Islamic Banking Third-party Funds Grouping uses the Data Mining Clustering

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Abstract. Islamic banking as an intermediary institution (intermediary) between people with excess funds and people who lack funds has a very important influence on the Indonesian economy. In this study, the third-party funds discussed were third-party funds of Islamic banking. The purpose of this study is to analyze the grouping of Islamic banking third-party funds on Indonesia's economic growth over the past 11 years, from 2009 to 2019 using the K-means algorithm. The data of this study uses time-series data from Islamic banking statistics, namely data on third-party funds for Islamic banking financing sourced from the official website of the Financial Services Authority. The findings of this analysis are in the context of a clustering of Islamic banking third-party funds containing 2 clusters: low (C1) and high (C2). The results obtained are there are 7 data with low clusters and 4 data with high clusters. The results of calculations carried out manually and testing using Rapid Miner, produce the same data grouping.

1. Introduction

Islamic banking is a bank that does not adopt the traditional banking theoretical model because Islamic banking has unique characteristics. Islamic Bank integrates information into Islamic principles and norms before being processed, exchanged, used and strengthened as seen in the theoretical model. As a result, the information management model was revamped to match Islamic bank characteristics [1]. Islamic banking as an intermediary institution (intermediary) between people with excess funds and people who are underfunded has a very important influence on the Indonesian economy. People with excess funds can invest their funds in Islamic banking and funds obtained by Islamic banking are in the form of third-party funds. Third-party funds obtained by Islamic banking are channeled to people who lack funds and need funds for productive business activities, consumptive needs, and other needs that are needed by the community. This activity of raising funds and distributing funds to the community certainly moves the economic life of the community and improves people's welfare and can affect Indonesia's economic growth.

The specific objective of this research is to provide input to the Government of Indonesia in making policies on Islamic banking nationally, both the development of third-party funds and Islamic banking financing so that this development can have an influence on Indonesia's economic growth and can improve people's lives. The development of Islamic banking referred to in this study is the total development of Islamic Commercial Banks, Islamic Business Units, and Islamic People's Financing Banks in Indonesia. Research data in the form of conventional banking third-party funds obtained from the Financial Services Authority. The grouping approach used in this analysis is the K-Means
clustering algorithm for mining data. Apart from grouping, data mining is also often used for data classification problems [2]–[6].

Table 1. Islamic Banking Third-party Funds 2009-2019 (Billion Rupiah)

| Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|------|-------------|-------------|-------------|-------------|
| 2009 | 39,074,23   | 43,185,79   | 46,539,03   | 53,521,61   |
| 2010 | 54,120,99   | 59,463,73   | 65,369,77   | 77,639,78   |
| 2011 | 81,323,30   | 88,810,63   | 99,658,37   | 117,510,33  |
| 2012 | 116,636,44  | 121,759,78  | 130,364,94  | 150,449,80  |
| 2013 | 160,096,99  | 167,175,45  | 175,112,19  | 187,200,17  |
| 2014 | 184,710,46  | 195,192,84  | 200,893,96  | 221,886,42  |
| 2015 | 217,141,00  | 217,576,09  | 223,960,04  | 235,976,89  |
| 2016 | 237,622,55  | 246,333,24  | 268,957,45  | 303,158,96  |
| 2017 | 292,197,52  | 308,055,11  | 325,060,74  | 341,706,28  |
| 2018 | 347,151,95  | 348,381,91  | 363,185,37  | 379,962,94  |
| 2019 | 390,869,99  | 394,723,76  | 398,437,34  | 425,289,89  |

Source: Financial Services Authority, Republic of Indonesia [7]

Figure 1. Graph of Islamic Banking Third-party Funds (Billion Rupiah)

Figure 1 depicts a graph of the development of Islamic banking third-party funds in the last 11 (eleven) years, which has continued to experience favourable growth. This can be seen from Table 1 and figure 1 that the development of Islamic banking third-party funds from the 1st quarter of 2009 to the 4th quarter of 2018 continues to experience significant growth. The lowest development of third-party funds occurred in the first quarter of 2009 amounting to 39,074,228 billion Rupiahs and the highest development of third-party funds in Islamic banking happened in the 4th quarter of 2019 amounting to 425,289.89 billion Rupiahs.

Many previous studies are related to this research, which discusses grouping using the K-Means algorithm, including Research on the group of rice plants in Indonesia based on 34 provinces. The results of this analysis were to group rice plant data grouped into 3 clusters, namely the high group consisting of 3 provinces, the standard cluster composed of 23 provinces and the low group composed of 8 provinces [8]. Subsequent research was carried out to group disaster-prone areas based on
provinces in Indonesia. The findings of this analysis are in the context of grouping data into 3 clusters on disaster-prone areas, namely the high group consisting of 4 provinces, the standard group composed of 14 provinces and the low group composed of 16 provinces [9]. Next, the research was conducted to classify population density, human development index, Open unemployment and school enrolment rates in Indonesia by province. Results of this research are in Cluster 1 of 12 provinces, group 2 consisting of 6 provinces and cluster 3 composed of 1 province, group 4 consisting of 6 provinces and cluster 5 composed of 9 provinces [10]. These related studies are the background of the research for the grouping of Third-party Funds for Conventional Banking. The findings of this study are in the form of details about the community of third-party national banking funds which are supposed to provide feedback to the Indonesian Government, the Financial Services Authority and Bank Indonesia in making policies on national banking so that this input can further improve banking business activities nationally which have an impact on the growth of the Indonesian economy and improving people's welfare.

2. Methods

2.1. Research Methods and Data
Research data in the form of Islamic banking third-party funds obtained from the Financial Services Authority, Republic of Indonesia [7]. This study uses the K-Means Clustering method. K-Means is one of the clustering algorithms included in the Unsupervised learning group which is used to divide data into several groups using a partition system. This algorithm accepts input in the form of data without class labels [11].

2.2. Research Flowchart
The following is a picture of the K-Means flowchart.

![Flowchart K-Means](image-url)
Steps to the cluster using the k-means algorithm are as follows [13][14].
a. Determine the number of clusters (k) in the data set.
b. Determine the center value (Centroid).
c. On each record, calculate the closest distance to Centroid
d. Group objects by distance to the nearest Centroid
e. Repeat step a to step b, iterating until Centroid is optimal

3. Results and Discussion

3.1. Determining the Initial Data to be in the Cluster
The initial data that will be in the cluster are data based on Table 1.

3.2. Determining Cluster Values
At this stage, it is to determine as many as 2 (two) clusters that will be applied in the K-Means manual calculation, namely the high cluster and the low cluster.

3.3. Calculating Centroid Value
The midpoint, or data centroid, is created when applying the K-means algorithm. The midpoint value-seeking method is conducted by taking the maximum value for C1 (high cluster) and the minimum amount for C2 (low cluster).

Table 2. Initial Centroid Value

| Centroid | (C1) Max | (C2) Min |
|----------|----------|----------|
|          | 390.869,99 | 39.074,23 |
|          | 394.723,76 | 43.185,79 |
|          | 398.437,34 | 46.539,03 |
|          | 425.289,89 | 53.521,61 |

3.4. Calculate Centroid Distance
To calculate the distance between the Centroid point and the point of each object using Euclidean Distance. The following is the formula.

\[ D_e = \sqrt{(x_i - s_i)^2 + (y_i - t_i)^2} \]  

Explanation:
\( D_e \) = Euclidean Distance
\( i \) = The number of objects
\( x, y \) = Object coordinates
\( s, t \) = Centroid coordinates

Table 3. Iteration Calculation Results 1

| Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | C1           | C2           | Euclidean |
|------|-------------|-------------|-------------|-------------|--------------|--------------|-----------|
| 2009 | 39.074,23   | 43.185,79   | 46.539,03   | 53.521,61   | 713.710,92   | 0,00         | 0,00      |
| 2010 | 54.120,99   | 59.463,73   | 65.369,77   | 77.639,78   | 676.456,78   | 37.784,38    | 37.784,38 |
| 2011 | 81.323,30   | 88.810,63   | 99.658,37   | 117.510,33  | 611.063,93   | 103.840,41   | 103.840,41 |
| 2012 | 116.636,44  | 121.759,78  | 130.364,94  | 150.449,80  | 545.080,97   | 169.149,71   | 169.149,71 |
| 2013 | 160.096,99  | 167.175,45  | 175.112,19  | 187.200,17  | 459.994,83   | 253.812,85   | 253.812,85 |
| 2014 | 184.710,46  | 195.192,84  | 200.893,96  | 211.886,42  | 403.374,14   | 310.625,51   | 310.625,51 |
| 2015 | 217.141,00  | 217.576,99  | 223.960,04  | 235.976,89  | 357.553,91   | 356.213,27   | 356.213,27 |
| 2016 | 237.622,55  | 246.333,24  | 268.957,45  | 303.158,96  | 277.822,84   | 438.724,38   | 438.724,38 |
| 2017 | 292.197,52  | 308.055,11  | 325.060,74  | 341.706,28  | 172.098,97   | 543.002,67   | 543.002,67 |
| 2018 | 347.151,95  | 348.381,91  | 363.185,37  | 379.962,94  | 85.767,52    | 628.399,08   | 85.767,52  |
| 2019 | 390.869,99  | 394.723,76  | 398.437,34  | 425.289,89  | 0,00         | 713.710,92   | 0,00      |
3.5. Determining Cluster Position
In determining the position of the cluster based on Table 3, it can be done by following the following statement. "If the value of the shortest distance is in column C1, then in the cluster position Table, column C1 is given a value of 1" and "If the shortest distance is in column C2, then in the Table cluster position, column C2 is given a value of 1". The value 1 is only for symbolic or a sign that the column has the shortest distance value representing the column. The following is a Table of Cluster positions based on Table 3.

Table 4. Iteration Cluster Position 1

| Year | C1 | C2 |
|------|----|----|
| 2009 | 1  |    |
| 2010 | 1  |    |
| 2011 | 1  |    |
| 2012 | 1  |    |
| 2013 | 1  |    |
| 2014 | 1  |    |
| 2015 | 1  |    |
| 2016 | 1  |    |
| 2017 | 1  |    |
| 2018 | 1  |    |
| 2019 | 1  |    |
| Results | 4 | 7 |

The process of calculating K-Means stops at the 2nd iteration, because the 2nd iteration is the same as the result of the 1st iteration. The results obtained were C1 amounting to 4 data and C2 amounting to 7, then the calculation process was stopped.

3.6. Testing with Rapid Miner
Based on the data in Table 1, data will be grouped into Islamic Banking Third-party Funds with Rapid Miner. Figure 2 displays the effects of grouping the K-Means algorithm using a Quick Miner with a value of k = 2.

Figure 3. Results Clustering using K-Means

Based on Figure 3, it can be explained that 2 clusters are starting from cluster 0 (low) and cluster 1 (high). While the detailed results of the grouping of Islamic Banking Third-party Funds can be seen in Figure 4 below.

Figure 4. Islamic Banking Third-party Fund Details Grouping
On the basis of figure 4, it can be clarified that Third-party Islamic Banking Funds are included in cluster 0 (low), namely: there are 7 data (2009 to 2015). Meanwhile, those included in cluster 1 (high) have 4 data (2016 to 2019).

4. Conclusion
Clustering for Islamic Banking Third-party Funds can be done using K-Means data mining. The results of manual K-Means calculations with the results of testing using Rapid Miner produce the same grouping, cluster 0 (low), namely 7 data, while cluster 1 (high) has 4 data.

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