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# Analyzing Decision Support System for Determining Eligibility of Home Ownership Loan Using Fuzzy Mamdani Logical Method and Technology Acceptance Model in Banking

***Ayi Bayyinah[1]and Wendi Usino[2]***

[1,2] *Master Program in Computer Science, Post Graduate Program,Universitas Budi Luhur*

**Abstract.** Every year, the number of people who want to own a house by credit increase, therefore the chances of increasing problem loans will be greater. Non-Performing Loan (NPL) is an indicator to assess the performance of bank functions. The higher the NPL value, the performance of the bank is considered worse.In order to maintain the caution of banks (creditors) in the provision of credit, the bank needs to assess and determine the criteria of debtors who can be given credit. So the bank can make decisions precisely and accurately. In this research, the Researcher will design decision support system with Mamdani fuzzy logic method with the resulted output in the form of "rejected" or "approved" decision.The accuracy rate in this study is 98%. 2% of the difference consists of 63.64% is a debtor with NPL credit status (problematic). After the system was designed in this study, the researcher conducted an analysis to see the user behavior when using the system.The method used is Technology Acceptance Model (TAM). The result of TAM analysis is the simultaneous relationship among of all variables on the acceptance of information technology (acceptance of IT) have a positive impact.However, a partial relationship between perceived usefulness and attitude toward using does not have a positive effect.

***Keyword:*** Decision Support System, Fuzzy Mamdani, Matlab, Technology Acceptance Model (TAM)

**Abstrak.** *Setiap tahun, jumlah orang yang ingin memiliki rumah sendiri dengan kredit meningkat, sehingga kemungkinan masalah yang terjadi pada proses pinjaman akan lebih besar. Non-Performing Loan (NPL) merupakan indikator untuk menilai pelaksanaan fungsi bank. Semakin tinggi nilai NPL, kinerja bank dianggap lebih buruk. Untuk menjaga keamanan proses penyediaan kredit, bank perlu menilai dan menentukan kriteria debitur yang dapat diberikan kredit agar bank dapat membuat keputusan yang tepat dan akurat. Dalam penelitian ini, peneliti akan merancang sistem pendukung keputusan dengan metode logika fuzzy Mamdani dengan menghasilkan output berupa "rejected" atau "approved". Tingkat akurasi dalam studi ini adalah 98%. 2% ketidak akuratan ini disebabkan 63.64% adalah debitur dengan NPL kredit status (bermasalah). Setelah sistem ini dirancang, peneliti melakukan analisis untuk melihat perilaku pengguna ketika menggunakan sistem. Metode yang digunakan adalah Technology Acceptance Model (TAM). Hasil analisis TAM adalah adanya hubungan simultan antara semua variabel. Penggunaan teknologi informasi memiliki dampak positif. Namun, hubungan parsial antara manfaat dan sikap pengguna tidak memiliki efek positif.*

**Kata Kunci:** *Sistem Pendukung Keputusan, Fuzzy Mamdani, Matlab, Technology Acceptance Model (TAM)*

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*Corresponding author at: Universitas Budi Luhur, Jl. Ciledug Raya, Petukangan Utara, Pesanggrahan, Kota Jakarta Selatan, Daerah Khusus Ibukota Jakarta 12260, Indonesia

E-mail address: wendi.usino@budiluhur.ac.id


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## 1. Introduction

Home Ownership Loan (KPR) is one way to fulfill the needs of the home and long-term investment. Every year, the more people who want to own the house and invest, the more problematic credit opportunities will be. This affects the NPL value of a bank (creditor). Non-Performing Loans (NPLs) or non-performing loans are indicators for assessing bank function performance. The higher the NPL value, the performance of the bank is considered worse. The progress of NPL KPR BCA both National and Jabodetabek can be seen in Figure 1.

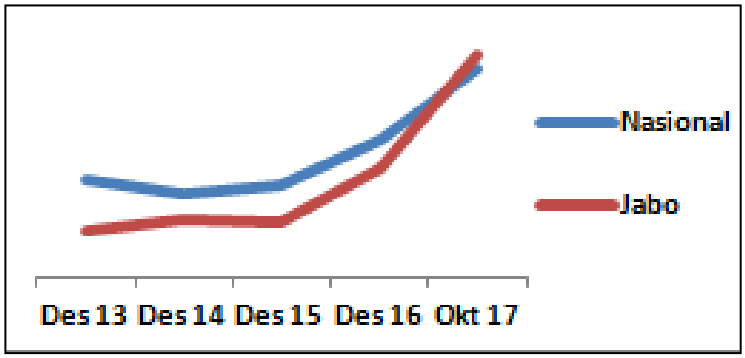


**Figure 1** The Progress of NPL KPR BCA Graphic

One of the causes of problem loans is less precise in determining the debtor who deserves credit. The accuracy in giving credit to debtors greatly influences the magnitude of NPLs in the future. In order to maintain the caution of banks (creditors) in the provision of credit, banks need to assess and determine the criteria of debtors who can be given credit. So that banks can make decisions accurately and accurately. To achieve this, it takes a decision support system (DSS) to produce a decision accurately and accurately. The Researcher uses a settlement method that is fuzzy mamdani technique support the system. This method has a simple concept and easy to understand, but can produce decisions accurately and accurately. In this research will be built a prototype decision support system of creditworthiness with GUI-based, then will be analyzed the positive impact given by the user to the system built in producing an accurate and objective decision. To measure the acceptance of information systems to users of decision support systems built using the Technology Acceptance Model (TAM) method. The constructs used in this research are perceived usefulness, perceive ease of use, attitude towards using and acceptance of IT. The problem limitation in this research as follows:

1. This research is conducted to grant housing loan from PT. Bank Central Asia, Tbk in Jabodetabek.
2. Method in this research is Fuzzy Mamdani method.
3. Technological Acceptance Model (TAM) method constructs used to assess acceptance of decision support systems are: perceived usefulness, perceived ease of use, attitude towards using and acceptance of IT.

## 2. Theoretical Framework

### 2.1 Decision Support System

Turban and Aroson (2001), stated that the concept of Decision Support System (DSS) first appeared in the early 1970s by Scott-Morton. They define DSS as a computer-based interactive system that can assist decision makers in using data and models to solve unstructured problems.

### 2.2 Fuzzy Logic

Fuzzy logic was first introduced by prof. Lotfi A. Zadeh in 1965. Fuzzy means blurred or vague. Fuzzy logic is a multivalued logic that makes it possible to define intermediate values between two different logics, such as true and false, high and low, heat and cold, and others (Kusumadewi and Purnomo, 2004). Steps of fuzzy process is shown in Figure 2.

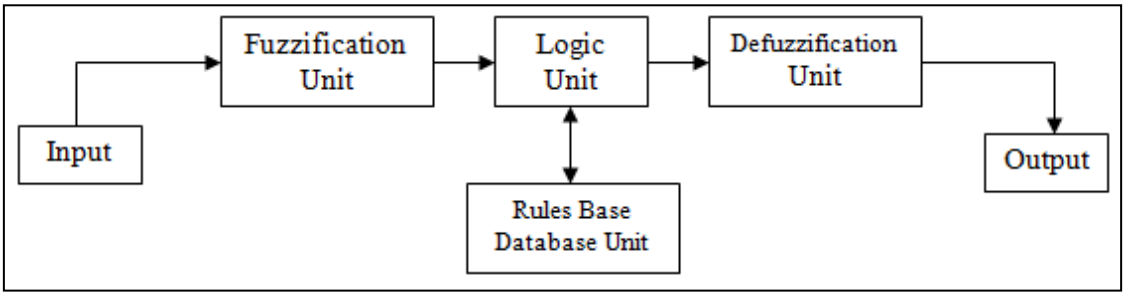


**Figure 2** Fuzzy Process

*A. Mamdani Method*

According to Kusumadewi et al. (2006), Mamdani method is often also known as min-max method. This method was introduced by Ebrahim Mamdani in 1975. Mamdani's method is most often used in applications because it has a simple structure, that is, using min-max or max-product operation. The process to get the output required the following four stages:

1. Fuzzification

   Fuzzification is the process of changing the input value firmly into a fuzzy input value.

2. Creation of Fuzzy Rules

   Fuzzy rules are established to get a firm output. The fuzzy rule used is the "if-then" rule with the operator between the input variables is the "and" operators. Statements that follow "if" are referred to as antecedent and statements that follow "hence" are called consequent.

3. Fuzzy Logic Analysis

   Every rule formed is a statement of implications. The fuzzy logic analysis used in this step is the min implication function, since the operators used in the "if-then" rule are the "and" operators. The result of the implication function of each rule is called α-predicate or commonly written α.

$$\alpha i = \mu A \cap B = \min(\mu Ai(x), \mu Bi(y)) \quad (1)$$

Furthermore, the max method is done inference fuzzy system, the composition between rules. The composition of the rules is the overall conclusion by taking the maximum membership level of each consequent application of the implication function and combining from all the conclusions of each rule, so that the fuzzy solution area is obtained as follows:

$$\mu sf\,[xi] = \max(\mu sf\,[xi], \mu kf[xi]) \quad (2)$$

4. *Defuzzification*

Defuzzification is a method to map the value of the fuzzy set into the crisp value. This research uses the method of centroid. Crisp settlement method is obtained by taking the center point (Z) fuzzy area, that is by formula:

$$Z = \frac{\int \mu(z).z\,.dz}{\int \mu(z).dz} \quad (3)$$

### 2.3 Home Ownership Loan (KPR)

KPR is a credit used to buy a home or for other consumer needs with a home guarantee. Although the use is similar, KPR is different from construction and renovation credits.

### 2.4 Non-Performing Loan (NPL)

According to Apriani (2011), Non-Performing Loan is a condition in which the customer is unable to pay part or all of its obligations to the bank as has been agreed. Meanwhile, according to Bank Indonesia in May 1993 deregulation policy package (PAKMEI 1993), non-performing loans are credits classified into Sub-standard Collectibility, Doubtful (D) and Loss (M).

### 2.5 Technology Acceptance Model (TAM)

Davis et al (1989) stated that the Technology Acceptance Model (TAM) is a theory of information systems that makes models about user processes willing to accept and use technology. This model explains that when users use information systems, a number of factors influence their decision on how and when to use the information system.

The basic model of technology acceptance in Technological Acceptance Model (TAM) is shown in Figure 3, as follows:

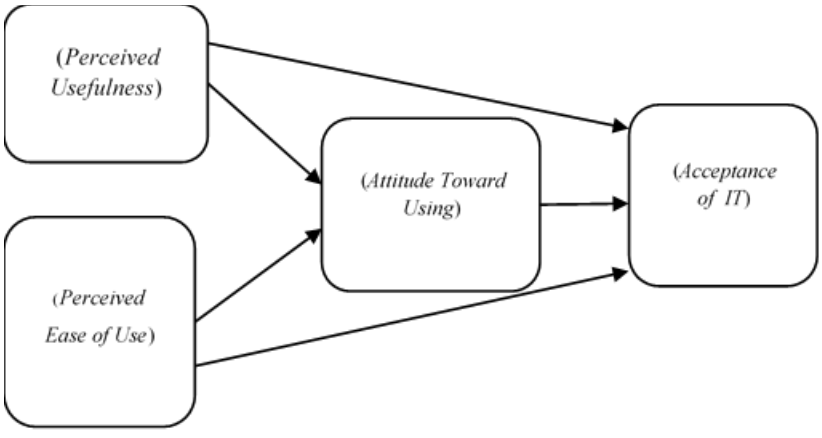


**Figure 3** Technology Acceptance Model [1]

## 3. Research Method

### 3.1 Identification of Assessment Criteria

In crediting KPR from BCA in Jakarta, there are criteria to be assessed in the credit analysis as follows.

1. Income
2. Business Type
3. Collateral Value
4. Household expenses
5. Other Credits
6. Age
7. Plafond
8. Tenor
9. LTV (Loan To Value)
10. Interest Rate
11. Business Risk

The "business risk" criterion is an additional criterion proposed by researchers in the process of credit analysis of mortgages that are expected to produce an appropriate and accurate decision.

### 3.2 Research Construct Indicators

In this research, the indicators used to measure each construct are presented in Table 1.

**Table 1** Indicators of research construct

| No | Construct | Indicator |
|---|---|---|
| 1 | *Perceived usefulness* | 1. Useful |
| | | 2. Simplify the job |
| | | 3. Increase Productivity |
| | | 4. Efficiency |
| | | 5. Effectiveness |
| 2 | *Perceived ease of use* | 1. Easy to learn |
| | | 2. Easy to use |
| | | 3. Easy to control |
| | | 4. Easy to understand |
| | | 5. Flexibility |
| 3 | *Attitude toward using* | 1. Believe |
| | | 2. A lot of benefits |
| | | 3. Easy to operate |
| | | 4. Good Idea |
| | | 5. Fun |
| 4 | *Acceptance of IT* | 1. Attitude to the presence of system |
| | | 2. Happy attitude to the system |
| | | 3. Satisfied attitude to the system |
| | | 4. Display |
| | | 5. Enthusiasm |

### 3.3 Flowchart

The flowchart design of the decision support system of the feasibility of providing KPR can be seen in Figure 4, and flowchart of Fuzzy Mamdaniin Figure 5.

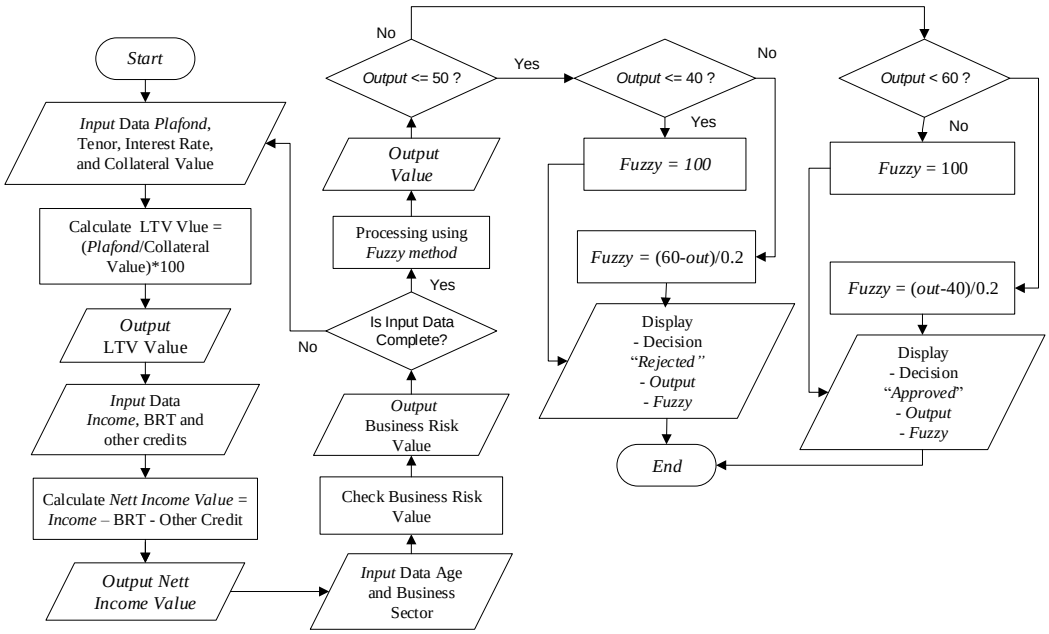


**Figure 4** DSS of the Feasibilty of providing KPR

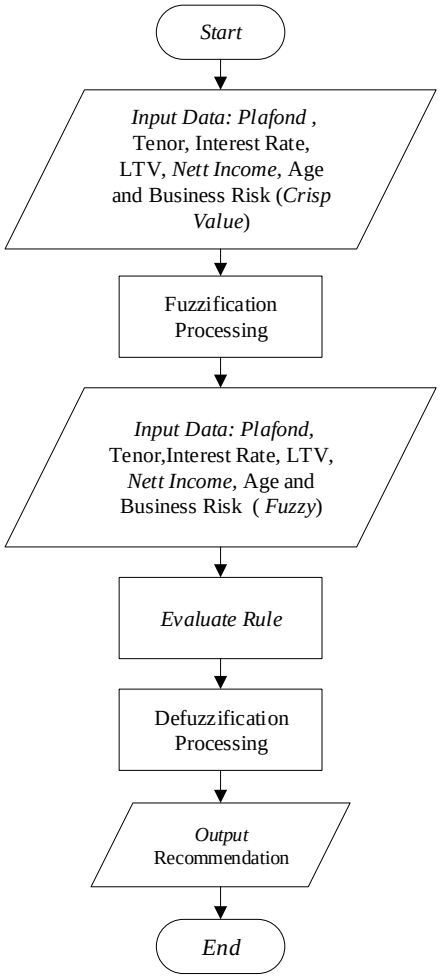


**Figure 5** Fuzzy Mamdani Process

### 3.4 User Interface System

In this study, the user interface is built using the GUI. Figure 6 shows the image of the debtor data input page as well as the result.

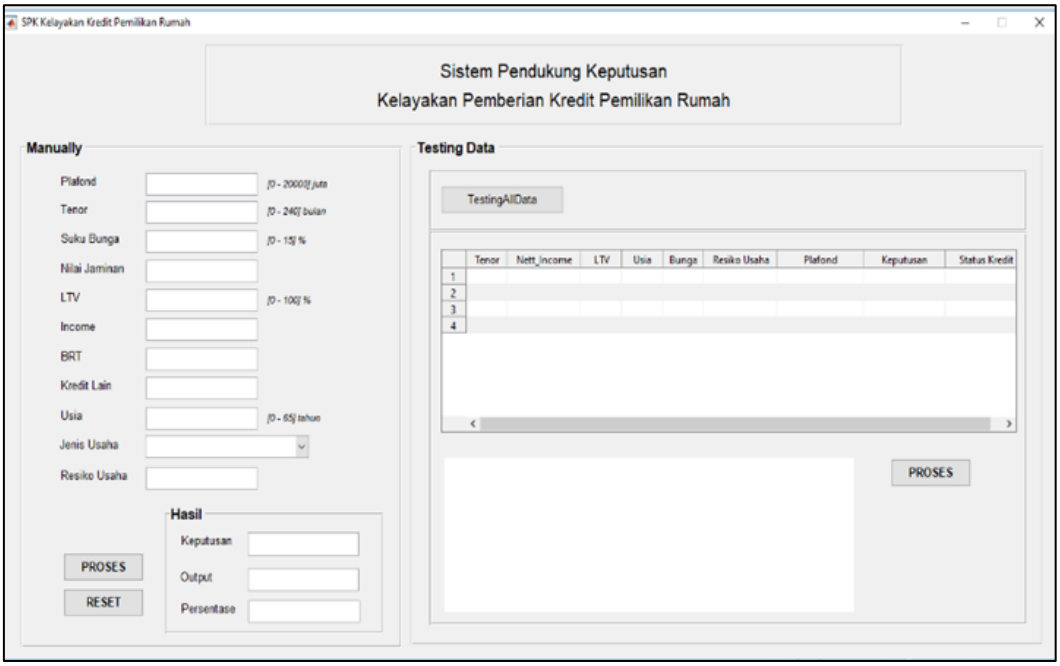


**Figure 6** User Interface System

## 4. Result and Discussion

### 4.1 Defining Variabels

1. Input Plafond Variable

**Table 2** Input Plafond Variable

| Variable | *FuzzyInput* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| *Plafond* | Very small | 0-20000 | [0 600] | [0 0 400 600] |
| | Small | | [400 1100] | [400 600 900 1100] |
| | Average | | [900 2100] | [900 1100 1900 2100] |
| | Large | | [1900 10100] | [1900 2100 9900 10100] |
| | Very Large | | [10000 20000] | [9900 10100 20000 20000] |

The equation of membership function for the plafond input variable is expressed in this equation:

$$\mu\, Sangat\ Kecil = \begin{cases} 1 & ; \quad 0 \le x \le 400 \\ \dfrac{600 - x}{600 - 400} & ; \quad 400 < x < 600 \\ 0 & ; \quad x \ge 600 \end{cases}$$

$$\mu Kecil = \begin{cases} \dfrac{x - 400}{600 - 400} & ; \quad 400 \le x < 600 \\ 1 & ; \quad 600 \le x \le 900 \\ \dfrac{1100 - x}{1100 - 900} & ; \quad 900 < x \le 1100 \end{cases}$$

$$\mu Sedang = \begin{cases} \dfrac{x - 900}{1100 - 900} & ; \quad 900 \le x < 1100 \\ 1 & ; \quad 1100 \le x \le 1900 \\ \dfrac{2100 - x}{2100 - 1900} & ; \quad 1900 < x \le 2100 \end{cases}$$

$$\mu Besar = \begin{cases} \dfrac{x - 1900}{2100 - 1900} & ; \quad 1900 \le x < 2100 \\ 1 & ; \quad 2100 \le x \le 9900 \\ \dfrac{10100 - x}{10100 - 9900} & ; \quad 9900 < x \le 10100 \end{cases}$$

$$\mu Sangat\ Besar = \begin{cases} 0 & ; \quad x < 9900 \\ \dfrac{x - 9900}{10100 - 9900} & ; \quad 9900 \le x < 20000 \\ 1 & ; \quad x \ge 20000 \end{cases}$$

2. Input Tenor Variable

**Table 3** Variabel Input Tenor

| **Variable** | ***FuzzyInput*** | ***Range*** | **Domain** | **Parameter** |
|---|---|---|---|---|
| Tenor | Short | 0 - 240 | [0 80] | [0 0 40 80] |
| | Medium | | [40 140] | [40 80 100 140] |
| | Long | | [100 240] | [100 140 240 240] |

The equation of membership function for the tenor input variable is expressed using this equation:

$$\mu Pendek = \begin{cases} 1 & ; \ 0 \le x \le 40 \\ \dfrac{80 - x}{80 - 40} & ; \ 40 < x < 80 \\ 0 & ; \ x \ge 80 \end{cases}$$

$$\mu Sedang = \begin{cases} \dfrac{x - 40}{80 - 40} & ; \ 40 \le x < 80 \\ 1 & ; \ 80 \le x \le 100 \\ \dfrac{140 - x}{140 - 100} & ; \ 100 < x \le 140 \end{cases}$$

$$\mu Panjang = \begin{cases} 0 & ; \ x \le 100 \\ \dfrac{x - 100}{140 - 100} & ; \ 100 < x < 140 \\ 1 & ; \ x \ge 140 \end{cases}$$

3. Interest Rate Input Variable

**Table 4** Interest Rate Input Variable

| Variable | *Fuzzy Input* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| Interest Rate | Low | 0-15 | [0 7] | [0 0 5 7] |
| | Standard | | [5 11] | [5 7 9 11] |
| | High | | [9 15] | [9 11 15 15] |

The equation of membership function for the interest rate variable is expressed using the equation:

$$\mu Low = \begin{cases} 1 & ;\ 0 \le x \le 5 \\ \dfrac{7-x}{7-5} & ;\ 5 < x < 7 \\ 0 & ;\ x \ge 7 \end{cases}$$

$$\mu Standard = \begin{cases} \dfrac{x-5}{7-5} & ;\ 5 \le x < \\ 1 & ;\ 7 \le x \le 9 \\ \dfrac{11-x}{11-9} & ;\ 9 < x \le 11 \end{cases}$$

$$\mu High = \begin{cases} 0 & ;\ x \le 9 \\ \dfrac{x-9}{11-9} & ;\ 9 < x < 11 \\ 1 & ;\ x \ge 11 \end{cases}$$

4. LTV Input Variable

**Table 5** LTV Input Variable

| Variable | *Input Fuzzy Set* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| LTV | Small | 0-100 | [0 55] | [0 0 45 55] |
| | Standard | | [45 90] | [45 55 80 90] |
| | Big | | [80 100] | [80 90 100 100] |

The equation of membership function for the LTV input variable is expressed using this equation:

$$\mu Kecil = \begin{cases} 1 & ;\ 0 \le x \le 45 \\ \dfrac{55-x}{55-45} & ;\ 45 < x < 55 \\ 0 & ;\ x \ge 55 \end{cases}$$

$$\mu Standard = \begin{cases} \dfrac{x-45}{55-45} & ;\ 45 \le x < 55 \\ 1 & ;\ 55 \le x \le 80 \\ \dfrac{90-x}{90-80} & ;\ 80 < x \le 90 \end{cases}$$

$$\mu Besar = \begin{cases} 0 & ;\ x \le 80 \\ \dfrac{x-80}{90-80} & ;\ 80 < x < 90 \\ 1 & ;\ x \ge 90 \end{cases}$$

5. Nett Income Input Variable

**Table 6** Nett Income Input Variable

| Variable | *Fuzzy Input* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| *Net Income* | Very small | 0-1000 | [0 10] | [0 0 8 10] |
| | Small | | [8 26] | [8 10 24 26] |
| | Average | | [24 41] | [24 26 39 41] |
| | Big | | [39 101] | [39 41 99 101] |
| | Very big | | [99 1000] | [99 101 9000 9000] |

The equation of membership function for input net income variable is expressed using equation:

$$\mu\, Sangat\ Kecil = \begin{cases} 1 & ;\ 0 \le x \le 8 \\ \dfrac{10-x}{10-8} & ;\ 8 < x < 10 \\ 0 & ;\ x \ge 10 \end{cases}$$

$$\mu Kecil = \begin{cases} \dfrac{x-8}{10-8} & ;\ 8 \le x < 10 \\ 1 & ;\ 10 \le x \le 24 \\ \dfrac{26-x}{26-24} & ;\ 24 < x \le 26 \end{cases}$$

$$\mu Sedang = \begin{cases} \dfrac{x-24}{26-24} & ;\ 24 \le x < 26 \\ 1 & ;\ 26 \le x \le 39 \\ \dfrac{41-x}{41-39} & ;\ 39 < x \le 41 \end{cases}$$

$$\mu Besar = \begin{cases} \dfrac{x-39}{41-39} & ;\ 39 \le x < 41 \\ 1 & ;\ 41 \le x \le 99 \\ \dfrac{101-x}{101-99} & ;\ 99 < x \le 101 \end{cases}$$

$$\mu Sangat\ Besar = \begin{cases} 0 & ;\ x < 99 \\ \dfrac{x-99}{101-99} & ;\ 99 \le x < 101 \\ 1 & ;\ x \ge 101 \end{cases}$$

6. Age Input Variable

**Table 7** Age Input Variable

| Variabel | *Fuzzy Input* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| Age | Young | 0-65 | [0 35] | [0 0 25 35] |
| | Middle-aged | | [30 50] | [25 35 40 50] |
| | Old | | [40 65] | [40 50 65 65] |

The equation of the membership function for the age input variable is expressed using the equation:

$$\mu Muda = \begin{cases} 1 & ; \ 0 \leq x \leq 25 \\ \dfrac{35-x}{35-25} & ; \ 25 < x < 35 \\ 0 & ; \ x \geq 35 \end{cases}$$

$$\mu Parobaya = \begin{cases} \dfrac{x-25}{35-25} & ; \ 25 \leq x < 35 \\ 1 & ; \ 35 \leq x \leq 40 \\ \dfrac{50-x}{50-40} & ; \ 40 < x \leq 50 \end{cases}$$

$$\mu Tua = \begin{cases} 0 & ; \ x \leq 40 \\ \dfrac{x-40}{50-40} & ; \ 40 < x < 50 \\ 1 & ; \ x \geq 65 \end{cases}$$

7. Business Risk Input Variable

**Table 8** Business Risk Input Variable

| Variable | *Fuzzy Input* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| Business Risk | Very small | 0-100 | [0 15] | [0 0 11 15] |
| | Small | | [11 32] | [11 15 28 32] |
| | Average | | [28 57] | [28 32 53 57] |
| | Big | | [53 88] | [53 57 84 88] |
| | Very big | | [84 100] | [84 88 100 100] |

The formula equation of membership function for business risk input variable is expressed by the following equation:

$$\mu \, Sangat \, Kecil = \begin{cases} 1 & ; \quad 0 \leq x \leq 11 \\ \dfrac{15-x}{15-11} & ; \quad 11 < x < 15 \\ 0 & ; \quad x \geq 15 \end{cases}$$

$$\mu Kecil = \begin{cases} \dfrac{x-11}{15-8} & ; \quad 11 \ \leq x < 15 \\ 1 & ; \quad 15 \leq x \leq 28 \\ \dfrac{32-x}{32-28} & ; \quad 28 < x \leq 32 \end{cases}$$

$$\mu Sedang = \begin{cases} \dfrac{x-28}{32-28} & ; \quad 28 \leq x < 32 \\ 1 & ; \quad 32 \leq x \leq 53 \\ \dfrac{57-x}{57-53} & ; \quad 53 < x \leq 57 \end{cases}$$

$$\mu Besar = \begin{cases} \dfrac{x-53}{57-53} & ; \quad 53 \leq x < 57 \\ 1 & ; \quad 57 \leq x \leq 84 \\ \dfrac{88-x}{88-84} & ; \quad 84 < x \leq 88 \end{cases}$$

$$\mu Sangat \, Besar = \begin{cases} 0 & ; \quad x < 84 \\ \dfrac{x-84}{88-84} & ; \quad 84 \leq x < 88 \\ 1 & ; \quad x \geq 88 \end{cases}$$

8. Output Decision Variable

**Table 9** Output Decision Variable

| Variable | *Fuzzy Input* | *Range* | Domain | Parameter |
|---|---|---|---|---|
| Decision | *Rejected* | 0-100 | [0 60] | [0 0 40 60] |
| | *Approved* | | [40 100] | [40 60 100 100] |

The equation of the membership function for the decision output variable is expressed by the following equation:

$$\mu Rejected = \begin{cases} 1 & ; \ 0 \leq x \leq 40 \\ \dfrac{x-40}{60-40} & ; \ 40 < x < 60 \\ 0 & ; \ x \geq 60 \end{cases}$$

$$\mu Approved = \begin{cases} 0 & ; \ x < 40 \\ \dfrac{100-x}{100-40} & ; \ 40 \leq x < 60 \\ 1 & ; \ x \geq 60 \end{cases}$$

After the membership function, then the next step is the rule base. This rule base consists of a set of decision rules with fuzzy mamdani method to declare the debtor is accepted or rejected credit. The base rule is shown in Figure 7 below:

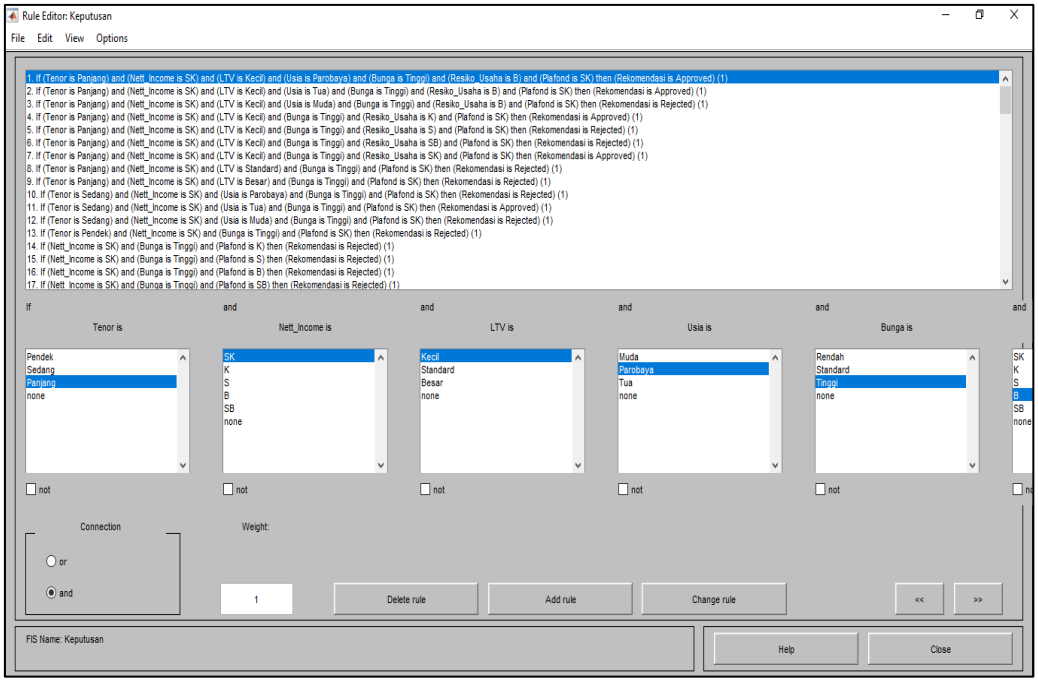


**Figure 7** Rule Based for Decision Making

After a rule is established, an application of the implication function is performed. The implication function used is MIN which means the membership level obtained from this process is the minimum value of the input variables to get the fuzzy area on the variable of the debtor's feasibility result for each rule.

### 4.2 Calculation of Mamdani Method

Based on the assessment sample of the debtor's feasibility, the implication function can be shown as follows:

Example:

Tenor = 168, Nett Income = 8,45, LTV = 54,19, Age = 40, Interest = 9,25, Risk = 90,5 and Plafond = 300

Thus, the membership value of each parameter is:

a. Tenor : μLong = 1

b. Nett Income : μVery Small = $\frac{10-8,45}{10-8}$ = 0,775

μSmall = $\frac{8,45-8}{10-8}$ = 0,225

c. LTV : μSmall = $\frac{55-54,19}{55-45}$ = 0,081

μStandard = $\frac{54,19-45}{55-45}$ = 0,919

d. Age : μMiddle-Aged = 1

e. Interest : μStandard = $\frac{11-9,25}{11-9}$ = 0,875

μHight = $\frac{9,25-9}{11-9}$ = 0,125

f. Business Risk : μVery Big = 1

g. Plafond : μVery Small = 1

So the implication function is as follows :

a. Rule 23

1;0,775;0,081;1;0,875;1;1 → *Rejected*

α23 = min {μTenor(168), μNettIncome(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μPlafond(300)}

= min {1;0,775;0,081;1;0,875;1;1}

= 0,081

b. Rule 6

1;0,775;0,081;1;0,125;1;1 → *Rejected*

α6 = min {μTenor(168), μ*NettIncome*(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μ*Plafond*(300)}

= min {1;0,775;0,081;1;0,125;1;1 }

= 0,081

c. Rule 25

1;0,775;0,919;1;0,875;1;1 → *Approved*

α25 = min {μTenor(168), μ*NettIncome*(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μ*Plafond*(300)}

= min {1;0,775;0,919;1;0,875;1;1}

= 0,775

d. *Rule* 8
1;0,775;0,919;1;0,125;1;1 → *Approved*

α8 = min {μTenor(168), μ*NettIncome*(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μ*Plafond*(300)}

= min {1;0,775;0,919;1;0,125;1;1}

= 0,125

e. Rule 61
1;0,225;0,919;1;0,875;1;1 → *Approved*

α61 = min {μTenor(168), μ*NettIncome*(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μ*Plafond*(300)}

= min {1;0,225;0,991;1;0,875;1;1}

= 0,225

f. *Rule* 56
1;0,225;0,919;1;0,125;1;1 → *Approved*

α56 = min {μTenor(168), μ*NettIncome*(8,45), μLTV(54,19), μAge(40), μInterest(9,25), μRisk(90,5), μ*Plafond*(300)}

= min {1;0,225;0,919;1;0,125;1;1}= 0,125

Composition rule function implication using MAX. It uses a way of taking the maximum value from the rule output. Max method is used to specify the composition of rules.

Output variable :

Degree of group correctness *Rejected*

= max (α6; α23)

= max (0,081; 0,081)

= 0,081

Degree of group correctness *Approved*

= max (α8; α25; α56; α61)

= max (0,125; 0,775; 0,125; 0,225)

= 0,775

Based on the membership function of the output of rejected variable, α6 obtained the value of 0.081 d (6) as follows:

$\mu_R(d6) = \alpha 6 \quad \leftrightarrow \quad \frac{d(6)-40}{60-40} = 0{,}081$

$d(6) - 40 = 1{,}62$

$d(6) = 41{,}62$

Based on the membership function of the approved output variable at α8, the value of 0.775 d (8) is obtained as follows:

$\mu_R(d8) = \alpha 8 \quad \leftrightarrow \quad \frac{100-d(8)}{100-40} = 0{,}775$

$100 - d(8) = 46{,}5$

$d(6) = 53{,}5$

Modified high membership function of the output variable after applied α cut is:

$$\mu(z) = \begin{cases} 0{,}081 & ; \ z \leq 41{,}62 \\ 0{,}667 & ; \ z \geq 53{,}5 \end{cases}$$

Next at the defuzzification stage, the Researchermakea calculation process using the method of centroid, as follows:

$M_1 = \int_0^{41,62}(0{,}081)z\,dz = \frac{0{,}081}{2}(41{,}62^2 - 0^2) = 70{,}155$

$M_2 = \int_{53,5}^{100}(0{,}667)z\,dz = \frac{0{,}667}{2}(100^2 - 53{,}5^2) = 2380{,}44$

$A_1 = \int_0^{41,62} 0{,}081\,dz = 3{,}371$

$A_2 = \int_{53,5}^{100} 0{,}667\,dz = 66{,}7 - 35{,}685 = 31{,}015$

So, the*crisp output* value is :

$Z = \frac{M_1 + M_2}{A_1 + A_2} = \frac{70{,}155 + 2380{,}44}{3{,}371+31{,}015} = \frac{2450{,}595}{35{,}327} = 69{,}37$

Output limitis:

Assessment "*Rejected*" : value limit*output* ≤ 50
Assessment "*Approved*" : value limit*output* > 50

So it can be concluded with existing data and after analyzed, the data used as samples are categorized to provide credit worthiness assessment with a value of 69.37.

## 4.3 Assessment and Analysis

### 4.3.1. Prototype Assessment

Testing is performed in 2 ways, namely by testing data and with manual. The following display of data and manual testing results can be seen in Figure 8 and Figure 9:

a. Testing Data Result

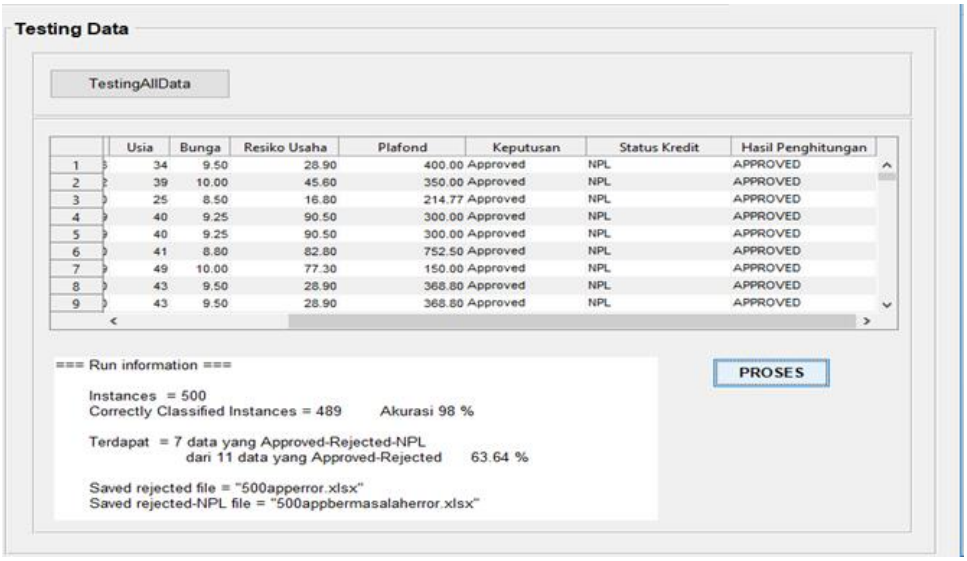


**Figure 8** Testing Data Result

b. Manual Result

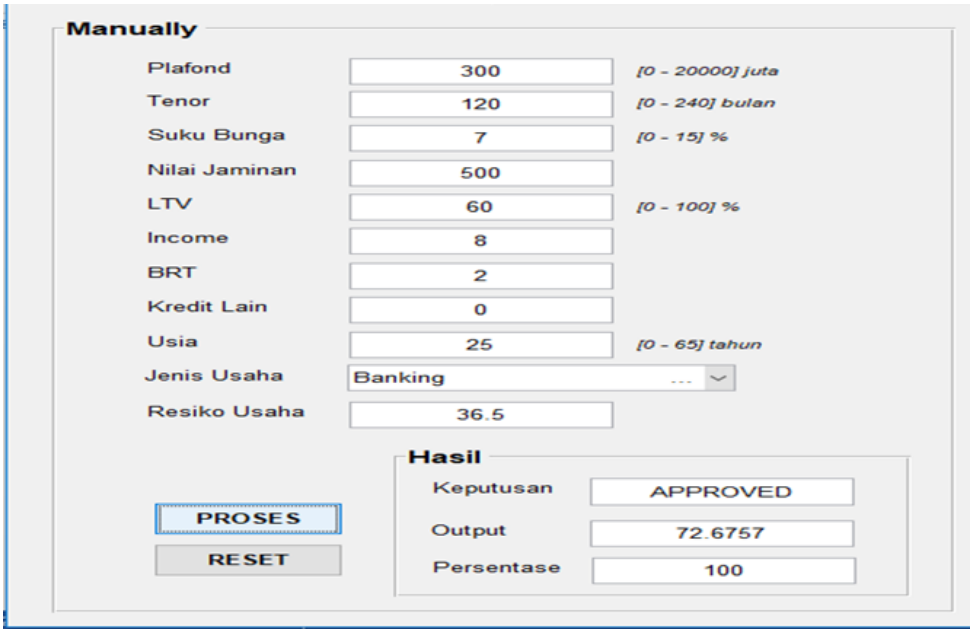


**Figure 9** Manual Result

After done if the data sample as much as 500 data, hence done comparation between result of DSS testing with method fuzzy Mamdani with original data. The comparative results can be seen in Figure 10 below.

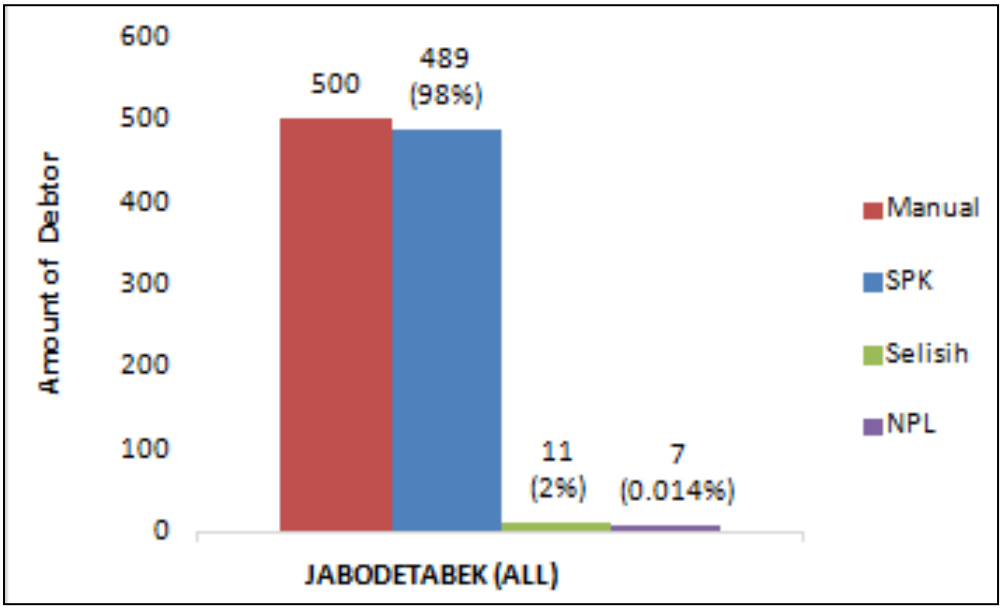


**Figure 10** Comparative Graph of DSS With Original Data

Based on the information in Figure 11, the result of comparison between DSS with the Mamdani fuzzy method with the original data visible to the accuracy of DSS is 98%. There are 11 data that give different results with the original data of 500 data used. From 11 different data, there are 7 data or 63,64% which is NPL debtor. So it can be said that DSS with fuzzy Mamdani method produces more accurate decision on this research.

### 4.3.2 Hypothesis Testing

Hypothesis testing is done by using path analysis as the development of multiple regression analysis with significance level = 0.05. There are two substructures that must be tested that are:

1. Substructure 1, test the influence of perceived usefulness ($X_1$), perceived ease of use ($X_2$) to attitude toward using (Y).

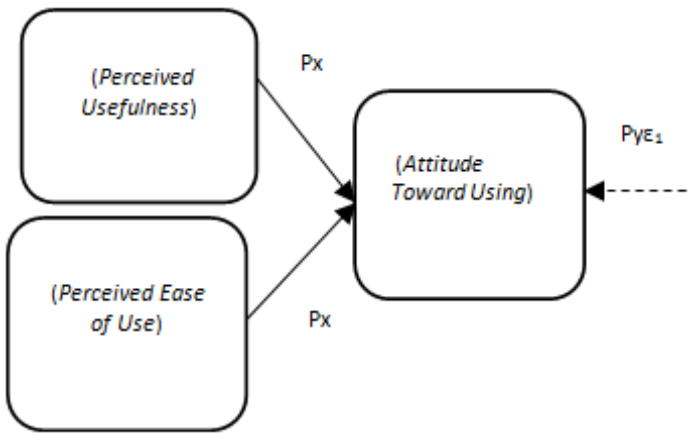


**Figure 11** Substructure 1 to Y

2. Substructure 2 tests the influence of perceived usefulness ($X_1$), perceived ease of use ($X_2$) dan attitude toward using (Y) to actual system usage (Z).

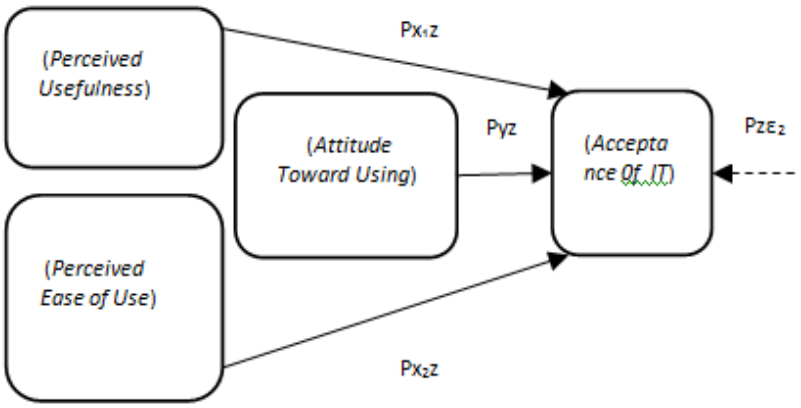


**Figure 12** Substructure 2 to Z

From the description of the results of research conducted with the calculation of path analysis (path analysis) with the help of software SPSS 16 then it can be concluded the results based on the formulation of hypotheses that have been made among others:

1. The Assessment of perceived usefulness influences to attitude toward using

   **Decision:**

   Significance Value = 0.531 > 0.005, so Ho is accepted and Ha is rejected

2. Assessment of *perceived ease of use* influences to a*ttitude toward using*

   **Decision:**

   Significance Value = 0.000 < 0.005, so Ha is accepted and Ho is rejected

3. Assessment of perceived usefulness influences to acceptance IT

   **Decision:**

   Significance Value = 0.000 < 0.005, so Ha is accepted and Ho is rejected

4. Assessment of *perceived ease of use* influences to *acceptance IT*

   **Decision:**

   Significance Value = 0.000 < 0.005, so Ha is accepted and Ho is rejected

5. Assessment of a*ttitude toward using* influences to *acceptance IT*

   **Decision:**

   Significance Value = 0.000 < 0.005, so Ha is accepted and Ho is rejected

6. Assessment of *perceived usefulness*, *perceived ease of use* and a*ttitude toward using* simultaneously influence to *acceptance IT*.

   **Decision:**

   Significance Value = 0.000 < 0.005, so Ha is accepted and Ho is rejected

## 5. Conclusion

From the results of research that has been done on, the support system of credit feasibility decision making using fuzzy logic method Mamdani as well as hypothesis analysis, the Researcher can conclude some findings as follows:

1. Test results show that DSS with Fuzzy logic method Mamdani can produce high accuracy in this case is 98%.
2. The result of analysis of hypothesis test shows that partial test of perceived usefulness variable has no positive effect toward attitude toward using on the use of credit lending decision support system. While the perceived ease of use variable has a positive influence on attitude toward using on the use of decision support system creditworthiness and all the variables have a positive influence on the variable acceptance IT.
3. The results of hypothesis analysis showed that simultaneous testing where all the variables have a positive influence on IT acceptance variables.

Based on the description of the research and conclusions obtained, the Researcher can provide suggestions for further research to further conduct a deeper study of the following issues:

1. Further research can be added another criterion in determining the feasibility of the debtor, so there are many possibilities that can be considered to determine the output.
2. Expand the research indicators and add some variables such as behavioral intention to use variables or other powerful external variables, to measure system acceptance.
3. In this study only produce output "Rejected" and "Approved". For further research this can be developed by adding the "Considered" output as well as issuing suggestions that allow for acceptable credit

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