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Application of Naïve Bayes Algorithm for Non-Cash Food Assistance Recipients in Kampar Regency

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Abstract: Non- Non-Cash Food Assistance (BPNT) is a non-cash food social assistance from the government given to beneficiary families (KPM) of 200,000 IDR per month which is given in the form of basic necessities by using an electronic card. The large number of residents who will be selected makes it difficult for village officials to make decisions on who is eligible or ineligible as recipients of non-cash food assistance every month. This research was conducted to design a decision support system for the eligibility of non-cash food assistance recipients by using the Naïve Bayes algorithm in order to help the Parit Baru Village apparatus every month in determining the eligibility of the next non-cash food assistance recipients, by perform Confusion Matrix calculations. From the results of the discussion carried out, it can be concluded that Naïve Bayes and the resulting rules had an accuracy rate of 95%, the Precision value was 94% and Recall was 100%. Therefore, the Naïve Bayes algorithm can be applied to the decision support system in determining the eligibility of recipients of non-cash food assistance.

Keywords: Non-Cash Food Assistance, decision support system, Naïve Bayes, confusion matrix.

INTRODUCTION

Non-Cash Food Assistance is a non-cash social food assistance from the government that is given to beneficiary families every month (Anggraeni et al., 2020). Non-Cash Food Assistance (BPNT) is given monthly to beneficiary families (KPM) in the amount of 200,000 IDR per month distributed in the form of basic necessities by using an electronic card called KKS (Prosperous Family Card) (Awal Amarudin et al., 2022). The Non-Cash Food Assistance Program (BPNT) is a transformation of the previous program, the Raskin Rice Program (Rachman et al., 2018). People who receive Non-Cash Food Assistance are families that have been registered as Beneficiary Families (Tim Pengendali Pelaksanaan Penyaluran Bantuan Sosial Secara Non Tunai, 2020).

Reporting from the website kemensos.go.id the beneficiary family is the family with the lowest 25% socioeconomic conditions in the implementation area (Sekretariat Direktorat Jenderal Penanganan Fakir Miskin, 2017). Based on the Central Statistics Agency (BPS) in March 2021, there are 27.54 million Indonesians with poor status (Badan Pusat Statistik, 2021). One of the efforts made by the Indonesian government to reduce the burden on the community is by providing assistance, this assistance is called Non-Cash Food Assistance (BPNT). One of the objectives of this program is to reduce the burden of expenditure on beneficiary families (KPM) and as social protection and poverty reduction (Syakhruddin, 2019).

Based on population data from Parit Baru Village in 2022, the total population is 2,170 people consisting of 520 families. The large number of residents who will be selected makes it difficult for village officials to make decisions on who is eligible or ineligible as recipients of non-cash food assistance every month. The absence of a fixed calculation pattern in the selection process makes the village apparatus only limited to seeing and proposing without first considering the eligibility of the data to be sent to the social service. Certainly**,** the data submitted is only subjective. The name of the candidate who has been determined by the village is entered into the DTKS (Integrated Data on Prosperous Families) and then the village submits the data of the prospective

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recipients of Non-Cash Food Assistance (BPNT) to the Social Service. The Social Service Office determines the data sent as recipients of non-cash food assistance called Beneficiary Families (KPM).

The Decision Support System (SPK) is built to make it easier for an agency to make a decision so that the decisions taken are more accurate. Making a decision must consider predetermined criteria. With the decision support system, it can certainly make it easier for the Parit Baru Village apparatus to make decisions to determine the eligibility of prospective recipients of non-cash food assistance by using predetermined criteria. The algorithm used in the decision support system is that by using the Naïve Bayes algorithm. Naïve Bayes can predict future opportunities based on previous experiences (Saleh, 2015).

The Naïve Bayes algorithm is a simple classification algorithm that has high accuracy. Besides, the Naïve Bayes algorithm only requires a small amount of training data for the estimation of the parameters required in the classification process. Based on previous research by (Huda et al., 2021) entitled Classification of mushrooms by using the Naïve Bayes algorithm produces an accuracy rate of 100%. Therefore, the Naïve Bayes algorithm is very suitable to be implemented in determining the eligibility of prospective recipients of Non-Cash Food Assistance (BPNT).

LITERATURE REVIEW

The literature review was carried out with the aim of looking at previous researches related to the research carried out today in order to obtain better results. By reviewing from a scientific point of view, the author was looking for several scientific references as a literature review including (Huda et al., 2021) conducting Selection of Non-Cash Food Assistance Recipients in Villages by Using the Naïve Bayes Method and Simple Additive Weighting. This study defined the problem of the difficulty in distributing social assistance unevenly and not on target. The emergence of this problem was due to the lack of consideration or stability of the BPNT recipient's analysis in determining eligibility when submitting data collection with an accuracy value of 85%, precision 85.71% and recall 92.31%.

Then (Rahmawati et al., 2018) carried out the Application of the Naïve Bayes Method in the decision support system to determine the hijab model. This research defined the problem of hijab models with various styles such as pashmina hijab models, syar'i hijab models, triangular hijab models and many other hijab models so that it often makes it difficult for Muslim women to choose the appropriate hijab in each activity. Furthermore, (Rizki et al., 2019) conducted a decision support system by using the Naïve Bayes Method for the Selection of Supervisors. Problems in the selection of supervisors sometimes occur when decisions were not optimal in which the appointed lecturers were not suitable with student criteria. As a result, the thesis produced was not of high quality or took a long time with an accuracy value of 77.50%.

Next (Damuri et al., 2021), implemented Data Mining with the Naïve Bayes Algorithm for the Classification of Eligibility of Staple Food Assistance Recipients. The problem raised was the provision of basic necessities that are not on target, so it required more valid data collection related to families who are eligible or ineligible to receive basic food assistance, resulting in 86% accuracy, 85% recall, and 85% precision.

METHOD

Software analysis was the first step to determine the picture of the system to be built or generated from a study conducted. The purpose of software analysis was to identify and evaluate problems, opportunities, obstacles that occurred and expected needs so that improvements can be proposed.

Then, the next step of system needs analysis was an analysis related to the application to be made. This stage of analysis aimed to obtain the information needed and get the concept of the system to be created. In this stage, the research began with making observations and interviews in order to get the information needed in building the system.

This research used the Naïve Bayes algorithm. The study classified eligibility into two categories, namely eligible and ineligible. The work of the system began with inputting training data, as well as inputting testing data. After that, the training data was analyzed by using the Naïve Bayes algorithm in the following ways:

1. Calculate the number of classes in the training data
2. Count the same number of cases for the same class
3. Multiply the results according to the testing data that the class will look for
4. Compare class results, the highest score is set as a new class.

To form a model on the data, later calculations was carried out by using the Naïve Bayes algorithm. Then the first step was to read the training data. The training data used were:

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Table 1. Data Training (BPNT Recipients)

No	Name	L<8m	JL	JD	TBA	BP	P<600 IDR	PKK	TB	KE
1	Azidarni	Yes	T	P	Su	TM	Yes	Elementary School	TA	L
2	Anisriati	Yes	S	P	Su	M	No	Elementary School	TA	L
3	Ariska	Yes	S	P	Su	TM	Yes	Elementary School	TA	L
4	Celi Marcelina	Yes	S	P	Su	M	No	Senior High School	TA	L
5	Devi Herlina	No	S	P	Su	TM	Yes	Senior High School	TA	L
6	Darniati	Yes	S	P	Su	TM	Yes	Senior High School	TA	L
7	Darni	No	K	BT	WP	M	No	Elementary School	Available	TL
8	Darlina	No	S	BT	WP	M	No	Senior High School	TA	L
9	Ernis	Yes	S	BT	WP	M	No	Elementary School	TA	L
10	Erni	No	K	BT	WP	M	No	Senior High School	TA	L
11	Erna	No	S	P	Su	TM	Yes	Elementary School	TA	L
12	Elma Wati	Yes	T	P	Su	TM	Yes	Senior High School	TA	L
13	Erda Wati	No	S	P	Su	TM	Yes	Senior High School	TA	L
14	Elpatri	No	S	P	WP	M	No	Elementary School	Available	TL
…	…..	….	…	….	….	….	……	…..	…...	…
180	Atika	Yes	K	BT	WP	TM	No	Elementary School	Available	TL

Information:
P : Board
BT : Bricks
Su : River
WP : Private Toilet
TM : Incapable
M : Able
TA : None
TL : Ineligible
L : Eligible
K : Ceramics
KE : Description
S : Cement
T : Land
JL : Floor Type
JD : Wall Type
TBA : Defecation Place
PKK : Education of Family Head
TB : Savings

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This research used 180 training data and 20 testing data that were used in the decision support system to be built.

Table 2. Test Data

No	Name	L <8m	JL	JD	TBA	BP	P <600 IDR	PKK	TB	KE
1	Risna	Yes	T	P	S	TM	Yes	Junior High School	TA	?
2	Khumairah	No	K	BT	WP	M	No	Elementary School	TA	?
3	Nurida	Yes	S	P	S	TM	No	Elementary School	TA	?
4	Azidarni	Yes	T	P	Su	TM	Yes	Elementary School	TA	?
5	Anisriati	Yes	S	P	Su	M	No	Elementary School	TA	?
6	Ariska	Yes	S	P	Su	TM	Yes	Elementary School	TA	?
7	Celi Marcelina	Yes	S	P	Su	M	No	Senior High School	TA	?
8	Devi Herlina	No	S	P	Su	TM	Yes	Senior High School	TA	?
9	Darniati	Yes	S	P	Su	TM	Yes	Senior High School	TA	?
10	Darni	No	K	BT	WP	M	No	Elementary School	Available	?
11	Darlina	No	S	BT	WP	M	No	Senior High School	TA	?
12	Ernis	Yes	S	BT	WP	M	No	Elementary School	TA	?
13	Erni	No	K	BT	WP	M	No	Senior High School	TA	?
14	Erna	No	S	P	Su	TM	Yes	Elementary School	TA	?
15	Elma Wati	Yes	T	P	Su	TM	Yes	Senior High School	TA	?
16	Erda Wati	No	S	P	Su	TM	Yes	Senior High School	TA	L
17	Elpatri	No	S	P	WP	M	No	Elementary School	Available	TL
18	Ermawati	Yes	T	P	Su	M	No	Elementary School	TA	L
19	Farida	Yes	T	P	Su	M	No	Junior High School	Available	L
20	Harmis	Yes	S	BT	WP	M	No	Elementary School	TA	L

Then, the next step was system designer which included creating a display interface, inputs, outputs, and designing databases. Through this design, the system overview was presented by using *Unified Modelling Language (UML)* so that the system workflow to be built can be implemented (Anam et al., 2020). *Unified Modelling Language (UML)* is a standardized software design model that uses object-oriented programming techniques (Asnal et al., 2022). This study used a Use case diagram. It describes an interaction between one or more actors and the system to be created. The use case diagram on the system to be built is useful to find out what functions and who plays a role in the system in using existing functions. The following is an overview of the *Use Case Diagram* of the system or application to be built:

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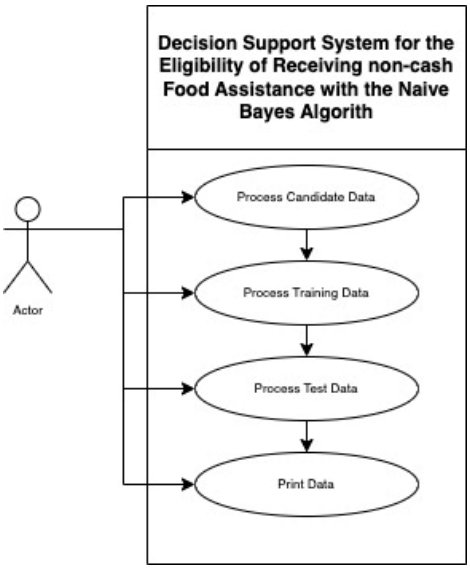

Figure 1. Proposed *Use Case* Diagram

In the Use Case Diagram above, it can be explained that the actor of this system is an Administrator. An administrator is allowed to manage all the data in the system consisting of processing candidate data, processing training data, logging in, and processing test data.

Table 3. *Use Case* Scenarios

No	*Use Case*	Description	Actor
1	*Login*	Describes the process of an admin logging in to the system	Admin
2	Candidate Data	Describes the admin process in managing prospective data	Admin
3	Data Training	Data Training Describes the admin process in managing training data from the assessment of prospective data	Admin
4	Test Data	Describes the admin process of managing test data from the assessment of prospective data	Admin
5	Print Report	Describes the admin process of printing reports	Admin

Then from the use case, which is designing the interface, figure 2 is an output where it displays candidate data information according to two eligibility criteria, namely eligible or ineligible which was obtained from the calculation results of the Naïve Bayes algorithm.

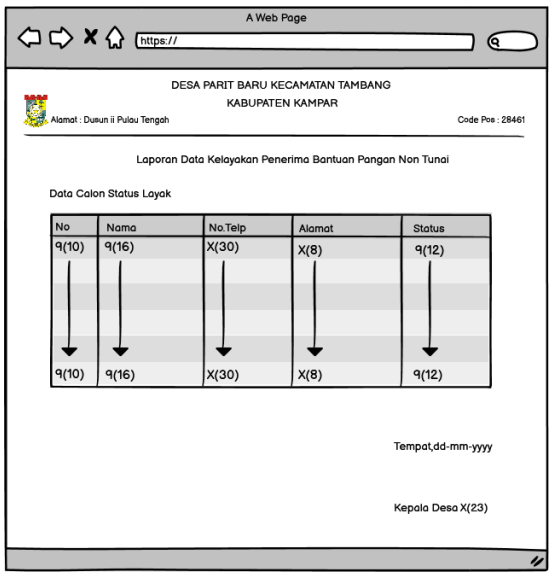

Figure 2. Admin Output *Interface* Candidate Status Data Report

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RESULT

The result of this study was to produce a system that can provide data on the eligibility of non-food aid recipients. Before going to the system, this study performed manual calculations. This calculation was carried out to obtain the accuracy, precision, and recall values of the processed dataset. In this case it was split data from training and test data. Here is the calculation:

Table 4. Predicted Results

Prediction Class	Eligible	Ineligible	The Prediction Result
Eligible	0.00073	0	Eligible
Eligible	0.00061	0.00116	Ineligible
Eligible	0.01111	0	Eligible
Eligible	0.01111	0	Eligible
Eligible	0.01090	0	Eligible
Eligible	0.01157	0	Eligible
Eligible	0.00143	0	Eligible
Eligible	0.00144	0.00001	Eligible
Eligible	0.00144	0.00001	Eligible
Ineligible	0.00021	0.07860	Ineligible
Eligible	0.01253	0	Eligible
Eligible	0.01090	0	Eligible
Eligible	0.00079	0	Eligible
Eligible	0.00352	0	Eligible
Eligible	0.00144	0.00001	Eligible
Eligible	0.00079	0	Eligible
Eligible	0.00445	0	Eligible
Ineligible	0	0.02566	Ineligible
Eligible	0.00151	0	Eligible
Eligible	0.00394	0	Eligible

From the prediction results in table 5, confusion matrix results were obtained. Confusion matrix is a table that is often used to measure the performance of classification models in machine learning. This table describes in more detail the amount of data classified correctly and incorrectly.

Table 5. Confusion Matrix Results

	Predictions	
Actual	Eligible	Ineligible
Eligible	17	1
Ineligible	0	2

Accuracy = (17+2)/(17+2+1+0) = 0.95 = 95%
Precision = (17)/(17+1) = 0.94 = 94%
Recall = (17)/(17+0) = 1 = 100%

From the results in table 5, then the calculation is carried out using the formula confusion matrix. From these calculations, a 95% guarantee is obtained, then precision gets 94%, and 100% Recall. This shows that this research is quite high when compared to other studies which get an accuracy of 58.28% (Agus Sugianto & Rizky Maulana, 2019).

Then the built system was used to help perform calculations. Figure 3 is a page that shows the calculation results of the test data using the Naïve Bayes algorithm which provides information on whether the data is eligible or not.

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Figure 3. Test data results

Then figure 4 is a page that contains information on candidate data that is eligible and ineligible of being used as the output of a report.

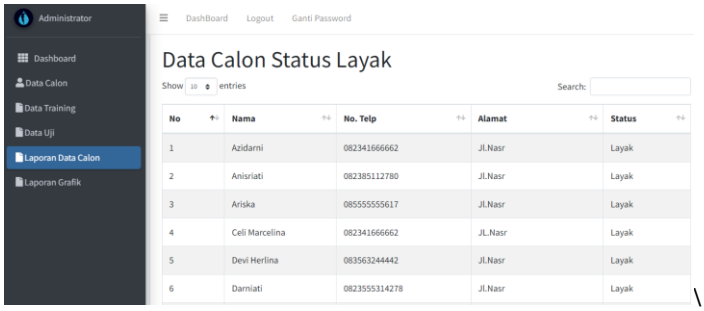

Figure 4. Data report of potential recipients

After the program was completed, the next step was to conduct a trial using black box testing. *Black Box* Testing or often known as functional testing is a software testing method used to test software without knowing the *internal* structure of the code or program (Jamaris et al., 2022). In this test, the tester was aware of what the program should do but has no knowledge of how to do it. Table 5 is the results of tests carried out using the *black box* testing method.

Table 6. *Blackbox Texting*

No	Scenario Testing	Expected Results	Conclusions
1	Login by entering the username "admin and password "admin"	The system successfully enters the system and displays the main menu page	Valid
2	Login by entering a username instead of "admin and password "admin"	The system does not log in successfully and displays an error message in the form of an incorrect username and password	Valid
3	Add candidate data (The data entered is incomplete, then click Save	System will not save when the columns are not filled in all, instead it will display the message "Incomplete data"	Valid
4	Add training data, (Data entered complete, then click save)	The system will save when the fields are all filled, it will display the message "Data successfully saved"	Valid
5	Add test data (Data that is input is complete, then click Save	System to annotate "System successfully calculated"	Valid
6	Displaying calculation results of Naïve Bayes algorithm	The system successfully performs test data calculations and displays the results of test data	Valid

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7	Print Report Data candidate	The system successfully performs the process of printing reports from candidate data	Valid
8	Displaying graph reports	The successful system displays a form of report in the form of a graph that shows graph information on the amount of data per candidate for status	Valid

DISCUSSIONS

This system was built to make it easier to determine potential recipients of non-cash assistance. Therefore, proper analysis was needed. This study conducted an analysis of the running system. After that, it did a needs analysis in making a system. The next was designing the system. In this system, people can see a graph of potential recipients with eligible and ineligible status which can be seen in figure 5.

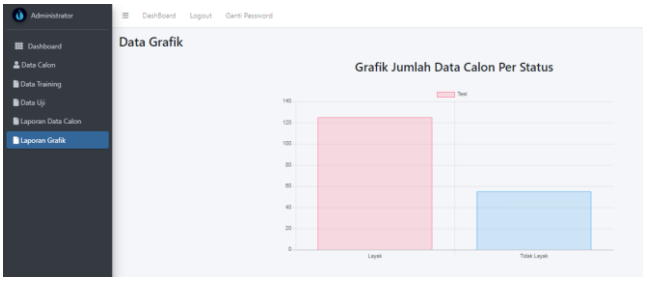

Figure 5. Graph Report

CONCLUSION

Based on the results of the discussion in the previous chapters, it can be concluded that the **eligibility** decision support system for prospective recipients of non-cash food assistance by using the Naïve Bayes algorithm can help village officials determine the eligibility of non-cash food assistance recipients, with an accuracy rate of 95%, and a precision of 94% and a recall of 100%.

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