student and Lecturer Interaction Variables

Student and Lecturer Interaction Variables consist of 3 sets*fuzzy* that is:

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

The membership function of Student and Lecturer Interaction is presented in Figure 4

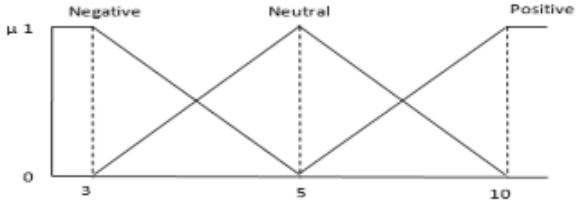

Figure 5. Membership Function Student and Lecturer Interaction

In Figure 5 above it can be seen that the membership function uses a decreasing linear representative, the membership function simply uses a triangular curve and the good membership function uses an ascending linear representation.

The following is the Membership Function Formula for Student and Lecturer Interaction

$$\mu\text{Student and Lecturer Interaction [x]} \begin{cases} 1, = \ \text{x} \ \leq 3 \\ 0 \leq x \leq 50 \ = \ \dfrac{5-\text{x}}{50-3}, \\ 0, = \ \text{x} \geq 50 \end{cases}$$

$$\mu\text{Student and Lecturer Interaction [x]} \begin{cases} 1, = \ \text{x} \ = \text{b} \\ 0 \leq x \leq 50 = \ \dfrac{\text{x}-3}{5-3}, \\ b \leq x \leq c \ = \ \dfrac{5-\text{x}}{10-50}, \\ 0, = \ \text{x} > 10 \ | \ \ |\text{x} < 3 \end{cases}$$

$$\mu\text{Student and Lecturer Interaction [x]} \begin{cases} 1, \ \text{x} \geq 5 \\ 50 \leq x \leq 100 = \ \dfrac{\text{x}-5}{10-5}, \\ 0, \ \text{x} \leq 5 \end{cases}$$

4. Quality of Lecturer Feedback

The Lecturer Feedback Quality Variable consists of 3 sets*fuzzy* that is:

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

The membership function of Lecturer Feedback Quality is presented in Figure 5

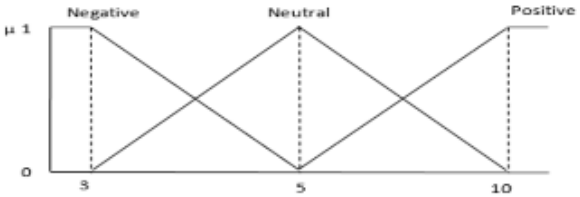

Figure 5. Lecturer Feedback Quality

In Figure 5 above it can be seen that the membership function uses a decreasing linear representative, the membership function simply uses a triangular curve and the good membership function uses an ascending linear representation.

The following is the Oil Absorption Membership Function Formula

$$\mu\text{Lecturer Feedback Quality Variable [x]} \begin{cases} 1, = \quad x \quad \leq 3 \\ 0 \leq x \leq 50 \; = \; \dfrac{5-x}{50-3}, \\ 0, = \quad x \geq 50 \end{cases}$$

$$\mu\text{Lecturer Feedback Quality Variable [x]} \begin{cases} 1, = \; x \; = b \\ 0 \leq x \leq 50 = \; \dfrac{x-3}{5-3}, \\ b \leq x \leq c \; = \; \dfrac{5-x}{10-50}, \\ 0, = \quad x > \; 10 \; | \quad |x < 3 \end{cases}$$

$$\mu\text{Lecturer Feedback Quality Variable [x]} \begin{cases} 1, \quad x \geq 5 \\ 50 \leq x \leq 100 = \quad \dfrac{x-5}{10-5}, \\ 0, \quad x \leq 5 \end{cases}$$

5. Sentiment Towards Lecturers:

Variable Sentimen Towards Lecturers: consists of 3 sets*fuzzy* that is:

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

Membership function of Lecturer Sentiment Quality: presented in Figure 4.6

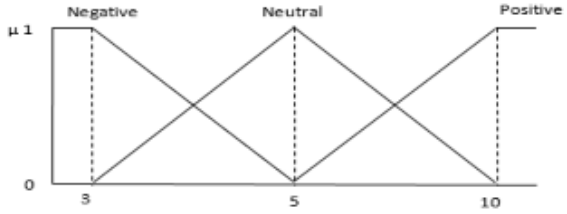

Figure 6 Membership Function Sentimen Towards Lecturers

In Figure 6 above it can be seen that the Dry membership function uses a descending linear representative, the Normal membership function uses a triangular curve and for the Oily membership function uses an ascending linear representative.

The following is the Membership Function Formula for Assessment and Examination Quality:

$$\mu\text{Sentimen Towards Lecturers [x]} \begin{cases} 1, = \quad x \quad \leq 3 \\ 0 \leq x \leq 50 \; = \; \dfrac{5-x}{50-3}, \\ 0, = \quad x \geq 50 \end{cases}$$

$$\mu\text{Sentimen Towards Lecturers [x]} \begin{cases} 1, = \; x \; = b \\ 0 \leq x \leq 50 = \; \dfrac{x-3}{5-3}, \\ b \leq x \leq c \; = \; \dfrac{5-x}{10-50}, \\ 0, = \quad x > \; 10 \; | \quad |x < 3 \end{cases}$$

$$\mu\text{Sentimen Towards Lecturers [x]} \begin{cases} 1, \quad x \geq 5 \\ 50 \leq x \leq 100 = \quad \dfrac{x-5}{10-5}, \\ 0, \quad x \leq 5 \end{cases}$$

4. Case Studies

Determine the quality of the lecturer's sentiment assessment if:
Teaching Quality = 2 positive words (8)
Material Availability = There are 2 neutral words (7)
Student and lecturer interactions = There is 1 negative word (4)

Lecturer Feedback Quality = There are 2 negative words (3)

1) **Teaching Quality Membership Function**

The following is the value of the teaching quality membership function [8]

a. Negative = [0-5]
b. Neutral = [3-5-10]
c. Positive= [5-10]

Based on the statement above, the formula used is that the value of x is between the values b and c of the Neutral set and a and b of the Positive set

μQuality of Teaching Neutral[8] $\frac{10-8}{10-5}$ = 0,4

so valueμQuality of Sufficient Teaching[80] is 0.4

Next μQuality of Teaching is Good [8]

$$\mu\text{Quality of Teaching is Good } [8] = \frac{8-5}{10-5}, = 0{,}6$$

μQuality of Teaching is Good [8] = is 0.6

2) **Material Availability Membership Function**

The following is the value of the membership function of material availability [7]

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

Material Availability Value 7 is in the Neutral and Positive sets

Based on the statement above, the formula used is that the value of x is between the values of b and c in the Neutral set and between a and b in the Positive set:

μAvailability of Sufficient Materials [7] = $\frac{10-7}{10-5}$=0,6

So rateμSufficient Material Availability [7] is 0.6

The next is

μAvailability of Sufficient Materials [7] =$\frac{7-5}{10-5}$ =0,4

so valueμSufficient Material Availability [7] is 0.4

3) **Student Lecturer Interaction Function**

The following is the Value of Student and Lecturer Interaction Functions [4]

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

Based on the statement above, the formula used is that the value of x is between the values a and b of the Negative set and between a and b of the Neutral set

μStudent and Lecturer Interaction Negative[4] = $\frac{5-4}{5-3}$ = 0,5

so value μStudent and Lecturer Interaction Negatif[4] adalah 0,5

The next is μStudent and Lecturer Interaction Netral[4]

μStudent and Lecturer Interaction[4] = $\frac{4-3}{10-3}$, = 0,14

so value Student and Lecturer Interaction[4] is 0,14

4) **Exam Assessment Membership Function**

The following is the value of the Membership Function Assessment Examination [30]

a. Negative = [3-5]
b. Neutral = [3-5-10]
c. Positive = [5-10]

Based on the statement above, the formula used is that the value of x is right in the negative set so value [3] is 1

Table 2 μ value of each variable

Teaching Qualification	m	Material Availability	m	Student and Lecturer Interaction	m	Lecturer Feedback	m
Negative	0	Negative	0	Negative	0,5	Negative	1
Neutral	0,6	Neutral	0,4	Neutral	0,14	Neutral	0
Positive	0,4	Positive	0,6	Positive	0	Positive	0

b. Inference

Next, enter the inference stage, which is to form a rule or rules to determine skincare that suits your skin type. The following are the rules from this study:

1. If Teaching Quality = Negative Or Student Lecturer Interaction = Negative Or Lecturer Feedback Quality = Negative, Then Student Sentiment = (Negative).
2. If the Quality of Teaching = Neutral and Availability of Material = Positive and Student Lecturer Interaction = Neutral and Kubd = 3.Positive, then Student Sentiment = (Neutral).
3. If the Quality of Teaching = Positive and the Availability of Material = Positive and Student Lecturer Interaction = Positive and Kubd = Positive, then Student Sentiment = (Positive).
4. If the Quality of Teaching = Negative and Availability of Material = Negative and Student Lecturer Interaction = Neutral, then Student Sentiment = N (Negative).
5. If Teaching Quality = Neutral and Student Lecturer Interaction = Positive, then Student Sentiment = E (Neutral).
6. If teaching quality = positive and material availability = metral and student-lecturer interaction = neutral, then student sentiment = P (positive).

Based on the 6 fuzzy rules above, the values of α and z are determined for each rule. Steps to convert the SIX rules so that the values of α and z are obtained for each rule.

a. If Teaching Quality = Negative Or Student Lecturer Interaction = Negative Or Lecturer Feedback Quality = Negative, Then Student Sentiment = (Negative).

α1: Teaching Quality = Negative Or Student Lecturer Interaction = Negative Or Lecturer Feedback Quality = Negative, Then Student Sentiment = (Negative).= MAX(0, 0.5, 0, 1) = 1

Then look for the membership function value z1 (μNegative Student Sentiment[x])

If: α1 = 1 then the value of z5 = 3

α1 = 0 then the value of z5 = 5

If α1 is between 0 and 1 then the formula applies

a1= (Z1-Zmin)/(Zmax-Zmin),

z1= 3

b. If the Quality of Teaching = Neutral and Availability of Material = Positive and Student Lecturer Interaction = Neutral and Kubd = 3.Positive, then Student Sentiment = (Neutral).

a21: MIN(If Teaching Quality = Neutral And Material Availability = Positive And Student Lecturer Interaction = Neutral And Lecturer Feedback = .Positive, Then Student Sentiment) = MIN(0.6, 0.6, 0.14, 0) = 0

Then look for the value of the membership function z2 (μNeutral Student Sentiment [x])

If: α21 = 1 then the value of z2 = 5

A21 = 0 then the value of z2 = 3

If α2 is between 0 and 1 then the formula applies

a21 = (MAX-Z31)/(MAX-MIN),

For α21 = 3

If: α22 = 1 then the value of z32 = 5

A22 = 0 then the value of z32 = 10

If α3 is between 0 and 1 then the formula applies

A22 =(Z32-min)/(max-min),

then α22 = 10

c. If the Quality of Teaching = Positive and Availability of Material = Positive and Student Lecturer Interaction = Positive And the Quality of Lecturer Feedback = Positive, then Student Sentiment = (Positive).

A3: MIN(Teaching Quality = Positive and Material Availability = Positive and Student Lecturer Interaction = Positive and Lecturer Feedback Quality = Positive) = MIN(0.4, 0.6, 0, 0) = 0

If: α3 = 1 then the value of z3 = 3

α3 = 0 then the value of z3 = 10

If α5 is between 0 and 1 then the formula applies

a5= (Z5-Zmin)/(Zmax-Zmin),

Maka z3 = 10

Defuzzification: find the value of z. Can be searched by the Tsukamoto centroid method

$$z^* = \frac{\alpha_{Pred1} * Z + \alpha_{Pred2} * Z2 + \alpha_{Pred3} * Z3 + \alpha_{Pred4} * Z4}{\alpha_{Pred1} + \alpha_{Pred2} + \alpha_{Pred3} + \alpha_{Pred4}}$$

$$z = \frac{1*3+0*3+0*10+0*0}{1+0+0+0}$$

Furthermore, the z value is made into a crisp value again according to the Student Sentiment value which is at value 3, namely Negative sentiment

4. CONCLUSION

The application of Fuzzy Tsukamoto can be applied to determine student sentiment towards lecturers through questionnaire comments by making rules that are in accordance with the Tsukamoto fuzzy method; students' sentiment decisions towards lecturers look more objective according to the type of input given and the rules set, so that it is more objective and resembles human intuition, the results obtained from case studies by describing the suitability between inputs given with the appropriate output output.

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