Implementation of Fuzzy Logic

by Syamsul Huda

Implementation of Fuzzy Logic in Describing Comparison of the Level of Faith in Urban and Rural Communities Judging from the Worship Aspect

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Abstract

Fuzzy logic theory is a set of logic theory with the ability to reason. The purpose of this study is to describe the fuzzy application in analyzing the comparison of the level of faith of urban and rural communities in terms of aspects of community worship. This study was included in a descriptive qualitative study with data collection techniques in the form of literature studies, interviews and questionnaires. Based on the results of the study, the Fuzzy method can present the level of faith of urban and rural communities based on prayer, fasting and zakat. After analyzing using the fuzzy method, the value of urban society's faith level is 78.23 so that the urban community's faith level is muhsin, and the rural community's level of faith is 65.035 so that the rural community's level of faith is a believer. Then it can be concluded that the level of faith of the urban community is better compared to rural communities in terms of worship.

Keywords: Fuzzy Logic, Level of Faith

Introduction

Religion is a system that regulates the system of belief (faith) in God Almighty and the set of procedures for worship and the rules of human association (Moody, 2019; Norenzayan et al., 2016). Islam is a religion created by Allah SWT with the foundation of faith, Islam, and ihsan, which has a high nobleness compared to other religions created by humans, because God himself created the religion of Islam, and is the only religion blessed by him. In Islam, worship is important because it is a form of obedience to Allah SWT. The content of worship is considered quality if it includes aspects of admiration, sincerity, obedience, hope and love at the same time

The use of the set in mathematics has been started since the end of the 19th century. Intuitively, the set can be expressed as a collection of objects both real objects and objects that are not real (abstract) that can be clearly defined. For example, a set of children aged 12 years. The members of this association are clear and can be distinguished which members, and which are not members. But in everyday life, sometimes not being able to decide on something with simple answers such as stating that someone's age is young or old, is very relative.

In 1965, Zadeh introduced a set of fuzzy logic theories (Ali et al., 2016; Mammadli, 2016; Sahana & Sajjad, 2017). The emergence of this theory of fuzzy logic became evidence that not all problems can be solved simply, as in boolean logic that can be defined numerically, but

sometimes a problem cannot be defined concretely, because its abstract existence. This logic indeed tends to be more practical to use because it is simple, easy to understand, flexible, and is better and more efficient. The emergence of fuzzy logic is also closely related in daily life (Eng, 2009), which so far many people think that mathematics is not widely used in daily life.

The problem of the level of faith is one of the problems that can be studied through fuzzy logic, because faith is the essence and existence of Islam as a religion whose conditions are flexible(Abrori & Hinung Primahayu, 2016). In reality, big sins except shirk do not cause the loss of the title of faith in someone. So the big sinner, except shirk still holds the title of faith even though the level of his faith is already incomplete due to his great sin. Besides that, not many people know about the level of faith in Islam itself because there is no system that can be used as a measurement tool to determine the level of faith..

The author also sees that there are differences in terms of the level of understanding and practice of Islam between urban and rural communities. For example, mosques and prayer rooms in urban areas are more crowded with pilgrims compared to mosques and prayer rooms in rural areas, people are more aware of the obligation of zakat, donations and alms this is evidenced by the many zakat institutions in urban areas that are running well, and so on. This research was conducted by giving a questionnaire, continued using fuzzy set theory and completed with a comparison of the level of faith of urban communities with the level of faith of rural communities. The use of fuzzy theory is widely used by previous studies (Haerani & Ramdaril, 2018; Jayanti & Hartati, 2012; Junaedi et al., 2018; Maulana & Rizki, 2018; Nadhif & Suryono, 2015; Nuraida et al., 2013; Putra & Febrianti, 2017; Uyun & Madikhatun, 2011; Widaningrum, 2016) but the use of fuzzy theory has never been used in describing the comparison of the level of people's faith. Therefore, the novelty of this study is to try to find a comparison of the level of faith by using fuzzy applications. Thus, the purpose of this study is to describe the fuzzy application in analyzing the comparison of faith levels in urban and rural communities in terms of aspects of community worship.

Research methods

This research is included in a descriptive qualitative research which aims to describe or describe the events that occur (Saelan, 2009), This study took samples from urban and rural communities, by calculating the sample size using the Slovin technique. The Slovin formula for determining samples is as follows (Matondang, 2015)
Information:

$$n = \frac{N}{1 + N(e)^2}$$

n = The sample size or the number of respondents
N = Population size
e = presentation of concessions to the accuracy of sampling errors that can still be tolerated, e = 0,05 (5%).

Based on the calculation of determining the sample, the respondents in this study were adjusted to 137 respondents or around 66.2% of the total population of urban communities and 59 respondents or around 86.8% of the total population of rural communities. This was done to facilitate data processing and for better testing results. Sampling in this study was carried out using insindental technique, that insindental sampling is determination of samples based on coincidences, ie anyone who meets coincidentally with a researcher can be used as a sample, if what is found is suitable as a data source needed(Haerani & Ramdaril, 2018). The scale used in measuring the level of faith is the Likert scale. Data collection techniques are in the form of literature studies, interviews and questionnaires. The lattice instruments of the faith level and their categories are presented in Tables 1 and 2.

Table 1. Grid Level of Instruments for Community Faith

Sub-Variables	Sub-Variables	Indicator
Worship	Prayer	1. Doing the obligatory prayers 2. Working sunnah prayers
	Fasting	3. Working fasting obligatory 1. Working sunnah fasting
	tithe	4. Paying zakat obligatory 1. Pengeluarkan donation and charity

Table 2. Category Level of Faith

Level of Faith	range
Muhsin	$70 \leq x \leq 100$
Mukmin	$40 \leq x \leq 80$
Muslim	$0 \leq x \leq 50$

The steps taken in this research are
1. Creating fuzzy variables, namely input and output variables
2. Determine the set, the universe of conversation, and the fuzzy domain
3. Perform Fuzzyfication (Determine the membership function of each fuzzy set on each fuzzy variable and calculate the value or degree of membership based on a predetermined membership function)
4. Formation of fuzzy rules
5. Defuzzyfication, defuzzyfication is done by the Centroid method

RESULTS AND DISCUSSION

The data collected in this study are questionnaire data that has been filled out by the Prumdam III Sukarame community as urban communities and the Pemalo Tahalo community as rural communities. After testing the instrument, the data on the level of faith in urban and rural communities were given including prayer, fasting and zakat. The amount of data used is 137 urban communities and 58 rural communities. The results obtained in the distribution of

questionnaires are urban communities that are 73 prayers, fasting 81, zakat 74. While rural communities are 65 prayers, 73 fasting, and 70 alms.

After the data collection is obtained, the subsequent data processing uses the fuzzy method. The first step is the formation of a fuzzy set consisting of output and input variables, the universe of speech and the fuzzy domain. Following table 3 formation fuzzy set.

Table 3. Formation of Fuzzy Input and Output Sets

Function	Variables	Assemblage	Universal	Domain
Input	Prayer	Very poor	[0-100]	[0 20 40]
		Not good	[0-100]	[20 40 60]
		Well	[0-100]	[40 60 80]
		Very good	[0-100]	[60 80 100]
	Fasting	Very poor	[0-100]	[0 20 40]
		Not good	[0-100]	[20 40 60]
		Well	[0-100]	[40 60 80]
		Very good	[0-100]	[60 80 100]
	Alms	Very poor	[0-100]	[0 20 40]
		Not good	[0-100]	[20 40 60]
		Well	[0-100]	[40 60 80]
		Very good	[0-100]	[60 80 100]
Output	The level of faith	Muslim	[0-100]	[0.10, 20.30, 40.50]
		the believers	[0-100]	[40,50,60,70,80]
		Muhsin	[0-100]	[70,80,90,100]

Based on the fuzzy set variables and domains that have been compiled, the next step determines the membership function for each variable and calculates the value or degree of membership based on the membership function that has been determined (fuzzyfication). The fuzzy set along with the membership function of the prayer, fasting and zakat variables will be presented based on data that has been obtained from the average value of filling community questionnaires, namely urban communities, namely 73 prayers, 81 fasting, 74 zakat. While rural communities namely prayer 65, fasting is 73, and zakat is 70. The urban function for the variable with the lowest domain uses the downward linear curve, the membership function for the highest domain uses the upward linear curve, while the membership function between the lowest and the highest uses a triangle curve. The following results are fuzzyfication in table 4.

Table 4. Results of Community Questionnaire Data Fuzzyfication

Variables	Urban Community			Rural Community		
	Prayer	Fasting	Alms	Prayer	Fasting	Alms
Assemblage	μvery poor [73] = 0	μvery poor [81] = 0	μvery poor [74] = 0	μvery poor [65] = 0	μvery poor [73] = 0	μvery poor [70] = 0
	μ less good [73]	μ less good	μ less good [74]	μ less good [65]	μ less good [73]	μ less good [70]

= 0	[81] = 0	= 0	= 0	= 0	= 0
μwell [73] = 0.35	μwell [81] = 0	μwell [74] = 0.3	μwell [65] = 0.75	μwell [73] = 0.35	μwell [70] = 0.5
μ very good [73] = 0.65	μ very good [81] = 1	μ very good [74] = 0.7	μ very good [65] = 0.25	μ very good [73] = 0.65	μ very good [70] = 0.5

The next stage that will be carried out after determining the membership function of each variable is compiling the fuzzy logic rules. Rules are made to state the relationship or relation between input and output according to data that has been obtained, to connect between two or more inputs using your operator while to connect between input and output using [*If – Then*]. Based on existing data, obtained by the rules of fuzzy rules as follows:

Based on available data, fuzzy rules are obtained as follows:

[R1] If (Prayer is Good) and (Fasting is Good) and (Alms is Good), Then (Level of Faith is Mukmin)

[R2] If (Prayer is Good) and (Fasting is Good) and (Alms is Very Good), Then (Level of Faith is Mukmin)

[R3] If (Prayer is Good) and (Fasting is Very Good) and (Alms is Good), Then (Level of Faith is Mukmin)

[R4] If (Prayer Is Good) and (Fasting Is Very Good) and (Alms Is Very Good), Then (Level Of Faith Is Muhsin)

[R5] If (Prayer is Very Good) and (Fasting is Good) and (Alms is Good), Then (Level of Faith is Mukmin)

[R6] If (Prayer is Very Good) And (Fasting is Good) And (Zakat is Very Good), Then (Level of Faith is Muhsin)

[R7] If (Prayer is Very Good) And (Fasting is Very Good) And (Zakat is Good), Then (Level of Faith is Muhsin)

[R8] If (Prayer is Very Good) And (Fasting is Very Good) And (Zakat is Very Good), Then (Level of Faith is Muhsin)

Based on the rules that have been made, then inference with the Mamdani method which is calculating the α-predicate of each rule with the implication of Min. The implication of Min in finding the smallest degree of membership value of each variable in a rule then doing the composition of the rules using the Max method. Max method is to take the fuzzy set solution obtained by taking the maximum value of the rule, then use it to modify the fuzzy region, and apply it to the output using the OR (union) operator. If all propositions have been evaluated, the output will contain a fuzzy set that reflects the contribution of each proportion. The following is an overall picture of the composition of fuzzy rules.

Data urban communities
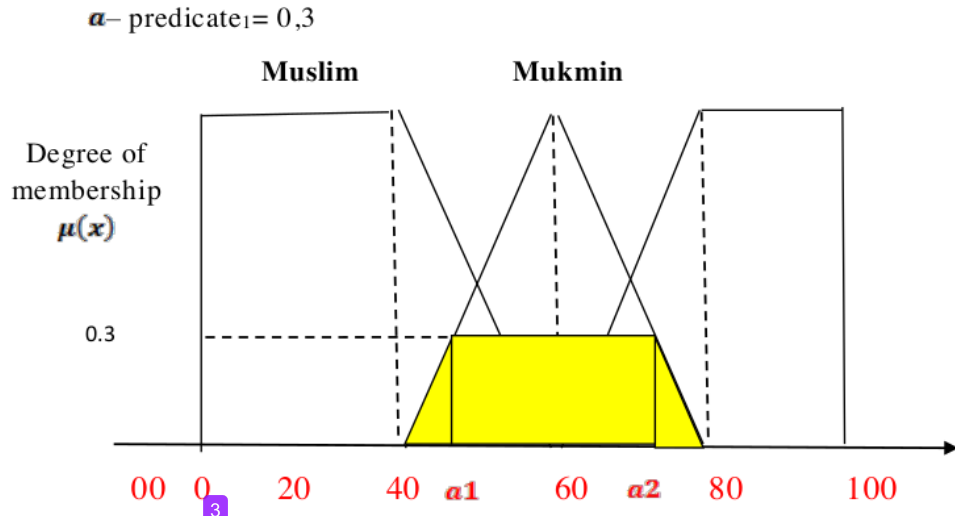
a– predicate$_1$= 0,3

Figure 1. The composition of fuzzy rules on the variable level of faith in urban communities

In Figure 1, our result areas are divided into 3 parts, namely A1, A2, and A3. Now we look for value $a1$ and $a2$
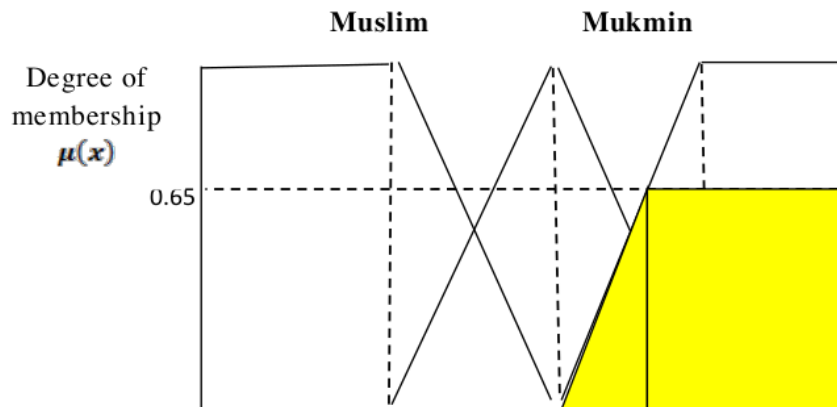
$$(a1 - 40)/(60 - 40) = 0.3 \text{ then } a1 = 46$$
$$(80 - a2)/(80 - 60) = 0.3 \text{ then } a2 = 74$$

Thus the membership function for the results of this composition is

$$\mu(z) = \begin{cases} 0 & x \leq 40, \ x \geq 80 \\ \dfrac{x-40}{60-40} & 40 \leq x \leq 46 \\ 0,3 & 46 \leq x \leq 74 \\ \dfrac{80-x}{80-60} & 74 \leq x \leq 80 \end{cases},$$

a– predicate$_4$ = 0,65

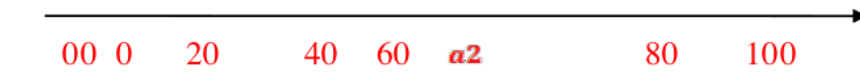$$\begin{array}{ccccccc} 00\ 0 & 20 & 40 & 60 & \textit{a2} & 80 & 100 \end{array}$$

Figure 2. The composition of fuzzy rules on the variable level of faith in urban communities

In Figure 2, the results area we divide into 2 parts, A1, and A2. Now we look for value **a1**,

$$(a1 - 60)/(80 - 60) = 0.65 \text{ then } a1 = 73$$

Thus the membership function for the results of this composition is

$$\mu(z) = \begin{cases} 0 & x \leq 60,\ x \geq 100 \\ \dfrac{x-60}{80-60} & 60 \leq x \leq 73 \\ 0,65 & 73 \leq x \leq 100 \end{cases}$$

Data rural communities
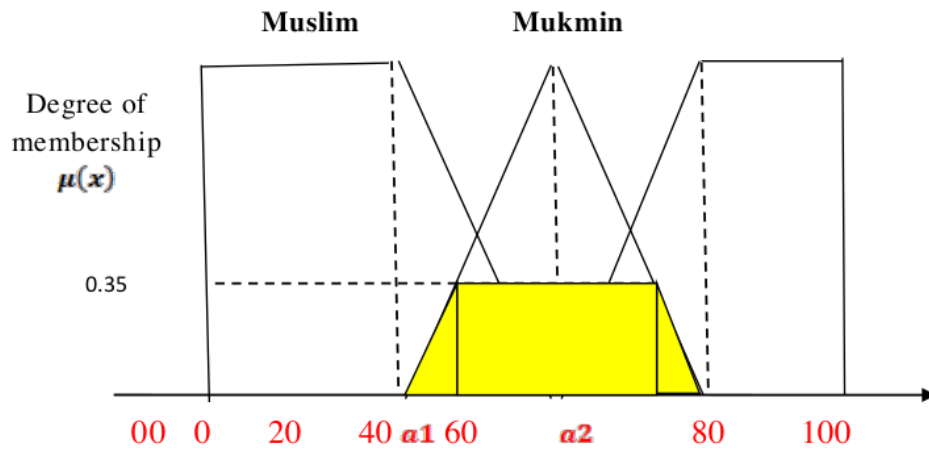
$$\textit{a}\text{- predicate}_1 = 0.35$$

Figure 3. The composition of fuzzy rules on the variable level of faith of rural communities

In Figure 3, that, our result area is divided into 3 parts, A1, A2, and A3. Now we look for value **a1 and a2**

$$(a1 - 40)/(60 - 40) = 0.35 \text{ then } a1 = 47$$
$$(80 - a2)/(80 - 60) = 0.35 \text{ then } a2 = 73$$

Thus the membership function for the results of this composition is

$$\mu(z) = \begin{cases} 0 & x \le 40,\ x \ge 80 \\ \dfrac{x-40}{60-40} & 40 \le x \le 47 \\ 0,35 & 47 \le x \le 73 \\ \dfrac{80-x}{80-60} & 73 \le x \le 80 \end{cases}$$

$\boldsymbol{a}$- predicates = 0.25

Muslim   **Mukmin**

Degree of
membership
$\boldsymbol{\mu(x)}$

0.25

00 0   20   40   60 $\boldsymbol{a2}$ 80   100
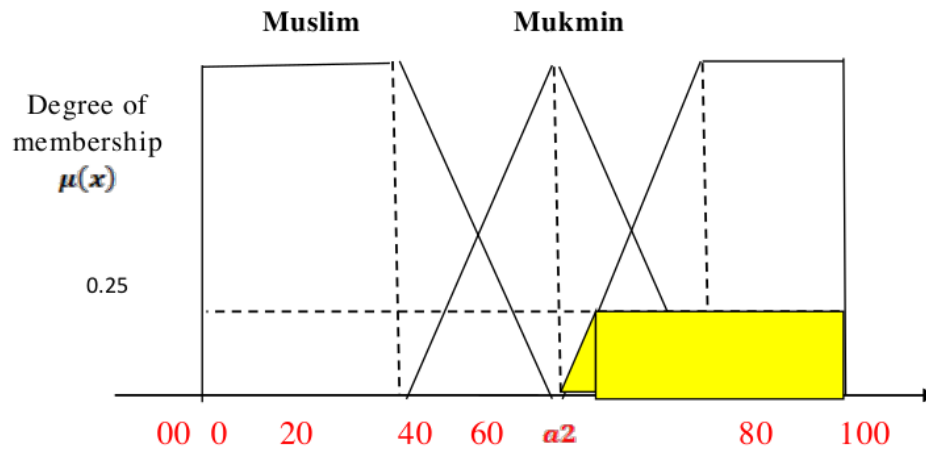
Figure 4. The composition of fuzzy rules on the variable level of faith of rural communities

In Figure 4. the results area we divide into 2 parts A1 and A2. Now we are looking for value.$\boldsymbol{a1}$

$(a1 - 60)/(80 - 60) = 0.25$ then $\boldsymbol{a1 = 65}$

Thus the membership function for the results of this composition is

$$\mu(z) = \begin{cases} 0 & x \le 60,\ x \ge 100 \\ \dfrac{x-60}{80-60} & 60 \le x \le 65 \\ 0,25 & 65 \le x \le 100 \end{cases}$$

The next step is defuzzyfication. Defuzzyfication that is to confirm or look for a firm value (crisp) using the centroid method (center point), for that we look for moments for each region,
Finding moments of urban community data

$$M1 = \int_{40}^{46}(0.05z - 2)z\,dz = \left[\frac{0.05}{3}z^3 - z^2\right]_{40}^{46} = 39.6$$

$$\vphantom{x}$$
,
,

$$M9 = \int_{73}^{100}(0.65)z\,dz = \left[\frac{0.65}{2}z^2\right]_{73}^{100} = 1518.1$$

Looking moments rural community data

$$M1 = \int_{40}^{47}(0.05z - 2)z\,dz = \left[\frac{0.05}{3}z^3 - z^2\right]_{40}^{47} = -249.8$$

,

,

,

,

$$M20 = \int_{65}^{100}(0.25)z\,dz = \left[\frac{0.25}{2}z^2\right]_{65}^{100} = 721.9$$

Then we calculate the area of each region in the image

Finding the area of urban community data

$$A7 = \frac{(46-40)\,x\,0.3}{2} = 0.9$$

,

,

,

$$A20 = (100-73)\,x\,0.65 = 17.55$$

Finding the area of rural community data

$$A1 = \frac{(47-40)\,x\,0.35}{2} = 1.225$$

,

,

,

$$A20 = (100-65)\,x\,0.25 = 8.75$$

defuzzyfication urban community data:

$$Z^* = \frac{39.6 + 504 + 28.43 + 79.23 + 964.4 + 57.6 + 846.6 + 290.12 + 1518.1}{0.9 + 8.4 + 0.9 + 0.7 + 11.55 + 0.9 + 10.2 + 4.225 + 17.55}$$

$$Z^* = \frac{4328.08}{55.325} = 78.23$$

defuzzyfication Data rural communities:

$$Z^* = \frac{\begin{array}{l} -249,8+546+92,28-249,8+546+92,28+116,6+600+183,4-373,3 \\ +1275+27,1+450+47,95+39,58+721,9+39,58+721,9+39,58+721,9 \end{array}}{\begin{array}{l} 1,225+9,1+1,225+1,225+9,1+1,225+2,5+10+2,5+2,5+15+0,625 \\ +7,5+0,625+8,75+0,625+8,75+0,625+8,75 \end{array}}$$

$$Z^* = \frac{5388,15}{82,85} = 65,035$$

So the defuzzyfication results, the level of urban society's faith is 78.23 so that the urban community's level of faith is muhsin, and the rural community's level of faith is 65.035 so that the rural community's level of faith is a believer (Mukmin).

Conclusions and Suggestions

Based on the results of research that has been conducted on respondents relating to fuzzy applications to analyze the level of faith of urban and rural communities, Prumdam III Sukarame Bandar Lampung community studies and Pematang Tahalo East Lampung communities covering coverage, zakat and fasting, it can be concluded that the Fuzzy Mamdani method can presented the level of community faith. After being analyzed using the fuzzy method, the urban community's faith level was 78.23 so that the urban community's level of faith was muhsin, and the rural community's level of faith was 65.035 so that the rural community's level of faith was a believer. Based on the above results, namely the level of faith of urban communities at the level of Muhsin and rural communities at the level of believers, it can be concluded that the level of faith of urban communities is better than rural communities in terms of worship.

This study uses fuzzy methods to measure the level of faith in urban and rural communities. The use of fuzzy logic is very helpful and leads researchers to determine the results of community faith levels accurately. Researchers also experience a little difficulty in using fuzzy logic, namely the number of steps and calculations that must be done in fuzzy logic. Further research can be investigated in other community settings, or can also be assisted by applications in the calculation of fuzzy methods, or measurement of the level of faith with other methods.

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