DATA MINING ALGORITHM C4.5 CLASSIFICATION DETERMINATION CREDIT ELIGIBILITY FOR JAYA BERSAMA COOPERATIVES (KORJABE)

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Abstract: This study uses the C4.5 classification algorithm to determine creditworthiness, classification aims to divide the assigned object into a number of categories called classes. In this study, the author using data mining and C4.5 algorithm as the selection method. The criteria used are loan installments, prospective customer income, term loan time, status of prospective customers. This study resulted in a classification model decision tree using the C4.5 algorithm is included in the Excellent category Classification with an accuracy value of 98.33% and a classification error of 1.67%, so that this study uses 70% training data and 30% test data. From result the calculation obtained shows that the C4.5 algorithm can be used to determine the feasibility of granting credit to Koperasi Jaya customers Together (KORJABE).

Keywords: Analysis, Credit Eligibility, C4 Algorithm, Data Mining, Method

Abstrak: Penelitian ini menggunakan metode Algoritma C4.5 klasifikasi untuk menentukan kelayakan kredit, klasifikasi bertujuan untuk membagi objek yang ditetapkan ke dalam satu nomor kategori yang disebut kelas. Dalam penelitian ini, penulis menggunakan data mining dan algoritma C4.5 sebagai metode pemilihannya. Kriteria yang digunakan yaitu , angsuran pinjaman, penghasilan calon nasabah, jangka waktu pinjaman, status calon nasabah. Penelitian ini menghasilkan model klasifikasi pohon keputusan menggunakan algoritma C4.5 termasuk dalam kategori Excellent Classification dengan nilai akurasi sebesar 98.33% dan klasifikasi error 1.67%, sehingga penelitian ini kan menggunakan data latih 70% dan data uji 30%. Dari hasil perhitungan yang diperoleh menunjukkan bahwa algoritma C4.5 dapat digunakan untuk menentukan kelayakan pemberian kredit kepada nasabah Koperasi Jaya Bersama (KORJABE).

Kata kunci: Algoritma C4.5, Analisis, Data Mining, Kelayakan Kredit, Metode
INTRODUCTION

Cooperatives have an important role for the Indonesian economy and the development of cooperatives in Indonesia is currently quite fast [1]. In order to develop its activities in the form of loans to cooperative members, it follows the precautionary principle applied to the banking world by conducting credit analysis to potential borrowers. At the time of providing loans, the cooperative conducts an analysis of the data of cooperative members who have the opportunity to be given loans, and also in providing loans to cooperative members there are also various problems, namely the inability of cooperative members to pay off a number of loans that have been given by the cooperative [2]. In decisions made by cooperatives, cooperatives do not only lend but must reduce loan risk in determining the amount of loans made by prospective customers. In granting credit, it is mandatory to go through several terms to analyze its feasibility. An in-depth analysis of both the data held by the prospective borrower and the authenticity of the supporting data for the feasibility of receiving a loan. The in-depth evaluation of credit awards was known to use the 5Cs, namely character (personality), capacity (ability), capital (capital), condition of economy (economic conditions), collateral (collateral). In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad. The in-depth evaluation of credit awards was known to use the 5Cs, namely character (personality), capacity (ability), capital (capital), condition of economy (economic conditions), collateral (collateral). In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad. In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad. In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad. In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad. In addition to the 5C principle in selecting all incoming credits, there are several considerations that become in passing the application, namely completeness of documents, credit risk based on large aspects of income and work history, having a smooth credit history. This is done so
that there is an adjustment in the ability to make credit payments, so that things don't happen that make the credit bad.

The method used in this research is C4.5. classification completion procedure determines creditworthiness, classification aims to divide objects assigned to only one category number which is called Tree class. With customer classification, if there is a problem with the same case, the cooperative only needs to look at the rules that have been formed from the resulting decision tree\[7\][8]. With a decision tree decision tree using the C4.5 algorithm requires a faster and optimal time. The scope extraction process uses more data capacity, because errors caused in decision making are minimized. These results were obtained using K-NN based on Forward Selection. The use of the Forward Selection feature in data processing will affect the accuracy of the output obtained. While using the C4.5 classifier algorithm in determining creditworthiness, he obtained an accuracy value using training data of 270 customers of 88.52%. The use of the Forward Selection feature in data processing will affect the accuracy of the output obtained. While using the C4.5 classifier algorithm in determining creditworthiness, he obtained an accuracy value using training data of 270 customers of 88.52%.

The use of the Forward Selection feature in data processing will affect the accuracy of the output obtained. While using the C4.5 classifier algorithm in determining creditworthiness, he obtained an accuracy value using training data of 270 customers of 88.52%. The purpose of this study is to classify dropped out and active students using the C4.5 algorithm as a reference in making policies and actions to reduce the number of dropped out students. The classification results from the C4.5 algorithm were evaluated and validated with a confusion matrix and Receiver Operating Characteristic (ROC) curve to determine the level of accuracy of the C4.5 algorithm in classifying potential dropout students. The results of the evaluation and validation obtained an accuracy rate of 97.75%. The rules obtained from the classification with the C4.5 Algorithm if applied to the new data obtained validation results with an
accuracy rate of 90.0% [12].

METHOD

Types Of Research
This study uses an associative quantitative approach with causality type. The quantitative approach is in the form of an associative causality type, which is a type of research that explains the influence of independent variables on the dependent variable. So, the research conducted is quantitative research, because it can be calculated mathematically, and the purpose of this classification research is to find functions and models that can distinguish or describes a concept or data class to estimate the unknown class of an object.

Materials
The data used in this study is data on credit customers with the attributes of id_customer, name, age, status, installment, time period, and description. The data taken from 2013 to 2020 is 1000 customer data.

Research Framework
The following is an explanation of the stages that will be carried out in the research:

a. Dataset
This stage is the process of searching for customer data datasets.

b. Data Cleaning.
At this stage, deletion of data with more than one primary key and deletion of data that is null or missing value, duplicate data.

c. Data Normalization
It is the stage of forming data relations into normal form to eliminate some of the data that is still ambiguous. This normal form is a rule that must be met in database relations. This normalization aims to normalize the data that was originally obtained is still messy so that a good and correct data is formed and produces a table with good quality.

d. Data Transformation
This stage needs to be done because there are several data mining methods such as association and clustering methods that require a special data format before being applied. In data transformation, the process of selecting data that is only needed by the data mining used is carried out. This phase determines the quality results of data mining. The purpose of data transformation is also to remove noise or data that contains errors.

e. C4.5 Algorithm
After processing the data, it is continued with the stages of the C4.5 Algorithm, namely the description tree or decision tree is a classification method that uses a tree structure representation where each internal node is an attribute, and each leaf node is an attribute. nodes) where the terminal node is the class label and the top node is the root node. The decision tree has several ways of determining the size of the data in the form of a tree, one of which is the C4.5 algorithm. The C4.5 algorithm uses the gain ratio as a determinant of roots, interiors and leaves.

f. Evaluation
The evacuation stage is called the classification stage because at this
stage testing for accuracy will be determined. The testing stage is to see the accuracy results in the classification process of the C 4.5 classifier algorithm.

1. Data Analysis
The data used in this study are customer credit data from the Jaya Bersama Cooperative (KORJABE), with the following explanation:

a. Customer credit data with attributes id_customer, name, age, status, income, installments, period, and payment information given to the administration and then given to the head of the cooperative so that it is in the form of a credit data report customers, current payments and non-performing payments.

b. The customer provides credit documents to the administration section, and the administration section provides it to the head or chairman of the cooperative. The head of the cooperative provides reports on credit data for current payment customers and credit data on customers who make non-performing payments to the administration, and the administration provides credit to the cooperative's employees. The criteria for credit delays in cooperatives are special supervision, substandard and non-performing.

RESULT AND DISCUSSION

In this study, primary data is used with data on credit customers with attributes such as nik_customer, age, customer status, income, installments, time period, and information. From the data collected as many as 1000 customer data records that will be processed and analyzed using the C4.5 Algorithm. The software used for this research is Microsoft Excel 2007 in preprocessing the data (preprocessing) and Rapid Miner Studio Version 9.6 in processing and analyzing the C4.5.

In Table 1. The dataset collected by the Jaya Bersama cooperative to determine creditworthiness will be selected for the variables before being processed and analyzed using the C4.5 algorithm. Prior to classifying credit customers, the data preprocessing stage is carried out including data cleaning, data integration, data selection, and data transformation. Data cleaning is carried out on data that does not have complete attributes. The next step is to normalize the data by determining the variables that determine eligibility. The variables used are salary ratio, payment period, customer status, age and customer payment information. After the normalization phase, the next phase is the data transformation phase, in this phase the date attribute is removed and the customer name attribute is not used in the analysis. The data transformation can be seen in Table 2.
### Table 1. Customer Data Table

| Date       | Customer Name          | Install-ment | Income  | Time period | Status    | Age | Information |
|------------|------------------------|--------------|---------|-------------|-----------|-----|-------------|
| 13/10/2013 | Novi Adistara          | 575000       | 5000000 | 12          | Married   | 28  | Fluent      |
| 24/07/2013 | Novi Ansari            | 575000       | 5000000 | 12          | Married   | 46  | Fluent      |
| 07/08/2013 | Meiri Aprilina         | 345000       | 3000000 | 6           | Married   | 24  | Fluent      |
| 15/05/2013 | Khairel Fadmi          | 345000       | 3000000 | 12          | Married   | 28  | Fluent      |
| 21/12/2013 | Agus Susilo            | 2000000      | 6000000 | 12          | Not married | 30  | Fluent      |
| 03/07/2013 | Syah Devi Andriani     | 2000000      | 3000000 | 18          | Married   | 46  | Congested   |
| 12/02/2013 | Nirwana                | 575000       | 1500000 | 12          | Not married | 24  | Congested   |
| 08/06/2013 | Helmiyanti Fernanda SH | 345000       | 1500000 | 12          | Not married | 30  | Congested   |
| 16/06/2013 | Nurjannah Nasution     | 345000       | 1500000 | 12          | Not married | 22  | Congested   |
| 15/06/2013 | Burhan                 | 850000       | 6000000 | 12          | Married   | 24  | Fluent      |
| 09/05/2013 | Rouli Ida M Hutagaol   | 515000       | 3500000 | 12          | Not married | 32  | Fluent      |
| 18/02/2013 | Tetti Anna Gultom      | 345000       | 3500000 | 12          | Married   | 24  | Fluent      |
| 23/06/2013 | Iglima                 | 575000       | 1500000 | 6           | Not married | 24  | Congested   |
| 28/09/2013 | Antoni                 | 575000       | 1500000 | 12          | Not married | 26  | Congested   |
| ...        | ...                    | ...          | ...     | ...         | ...       | ... | ...         |
| 24/12/2013 | Subono                 | 1000000      | 6000000 | 12          | Married   | 23  | Fluent      |

### Table 2. Result of Transformation of Customer Data

| Ratio | Time period | Status       | Information |
|-------|-------------|--------------|-------------|
| 25    | 12          | Marry        | Fluent      |
| 25    | 12          | Marry        | Fluent      |
| 15    | 6           | Marry        | Fluent      |
| 12    | 12          | Marry        | Fluent      |
| 66    | 12          | Not married  | Fluent      |
| 66    | 18          | Marry        | Congested   |
| 15    | 12          | Not married  | Congested   |
| 14    | 12          | Not married  | Congested   |
| 11    | 12          | Marry        | Fluent      |
| 11    | 12          | Not married  | Fluent      |
| 10    | 12          | Marry        | Fluent      |
| 10    | 6           | Not married  | Congested   |
| 12    | ---         | ---          | ---         |
| 66    | 12          | Marry        | Fluent      |
In table 2 the transformed dataset will be processed by applying the C4.5 Algorithm using Rapid Miner Studio software. The display of the C4.5 algorithm implementation circuit using the Spilt Validation Operator can be seen in Figure 1.

In testing the C4.5 algorithm is included in supervised so it requires training data

Table 3. Training Data 70% and Test Data 30%

| Data Sampling | Accuracy | Classification Errors |
|---------------|----------|-----------------------|
| Linear        | 98.33%   | 1.67%                 |
| Shuffle       | 95.33%   | 4.67%                 |
| Stratified    | 95.67%   | 4.33%                 |
| Automatic     | 98.33%   | 1.67%                 |

Performance Assessment of Split Validation Operator Accuracy can be classified into 5 categories:

1. 0.90 – 1.00 = Excellent Classification
2. 0.80 – 0.90 = Good Classification
3. 0.70 – 0.80 = Fair Classification
4. 0.60 – 0.70 = Poor Classification
5. 0.50 – 0.60 = Failure

Based on the training data and test data, the best C4.5 classification modeling lies in the Linear data sampling model, namely the highest Accuracy value and the lowest Classification Error with an accuracy value of 98.33% and a classification error of 1.67% included in the Excellent Classification category, so that this study uses 70% training data and 30% test data so that it produces knowledge of determining creditworthiness to prospective customers in the form of a decision tree (decision tree).

Based on the decision tree in Figure 3 it can be seen that the time period becomes the main node (root) to determine eligibility in determining credit. With an accuracy rate of 98.33% and a classification error of 1.67%. After the decision tree is formed, the next process is to change the shape of the decision tree into a rule form. This study produces several rules that influence the determination of creditworthiness which is a factor in the
smooth or non-performing of customer payments.

1. and if the ratio is less than 45% to 36% then the payment is stuck.
2. If the salary ratio is more than 45% to 54%, tenure is less than 15 months, married status, then the payment is smooth and if the salary ratio is less than 45% to 36% then the payment is stuck.
3. If the salary ratio is more than 51% to 54%, the term is 9 to 15 months, then the payment is stuck.
4. If the salary ratio is less than 51% to 36%, period of 9 to 15 months, married status, then the payment is smooth.
5. If the salary ratio is more than 45% to 51%, the period of 9 to 15 months, the status is not married, then the payment is smooth.
6. If the salary ratio is less than 45% to 36%, the period of 9 to 15 months, the status is not married, then the payment is stuck.

![Figure 3. Korjabe Credit Eligibility Decision Tree](image)

Based on the training data and test data, the best C4.5 classification modeling lies in the Linear data sampling model, namely the highest Accuracy value and the lowest Classification with an accuracy value of 98.33% and a classification error of 1.67%. The results of testing the C4.5 algorithm using Rapid Miner tools in determining the accuracy value and error classification value as shown in Figure 3.

| Data Sampling | Accuracy | Classification Error |
|---------------|----------|----------------------|
| Linear        | 98.33%   | 1.67%                |
| Shuffle       | 95.33%   | 4.67%                |
| Stratified    | 95.67%   | 4.33%                |
| Automatic     | 98.33%   | 1.67%                |

In this study, testing was also carried out using the Naive Bayes method with the aim of comparing the value of accuracy and classification of errors. The results of testing the Naive Bayes algorithm after testing using the Split Validation Operator with 70% training data and 30% test data resulted in an accuracy value of 95.33% and an error classification value of 1.67%. And information can be taken from the data tested using Rapid Miner tools that the C4.5 algorithm has a higher accuracy rate than the Naive Bayes algorithm.

CONCLUSION

Based on the last decision tree, a rule with the following rules is obtained:

If the salary ratio is less than 45% to 36%, and the period is 9 to 15 months, the status is not married, then the pay-
ment is declared non-performing. Meanwhile, if the salary ratio is more than 45% to 51%, the period is 9 to 15 months, the status is not married, then the payment is smooth. This study resulted in a decision tree classification model using the C4.5 algorithm which is included in the category Excellent Classification with an accuracy value of 98.33% and 1.67% error classification, so this study uses 70% training data and 30% training data. Data Mining with Decision Tree can make a decision by considering each customer acceptance based on customer payments are smooth or bad based on the C4.5 algorithm method.

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