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Application of Naïve Bayes Classifier Algorithm for Classification of Scholarship Recipients at SMA PGRI 2 Bandung

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ABSTRACT

Education is one of the rights that each Indonesian citizen has. In this manner, there's a require for government consideration to assist underprivileged individuals in instruction, to be specific through grants. SMA II PGRI is one of the schools that organizes an underprivileged grant program, the grant is within the frame of educational cost waiver help. In its execution, officers regularly have trouble in deciding understudies who get grants based on foreordained criteria. In this way, it is fundamental to analyze information mining procedures utilizing naïve bayes classifiers in information preparing and is anticipated to be utilized to analyze grant grants for grant candidates. In this way it is fundamental to analyze information mining procedures utilizing naïve bayes classifiers in information handling and is anticipated to be utilized to analyze grants for grant candidates. Grant candidate information is carried out a information cleaning and decrease prepare so that the information is less but enlightening, so that it is appropriate for assist handling. At that point classification is done with Naïve Bayes classifier to deliver a classification likelihood demonstrate. The test brought about in an precision of 87.39% and was included within the great classification criteria.

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1. Introduction

Education has a very big role and at the same time is a very important resource(Improvement & Islamic, 2023). Education is everywhere segmented and differentiated(Altbach & De Wit, 2020), Education is the foundation of a child's academic journey (Tajiddinovna, 2024). education is a human effort to grow and develop the talents and potential possessed from birth both physically and spiritually in accordance with the values that exist in social life and culture(Agustini, D., Farida, M., Sari, M., & Rosadi, 2022), Implementing the principles of inclusive education within higher education can be challenging(Moriña, 2019). Education is one of the sectors most influenced by technological developments(Erwis et al., 2024)

Providing Scholarships is a work program that exists in every school(Silviana, 2024) and scholarships are assistance provided by certain parties(Telaumbanua & Nainggolan, 2021). The provision of scholarships is intended as a form of appreciation given to individuals so that they can continue their education at a higher level. to individuals so that they can continue their education to a higher level(Hasmin & Aisa, 2019), Scholarship is a provision in the form of financial assistance

provided to individuals that aims to be used for the continuity of education pursued(Nurdin & Informatikan, 2018), Scholarship is the provision of awards in the form of financial assistance to people(Pasa, I. Y., Prasetya, N. W. A., & Maharrani, 2022) or organization for work achievements made SMA 2 PGRI is a senior high school located in Bandung City that organizes an underprivileged scholarship program for its students. The scholarship is in the form of assistance in the payment of tuition fees (Contribution of Educational Facilities). Therefore, it is necessary to analyze scholarship recipients which can be done with data mining techniques.

Information technology is a field that studies and develops skills in engineering with certain steps and techniques(Dola Ramalinda, S.Si. et al., 2024) .Information mining may be a strategy for finding certain designs from a set of information or a handle that employments factual, scientific, manufactured intelligence, and machine learning methods Information Mining could be a term utilized to depict the disclosure of information in databases, information mining is the information covered up in databases that are prepared to find patterns and factual strategies arithmetic, fake insights, and machine learning Information Mining may be a strategy of preparing information to discover covered up designs from the information(Prastiwi et al., 2022)(Nabila et al., 2021)(Utomo & Mesran, 2020)(Ordila, R., Wahyuni, R., Irawan, Y., & Yulia Sari, 2020).

By applying the Naïve Bayes Classifier classification the school can find out which students are entitled to a scholarship or not. besides that this application makes it easier for school dividers to filter which students are entitled to a scholarship or not.

2. Research Method

A research methodology is a systematic framework or approach used researchers use to plan, conduct, and analyze research. The purpose of research methodology is to ensure the systematic, reliable and competent conduct of research Copyright(Sutisna et al., 2024).

2.1 Research Stages

To conduct a research, it is necessary to have stages that are well organized and systematic so that the implementation of the research can achieve the expected goals. The stages carried out by the author are as follows:

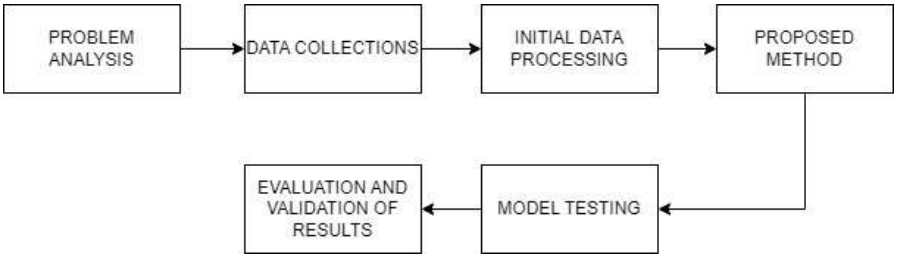

Figure 1. Research Stages

2.2 Research Instruments

In this research, several research instruments will be used, including the following:

a). Software

The software used in this research is rapidminer. Rapid miner is a data mining processing software that includes tools(Ginting Indah Sapna & Iqbal Muhammad, 2022)

b). Dataset

Dataset is the process of training an optical character recognition model using a collection of datasets(Asroni et al., 2023).This study uses a dataset of student data from SMA PGRI 2 Bandung in 2019 as many as 793 student data and attributes that have been transformed consisting of students' names, grades, attendance, parents' income, number of parents' dependents, certificates of incapacity and scholarships. This dataset is divided into 2 parts, namely training data and testing data.

c). Modeling

In this research, data mining processing is carried out using the naïve bayes classification algorithm. This is done with the aim of obtaining a higher accuracy value in the application of the scholarship acceptance dataset.

2.3 Data Collection Method

To understand the process of data collection it is necessary to understand the field where the data creation is happening(Alexandra Schlemitz, 2024).The research data used primary data. Primary data is from the data of scholarship recipients of SMA Negeri 1 Karangkobar, the data is data on students who receive and do not receive. The data in this study is divided into two, namely training and testing data, then grouped according to attribute values that match the research needs.

2.4 Population

The population in the study used a scholarship dataset of 793 records with attribute data in this study, namely the names of students, grades, attendance, total parental income, number of parental dependents and certificate of incapacity. The data is classified into 2 classes, namely yes and no, which will be divided into training and testing data.

2.5 Sample

Samples used for testing the resulting model or can be said to be testing data, while training data serves as training material for a model. The scholarship dataset has a total of 793 records, then the data will be divided into two parts, namely training data and testing data following the details of the separation of the scholarship dataset

Table 1. Testing and Training Data

No	type of classification	number of dataset records	Data Training	Data Testing
1	Yes	91	64	27
2	No	702	491	211
Amount		793	555	238

2.6 Data Analysis Method

Initial Data Processing

The process begins with preprocessing, which consists of collecting data to data collection to produce the raw data needed by data mining.(Raharja et al., 2024) Initial data processing is carried out to prepare data that is truly valid before being processed at the next stage. The amount of initial data is 793 records with 10 attributes but not all attributes are used because they have to go through several stages of data preparation, the initial data management stage (preparation data) is as follows:

a. Sampling

The scholarship dataset consists of 793 data records. To test the applied model, the data is divided into two parts, namely training data used for model development, while testing data is used for model testing. After knowing the number of datasets, 70% of the data is used for training data and 30% for testing data, with 555 and 238 data respectively.

b. Data Cleaning

Before carrying out the data mining process, it is necessary to do the data cleaning process first. At this stage, the selection of data attributes that will be used in the study is carried out, then for unused attributes such as Nis, gender and class will be removed.

c. Data Transformation

Transformation is changing the original format data into a suitable form to facilitate the data mining process. Berkut is the transformation data of the value attribute, the attendance attribute, the attribute of the amount of parents' income, and the attribute of the number of dependents of parents.

d. Data Reduction

Reducing the data set by reducing the number of attributes and records to make it less but informative. In this research, removing attributes with the same value or less important in the excel sheet, namely removing no, nis, gender and class.

The results of the initial data processing after cleaning, transforming, and reducing the data set aside 7 attributes and 793 records. Can be seen in the following table:

Table 2. Initial Data Processing Results

Name	Value	Absence	Parents' income	Number of parents' dependents	Sktm	Scholarship
Agus pujianto	High	B	Medium	Medium	Include	No
Ajrina willin nandita	High	B	Low	Medium	Include	No
Armanto	High	B	Low	Medium	Include	No
Arta deka anindita	Medium	B	High	Medium	No	No
Aulyes aduyah	High	B	High	High	No	No
Desima nur safitri	High	B	Low	Low	Include	No
Dika budi pangestu	High	B	Low	Medium	Include	No
Dwi sovia arlinda	High	B	High	High	Include	No
Helar wilda adella	High	B	High	High	Include	No
Hendri setiawan	Medium	C	Low	Medium	Include	No
Ismi umu kamilah	High	B	Medium	Medium	Include	No
Junnatunnisa	High	B	High	Medium	No	No
Muhammad saba alam syah	Medium	C	Low	Medium	Include	No
Muhammad syarif al farizi	Medium	B	Low	High	Include	No
Mutiara prasasty	Medium	B	Low	Medium	Include	No
Naila nurjihan nabilah rofif	High	B	High	Low	No	No
Natasva auua re erilina	Medium	B	High	Medium	No	No
Nisuwarti	High	B	Low	Medium	Include	Lya
Panji candra nugraha	High	B	High	Medium	No	No
Prema safira	Medium	B	Low	Low	Include	No
Qoidah nur setia	Medium	B	High	Low	No	No
Rona rayshiva moura putr) s	High	C	Low	High	Include	Lya
Shofi falah dina	High	B	High	High	Include	No
Sinta dewi marsela	Medium	B	Low	High	Include	No

2.7 Proposed Method

In this research, the proposed method is the naïve bayes algorithm data mining classification method. Model testing uses split validation with a division of 70% treaning data and 30% testing data. Classification results will be measured using the accuracy rate. The flow of the proposed method is shown in the figure.

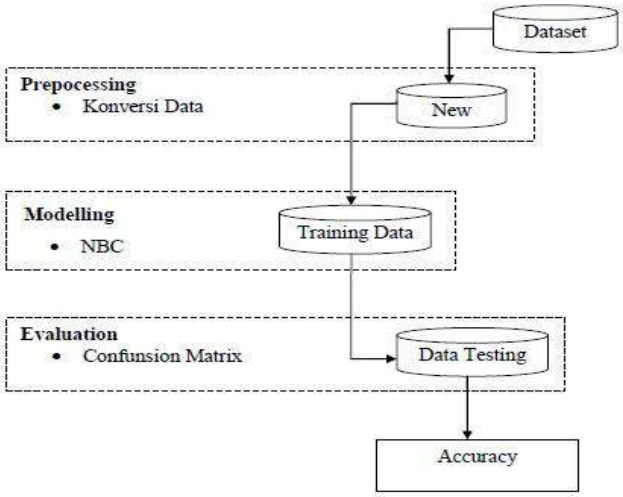

Figure 2. Proposed Method

2.8 Model Testing

The testing model is the data that has been divided before the training model(Setyawati et al., 2021) In this study using rapidminer software. To form the naïve bayes method, Rapidminer tools are used. In the process of using rapidminer.

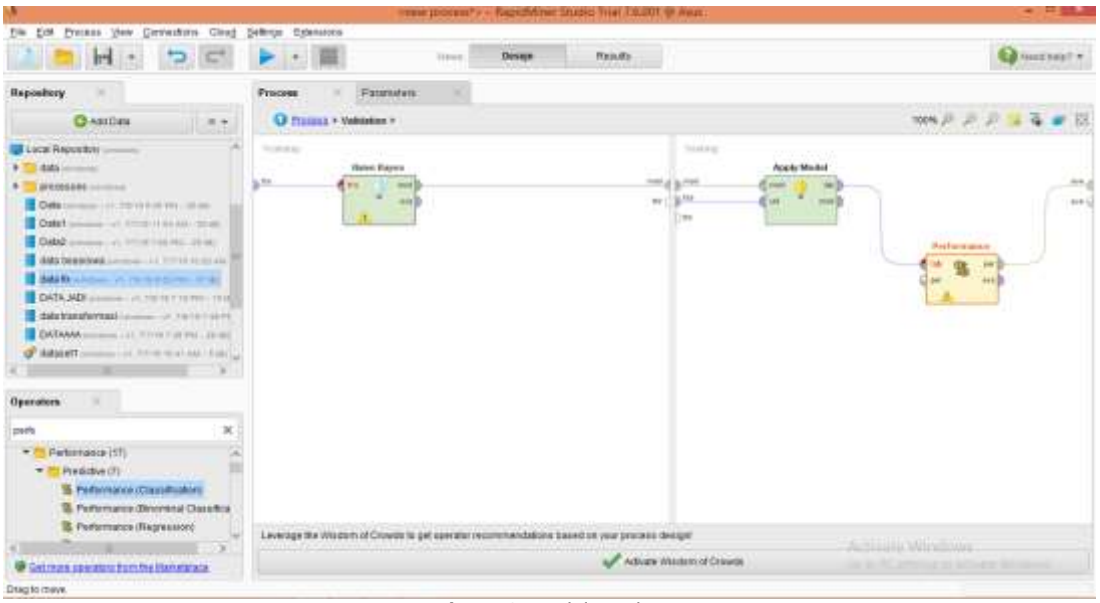

Figure 3. Model Testing

2.9 Evaluation and Validation

At this stage, we will evaluate the quality and effectiveness of the model that has been created. This evaluation process will use the accuracy, recall and precision values. The goal is to measure performance and classification results. Then the evaluation stage of the scholarship recipient selection dataset uses rapidminer software by entering tests as in the previous explanation and it is expected that naïve bayes modeling will produce a high level of accuracy.

3. Result and Discussion

The calculation process of the accuracy value can be done by evaluating the accuracy level of the naïve bayes algorithm.Tools used in this research are using rapidminer software and using split validation and confusion matrix. The result of testing the model that has been done is to measure the level of accuracy. Confusion matrix will describe the accuracy results ranging from correct positive predictions (TP), wrong positive predictions (TN), correct negative predictions (FP), and wrong negative predictions (FN).

3.1 Experiment Results Using Naïve Bayes Algorithm

At this stage is the experimental process with naïve bayes testing using rapidminer software. The student dataset is divided into several sizes of training data and testing data. The dataset that has been prepared for the implementation of the model test process is then tested on the naïve bayes algorithm with the split validation method. The following are the results of the counfussion matrix using data totaling 793 records.

Tabel 4. *Confussion Matrix Accury: 87,39*

	True No	True Yes	Class precission
Pred No	189	8	95,94
Pred Yes	22	19	46,34
Class recall	89,57	70,37	

This experiment uses data totaling 793 records. Based on confusion, it can be seen that 189 records are predicted not as a no data group, and as many as 8 records are predicted not as a yes data group, 22 records are predicted yes as a no data group and as many as 19 records are predicted yes as a yes data group.

a). Calculating Accuracy

The accuracy value is the proportion of the number of correct predictions calculated using equation as follows:

$$\text{Akurasi} = \frac{\text{TP+TN}}{\text{TP+TN+FP+FN}}$$

$$\text{Akurasi} = \frac{189+19}{189+19+22+8} \text{ x } 100\ \%$$

b). *Naïve Bayes Algorithm Calculation*

Naive baiyes is a working method for the most popular classifiers with a good average accurization rate (Ginting Indah Sapna & Iqbal Muhammad, 2022). Naïve Bayes is a classification method that computes a set of probabilities of combinations (Adnyana, 2020) that it only requires a limited amount of training data.(Rayuwati et al., 2022) and is a classification method based on probability.(Zuhra & Rahmad, 2023).

In this study, the criteria or attributes used in determining the selection of scholarship recipients include the names of students, attendance, grades, parents' income, the number of dependents of parents, certificates of incapacity and scholarships. The criteria used in this study are in accordance with the needs used by the school. The value of these criteria will be implemented using the naïve bayes classifier algorithm.

In this classification calculation, the data used is 793 data which is divided for training data as much as 555 and testing data as much as 238. The following is a training data table.

Tabel 5. Data *Training*

No	Name	Value	Absence	Parents' income	Number of parents' dependents	Sktm	Scholarship
1	Agus pujianto	High	B	Medium	Medium	Include	No
2	Ajrina willin nandita	High	B	Low	Medium	Include	No
3	Armanto	High	B	Low	Medium	Include	No
4	Arta deka	Medium	B	High	Medium	No	No

5	anindita Aulyes aduyah	High	B	High	High	No	No
6	Desima nur safitri	High	B	Low	Low	Include	No
	↓	↓	↓	↓	↓	↓	↓
555	Sinta dewi marsela	Medium	B	Low	High	Include	No

The following are the steps to determine the classification of scholarship recipient data when given

1). new input.

Table 6. New Input Data

Name	Value	Absence	JPO	JTO	SKTM	Scholarship
Jannatunnisa	HIgh	B	High	Medium	No	?

In the prediction data with P(C1) is the target class, then the attribute class used will be determined with the following conditions:$C_{1=}$ (Scholarship=”Yes”)

$C_{2=}$ (Scholarship=”No”)

X_1 = (Value= “HIgh”)

X_2 = (Absence= “B”)

X_3 = (JPO= “HIgh”)

X_4 = (JTO= “Medium”)

X_5 = (SKTM= “No”)

2). Calculating the Sum of Prior Probabilities for the first class/label

a). $P(C_1)$= P(Scholarship= “Yes”) = 63/555 = 0,113

b). $P(C_2)$= P(Scholarship= “No”) = 492/555 = 0,886

3). Calculates the sum of conditional probabilities for each class P(X|Ci), i=1,2, 1=Yes, 2=No for each attribute in the sample and input.

a) $P(X_1|C_1)$=P(Value=“HIgh”|Scholarship=”Yes”) = $\frac{52}{63}$ = 0,825396

b) $P(X_1|C_2)$=P(Value=“HIgh”|Scholarship=”No”) = $\frac{284}{492}$ = 0,577235

c) $P(X_2|C_1)$=P(Absence=“B”|Scholarship=”Yes”) = $\frac{55}{63}$ = 0,873015

d) $P(X_2|C_2)$=P(Absence=“B”|Scholarship=”No”) = $\frac{458}{492}$ = 0,930894

e) $P(X_3|C_1)$ =P(JPO= “HIgh” | Scholarship= “Yes”) = $\frac{1}{63}$ = 0,015873

f) $P(X_3|C_2)$=P(JPO=“HIgh”| Scholarship= “No”) = $\frac{115}{492}$ = 0,233739

g) $P(X_4|C_1)$=P(JTO=“Medium”|Scholarship= “Yes”) = $\frac{47}{63}$ = 0,746031

h) $P(X_4|C_2)$=P(JTO=“Medium”|Scholarship= “No”) = $\frac{253}{492}$ = 0,514227

i) $P(X_5|C_1)$=P(SKTM=”No”|Scholarship= “Yes”) = $\frac{0}{63}$ = 0

j) $P(X_5|C_2)$ =P(SKTM= ”No” | Scholarship= “No”) = $\frac{188}{492}$ = 0,382113

k) $P(X_1|C_1)$=P(Value=“HIgh”|Scholarship=”Yes”) = $\frac{52}{63}$ = 0,825396

l) $P(X_1|C_2)$=P(Value=“HIgh”|Scholarship=”No”) = $\frac{284}{492}$ = 0,577235

m) $P(X_2|C_1)$=P(Absence=“B”|Scholarship=”Yes”) = $\frac{55}{63}$ = 0,873015

n) $P(X_2|C_2)$=P(Absence=“B”|Scholarship=”No”) = $\frac{458}{492}$ = 0,930894

o) $P(X_3|C_1)$ =P(JPO= “HIgh” | Scholarship= “Yes”) = $\frac{1}{63}$ = 0,015873

p) $P(X_3|C_2)$=P(JPO=“HIgh”| Scholarship= “No”) = $\frac{115}{492}$ = 0,233739

q) $P(X_4|C_1)$=P(JTO="Medium"|Scholarship= "Yes") = $\frac{47}{63}$ = 0,746031

r) $P(X_4|C_2)$=P(JTO="Medium"|Scholarship= "No") = $\frac{253}{492}$ = 0,514227

s) $P(X_5|C_1)$=P(SKTM="No"|Scholarship= "Yes") = $\frac{0}{63}$ = 0

t) $P(X_5|C_2)$ =P(SKTM= "No" | Scholarship= "No") = $\frac{188}{492}$ = 0,382113

4). Multiply the probabilities P(X|C1) P(C1) for each class C1 and C2

a). P(X|Scholarship="Yes")P(Scholarship"Yes)
= P(Value=HIgh | C_1=Yes) * P(Absence=B | C_1=Yes) * P(JPO =HIgh | C_1=Yes) * P(JTO=Medium | C_1=Yes) * P(SKTM=No | C_1=Yes)
= 0.825396 * 0,873015 * 0,015873 * 0,746031* 0
= 0

b). P(X|Scholarship="No")P(Scholarship"No")
= P(Value=HIgh | C_1=No) * P(Absence=B | C_1=No) * P(JPO =HIgh | C_1=No) * P(JTO=Medium | C_1=No) * P(SKTM=No | C_1=No)
= 0,557235 * 0,930894 * 0,233739 * 0,514227 * 0,382113
= 0,023824

5). Compare the results of the posterior probability class Yes with No P(X|C1)P(C1) from the above results, it can be seen that the highest probability value is in the class (P | No), so it can be concluded that the category of the scholarship recipient candidate is included in the "No" category.

4. Conclusion

Based on the results of the analysis and discussion of the selection of scholarship recipients at SMA PGRI 2, it can be concluded that: Based on the results of confusion matrix testing with split validation techniques, the use of the naïve bayes classification method on the dataset that has been taken on the object of research obtained an accuracy rate of 87.39% or still in the good classification category. While the precision value is 95.94% and recall is 89.57%. Based on this, it can be stated that the classification system built can be used as input for decision making. This research can develop new classification models or adapt existing models to more accurately identify scholarship recipients based on various factors such as academic achievement, extracurricular activities, economic background, and other factors. This model can enrich the literature in the field of data science and machine learning with specific applications in education.

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