The K-NN method was used to assess student satisfaction with the services provided by employees of research and service institutions

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Abstract

Population growth caused by the year of birth led to the classification of population groups into several generations. Classification is important because in each generation there is based on population growth has different characteristics and traits in each generation. This research was conducted to try to group generations based on provinces in Indonesia based on the number of residents owned. When researchers analyzed the data obtained from population census data conducted by the central statistics agency (BPS). The method used in generation classification grouping uses the K-Means algorithm method based on 3 clusters. Based on the results of calculations carried out for 3 clusters obtained cluster 1 has 25 provinces, cluster 2 has 3 provinces and cluster 3 has 6 provinces. Based on the 2020 census that has been conducted, the current population is generation Z, generation and Pre Boomer generation is last in line so that from the available data can provide information about mapping in 34 provinces to be able to improve communication patterns between generations and fulfill public facilities that can be used every generation.

Keywords: Generation clustering, K-Means, Clustering

1. Introduction

Service is an action taken to meet the needs of others (consumers, customers, guests, clients, patients, passengers, etc.) whose level of satisfaction can only be felt by those who serve and those who are served. The services provided can lead to a person's positive or negative attitude towards service providers [1]. Therefore, the service must be carried out optimally so that satisfaction arises between the person being served and the person serving. Customer satisfaction or the satisfaction of someone being served is a person's feeling of pleasure or disappointment that arises after comparing his perceptions or impressions of the performance or results of a product and his expectations [1]. If the service provided is in accordance with customer expectations, then they will feel satisfied. This research was conducted in one of the universities in the province of South Kalimantan. The performance of research and community service institutions (abbreviated as LPPM) in an institution can be assessed from the services provided by the institution to lecturers and students. From this, it can be analyzed how the services provided by the institution to lecturers, especially to students. Services that are less than optimal can affect the achievement of the institution's goals. Due to the need for a reciprocal relationship between students and the institution in order to fulfill the assigned tasks. An LPPM has several tasks, one of which is realizing planning, implementing, and coordinating research activities, application and updating of science and technology within the institution, both in the form of research and community service for the prosperity of the community and increasing the competitiveness of the nation.
Based on these problems, research was conducted to assess student satisfaction with the services of LPPM employees as a form of evaluation so that existing employees can improve services and can realize the vision and mission that has been set. Many branches of computer science can solve this case. One of them is decision support system [2]–[6], datamining [7]–[9], artificial neural network [10]–[13] and others. Each branch of science has its own advantages. Based on these problems, researchers used data mining with the K-Nearest Neighbors (KNN) method. Data mining is a series of processes that use one or more computer learning techniques to analyze and expand knowledge automatically or a series of processes to explore more values from a data set in the form of knowledge that has not been known manually [14]. The application of data mining in predicting the level of satisfaction has been carried out in previous studies. One of them is a study conducted by [15], on the assessment of the satisfaction level of visitors to the animal park as a result of this study. The results of processing the C4.5 method using the RapidMiner software where the attributes of infrastructure (C2) and service officers (C5) are the attributes that most influence the level of satisfaction of animal park visitors. Based on these reasons, it is hoped that research using the K-NN algorithm can produce an analysis and implementation of a system on student satisfaction in LPPM employee services so that it can be input to improve service quality and achieve the existing vision and mission.

2. Research and Methodology

2.1. Classification

Data classification is a process that finds the same properties in a set of objects in a database and classifies them into different classes according to a defined classification model [16-20]. The purpose of classification is to find a model from the training set that distinguishes attributes into the appropriate category or class, the model is then used to classify attributes whose class has not been previously known [20-22].

2.2. K-NN (K-Nearest Neighbor)

The K-Nearest Neighbor (KNN) algorithm is a method for classifying objects based on learning data that has the closest distance to the object. Learning data is projected into a multidimensional space, where each dimension displays the characteristics of the data [23-25]. The application of the K-NN method through several steps.

a) Determine the parameter k.
b) Calculate the distance between the data to be evaluated with all training.
c) Sort the distance formed (in ascending order).
d) Determine the closest distance to the order k.
e) Match the appropriate class.
f) Find the number of classes from the nearest neighbor and set the class as the data class to be evaluated [26].

3. Results and Discussion

3.1. Solution to problem

a) Data

After analyzing the existing problems with the data mining stages to produce a classification of student satisfaction at LPPM employee services, this analysis ends with carrying out the actual data mining process, the results achieved are to determine the classification of student satisfaction levels in LPPM employee services. This study uses the help of the RapidMiner application to facilitate the data mining process that produces information on the classification of student satisfaction.

| Table 1. Criteria/Attributes |
|-----------------------------|
| No | Attribute   |
|----|-------------|
| 1  | Ability     |
From the attributes that have been determined, the results of the assessment given by the respondents have been converted into the form of training data as follows:

| No | Attribute    |
|----|--------------|
| 2  | Appearance   |
| 3  | Responsibility |
| 4  | Attitude and Behavior |

Table 2. Conversion Data

| Ability | Appearance | Responsibility | Attitude and Behavior | Label |
|---------|------------|----------------|-----------------------|-------|
| 81,5    | 90         | 90             | 88                    | 1     |
| 85      | 96         | 91             | 89                    | 1     |
| 83,5    | 78         | 88             | 88                    | 1     |
| 79      | 87         | 87             | 77                    | 2     |
| 65      | 88         | 78             | 91                    | 1     |
| 78      | 85         | 88             | 88                    | 1     |
| 77      | 67         | 83             | 78                    | 2     |
| 66,5    | 78         | 85             | 77                    | 2     |
| 91      | 66         | 88             | 85                    | 1     |
| 71      | 65         | 84             | 86                    | 1     |
| 68      | 78         | 67             | 76                    | 2     |
| 78      | 77         | 88             | 78                    | 2     |
| 79      | 80         | 78             | 87                    | 1     |
| 88      | 89         | 66             | 79                    | 2     |
| 83      | 88         | 78             | 88                    | 1     |
| 84      | 78         | 87             | 86                    | 1     |
| 74      | 86         | 77             | 85                    | 1     |
| 67      | 75         | 67             | 78                    | 2     |
| 78      | 77         | 75             | 77                    | 2     |
| 79      | 67         | 73             | 89                    | 1     |
| 81      | 88         | 77             | 90                    | 1     |
| 78      | 79         | 88             | 88                    | 1     |
| 68      | 77         | 76             | 89                    | 1     |
| 77      | 69         | 76             | 78                    | 1     |
| 76      | 77         | 73             | 88                    | 1     |
| 68      | 66         | 76             | 87                    | 2     |

The dataset in Table 3 is obtained from the results of the conversion of the questionnaire into the form of testing data. The data was obtained by distributing questionnaires to the respondents and the respondents assessed in a range between 1-100 against each of the existing criteria which were converted into training data.

b) K-Nearest Neighbor

Based on the data mining stages for the K-Nearest Neighbor algorithm, the steps for the K-Nearest Neighbor are:

1) Determination of the value of k. The determination of the value of k used does not have a standard rule.
2) Calculate the distance between the training data and test data (Test) in the transformation stage using the Euclidean distance calculation as follows:
   
   \[ d_1 = \sqrt{(81.5 - 88)^2 + (90 - 89)^2 + (90 - 87)^2 + (88 - 88)^2} = 7.228 \]
   
   \[ d_2 = \sqrt{(85 - 88)^2 + (96 - 89)^2 + (91 - 87)^2 + (89 - 88)^2} = 8.660 \]
   
   \[ d_3 = \sqrt{(83.5 - 88)^2 + (78 - 89)^2 + (88 - 87)^2 + (88 - 88)^2} = 11.926 \]
   
   \[ d_4 = \sqrt{(79 - 88)^2 + (87 - 89)^2 + (87 - 87)^2 + (77 - 88)^2} = 14.352 \]
   
   \[ d_5 = \sqrt{(65 - 88)^2 + (88 - 89)^2 + (78 - 87)^2 + (91 - 88)^2} = 24.899 \]
From the distance calculation results, complete results are obtained which are summarized in the following table:

**Table 3. Results of distance calculations using euclidean distance**

| Ability | Appearance | Responsibility | Attitude and Behavior | Label | Distance |
|---------|------------|----------------|-----------------------|-------|----------|
| 81.5    | 90         | 90             | 88                    | 1     | 7,228416 |
| 85      | 96         | 89             | 91                    | 1     | 8,660254 |
| 83.5    | 78         | 88             | 89                    | 1     | 11,92686 |
| 79      | 87         | 77             | 87                    | 2     | 14,3527  |
| 65      | 88         | 78             | 91                    | 1     | 24,8998  |
| 78      | 85         | 88             | 88                    | 1     | 10,81665 |
| 77      | 67         | 83             | 78                    | 2     | 26,85144 |
| 66.5    | 78         | 85             | 77                    | 2     | 26,61297 |
| 91      | 66         | 88             | 85                    | 1     | 23,4094  |
| 71      | 65         | 84             | 86                    | 1     | 29,63106 |
| 68      | 78         | 67             | 76                    | 2     | 32,63434 |
| 78      | 77         | 88             | 78                    | 2     | 18,57418 |
| 79      | 80         | 78             | 87                    | 1     | 15,6205  |
| 88      | 89         | 66             | 79                    | 2     | 22,84732 |
| 83      | 88         | 78             | 88                    | 1     | 10,34408 |
| 84      | 78         | 87             | 86                    | 1     | 11,87434 |
| 74      | 86         | 77             | 85                    | 1     | 17,72005 |
| 67      | 75         | 67             | 78                    | 2     | 33,71943 |
| 78      | 77         | 75             | 77                    | 2     | 22,56103 |
| 79      | 67         | 73             | 89                    | 1     | 27,60435 |
| 81      | 88         | 77             | 90                    | 1     | 12,40967 |
| 78      | 79         | 88             | 88                    | 1     | 14,17745 |
| 68      | 77         | 76             | 89                    | 1     | 28,80698 |
| 77      | 69         | 76             | 78                    | 1     | 27,23968 |
3) Sequencing of the calculated data. The distance that has been obtained is then sorted again from the closest to the farthest (ascending).

4) d) Determine the test data group based on the majority label from the k closest neighbors, because the value of k = 10, the 10 smallest distances are taken.

### Table 4. Calculation Results with K=1, K=5, and K=10

| Ability | Appearance | Responsibility | Attitude and Behavior | Label | Distance |
|---------|------------|----------------|-----------------------|-------|----------|
| 81.5    | 90         | 90             | 88                    | 1     | 7,228416 |
| 85      | 96         | 91             | 89                    | 1     | 8,660254 |
| 83.5    | 78         | 88             | 88                    | 1     | 11,92686 |
| 79      | 87         | 87             | 77                    | 2     | 14,3527  |
| 65      | 88         | 78             | 91                    | 1     | 24,8998  |
| 78      | 85         | 88             | 88                    | 1     | 10,81665 |
| 77      | 67         | 83             | 78                    | 2     | 26,85144 |
| 66.5    | 78         | 83             | 77                    | 2     | 26,61297 |
| 91      | 66         | 88             | 85                    | 1     | 23,4094  |
| 71      | 65         | 84             | 86                    | 1     | 29,63106 |
| 68      | 78         | 67             | 76                    | 2     | 32,63434 |
| 78      | 77         | 88             | 78                    | 2     | 18,57418 |
| 79      | 80         | 78             | 87                    | 1     | 15,6205  |
| 88      | 89         | 66             | 79                    | 2     | 22,84732 |
| 83      | 88         | 78             | 88                    | 1     | 10,34408 |
| 84      | 78         | 87             | 86                    | 1     | 11,87434 |
| 74      | 86         | 77             | 85                    | 1     | 17,72005 |
| 67      | 75         | 67             | 78                    | 2     | 33,71943 |
| 78      | 77         | 75             | 77                    | 2     | 22,56103 |
| 79      | 67         | 73             | 89                    | 1     | 27,60435 |
| 81      | 88         | 77             | 90                    | 1     | 12,40967 |
| 78      | 79         | 88             | 88                    | 1     | 14,17745 |
| 68      | 77         | 76             | 89                    | 1     | 25,80095 |
| 77      | 69         | 76             | 78                    | 2     | 27,23968 |
| 76      | 77         | 73             | 88                    | 1     | 22      |
| 68      | 66         | 76             | 87                    | 2     | 32,41913 |

5) By using the most majority nearest neighbor category, it can be predicted that the level of satisfaction in the next data can be predicted.

c) **RapidMiner Implementation**

Rapidminer is one of the data mining software for dataset processing to find data patterns according to the purpose of processing the data.

![Figure 1. Input excel data into the RapidMiner process](image-url)

Figure 1 shows how the process of entering data in excel format into the RapidMiner process and connecting it to the validation process.
Figure 2 is a process in the validation that is connecting the KNN algorithm with the validation test process which will then produce the values of the validation, namely accuracy data, recall and precision. The results of the accuracy of performance at validation = 5 of 81.33% for the process carried out in the model above can be seen in Figure 3.

Figure 3. Accuracy value on validation = 5

Figure 4. Validation chest precision value = 5

Figure 5. Recall value on validation = 5
And at validation = 10 the following results are obtained:

![Figure 6](image1.png)

**Figure 6.** Accuracy value on validation = 10

![Figure 7](image2.png)

**Figure 7.** Validation chest precision value = 10

![Figure 8](image3.png)

**Figure 8.** Recall value on validation = 10

### 3.2. KNN Algorithm Results

| Ability | Appearance | Responsibility | Attitude and Behavior | Label | Distance | K=10 |
|---------|------------|----------------|-----------------------|-------|----------|------|
| 81,5    | 90         | 90             | 88                    | 1     | 7,228416 | 1    |
| 85      | 96         | 91             | 89                    | 1     | 8,600254 | 1    |
| 83,5    | 78         | 88             | 88                    | 1     | 11,92686 | 1    |
| 79      | 87         | 87             | 77                    | 2     | 14,3527  | 1    |
| 65      | 88         | 78             | 91                    | 1     | 24,8998  | 1    |
| 78      | 85         | 88             | 88                    | 1     | 10,81665 | 1    |
| 77      | 67         | 83             | 78                    | 2     | 26,85144 |       |
| 66,5    | 78         | 85             | 77                    | 2     | 26,61297 |       |
From the calculation results, it is found that determining the test data group based on the majority label from the k nearest neighbors. Because the value of k = 10 then the 10 smallest distance is taken. By using the Nearest Neighbor category, which is the majority, it can be predicted that the results of the classification of satisfaction in the next data can be predicted. It was obtained from the results of the research that label 1 (Satisfied) appeared the most so that it could be determined that the classification results on student satisfaction with the services of LPMM employees were "PUAS" or students were satisfied with the services provided by LPPM employees. And here is a table of cross validation test results using the RapidMiner application.

| Ability | Appearance | Responsibility | Attitude and Behavior | Label | Distance | K=10 |
|---------|------------|----------------|-----------------------|-------|----------|------|
| 91      | 66         | 88             | 85                    | 1     | 23,4094  |      |
| 71      | 65         | 84             | 86                    | 1     | 29,63106 |      |
| 68      | 78         | 67             | 76                    | 2     | 32,6344  |      |
| 78      | 77         | 88             | 78                    | 2     | 18,57418 |      |
| 79      | 80         | 78             | 87                    | 1     | 15,6205  | 1    |
| 88      | 89         | 66             | 79                    | 2     | 22,8473  |      |
| 83      | 88         | 78             | 88                    | 1     | 10,34408 | 1    |
| 84      | 78         | 87             | 86                    | 1     | 11,87344 | 1    |
| 74      | 86         | 77             | 85                    | 1     | 17,72005 |      |
| 67      | 75         | 67             | 78                    | 2     | 33,71943 |      |
| 78      | 77         | 75             | 77                    | 2     | 22,56103 |      |
| 79      | 67         | 73             | 89                    | 1     | 27,60435 |      |
| 81      | 88         | 77             | 90                    | 1     | 12,40967 | 1    |
| 78      | 79         | 88             | 88                    | 1     | 14,17745 | 1    |
| 68      | 77         | 76             | 89                    | 1     | 25,80698 |      |
| 77      | 69         | 76             | 78                    | 1     | 27,23968 |      |
| 76      | 77         | 73             | 88                    | 1     | 22      |      |
| 68      | 66         | 76             | 87                    | 2     | 32,41913 |      |

From the 26 existing conversion data, it can be seen that the results of testing data using cross validation are validation = 5 which has a more accurate value on the existing data.

4. Conclusion

The conclusion that can be drawn after calculating the classification of student satisfaction with LPPM employees is that the classification of student satisfaction with LPPM employees using the K-NN (Nearest Neighbor) Algorithm can be applied. From the data that has been obtained, it can be determined that the predicted results of student satisfaction for the next data are "PUAS" or students are satisfied with the services provided by LPPM employees. From the calculations that have been done, KNN is more suitable with large amounts of data or has a large amount of data so that it can obtain more accurate results.

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