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VILLAGE GROUPING BASED ON THE NUMBER OF HEALTH FACILITIES IN WEST JAVA USING K-MEANS CLUSTERING ALGORITHM

Frieyadie[1*], Anggie Andriansyah[2], Tyas Setiyorini[3]

Sistem Informasi[1,2], Teknik Informatika[3]
Universitas Nusa Mandiri
www.nusamandiri.ac.id
frieyadie@nusamandiri.ac.id[1*], anggie.andriansyah@gmail.com[2], tyas.setiyorini@gmail.com[3],
(*) Corresponding Author

Abstract

Health is very important for the welfare and development of the Indonesian nation because as a capital for the implementation of national development, it is essentially the development of all Indonesian people and the development of all Indonesian people. Due to the outbreak of the Covid-19 virus, many health facilities must be provided for patients. Of course, the government must pay attention to the health facilities that can be used in every district/city in West Java in the future. Therefore, to determine the level of availability of sanitation facilities in each district/city in West Java, we need a technology that can classify data correctly. One method of data processing in data mining is clustering. The application of clustering to this problem can use the K-Means algorithm method to group the most frequently used data. The purpose of this study is to classify sanitation data on the highest sanitation facilities, medium sanitation facilities, and low sanitation facilities, so that areas/cities that are included in the low cluster will receive more attention from the government to improve/provide sanitation facilities.

Keywords: Health Facilities; Covid-19, Clustering, K-Means Algorithm

Abstrak

Kesehatan sangat penting artinya bagi kesejahteraan dan pembangunan bangsa Indonesia, karena sebagai modal terselenggaranya pembangunan nasional pada hakekatnya pembangunan seluruh rakyat Indonesia dan pembangunan seluruh masyarakat Indonesia. Dikarenakan merebaknya virus Covid-19, maka banyak fasilitas kesehatan yang harus disediakan untuk pasien. Tentunya pemerintah harus memperhatikan fasilitas kesehatan yang bisa digunakan di setiap kabupaten/kota di Jawa Barat ke depan. Oleh karena itu, untuk mengetahui tingkat ketersediaan sarana sanitasi di setiap kabupaten/kota di Jawa Barat, diperlukan suatu teknologi yang dapat mengelompokkan data dengan benar. Salah satu metode pengolahan data dalam data mining adalah clustering. Penerapan clustering pada permasalahan ini dapat menggunakan metode algoritma K-Means untuk mengelompokkan data yang paling sering digunakan. Tujuan dari penelitian ini adalah untuk mengelompokkan data sanitasi fasilitas sanitasi tertinggi, fasilitas sanitasi sedang, dan fasilitas sanitasi rendah, sehingga daerah/kota yang termasuk dalam cluster rendah akan mendapat perhatian lebih dari pemerintah untuk meningkatkan/menyediakan fasilitas sanitasi.

Kata Kunci: Sarana Kesehatan; Covid-19, Klastering, Algoritma K-Means

INTRODUCTION

The need for public health facilities is one of the most important things for the community. With the current state of the Covid-19 virus outbreak. Health facilities are urgently needed because many patients must be treated quickly. We can get health services or facilities from where we live, but can we use health facilities if the current conditions are the spread of the Covid-19 virus outbreak? Moreover, if the health facilities owned by the district/city where we live have low health facilities, it will be difficult to use/obtain these health facilities.

With the boom in the use of health facilities for patients due to the Covid-19 virus outbreak, of course, the government must have thought about the health facilities available in every Regency/City of West Java in the future. Therefore, to determine the level of availability of health facilities owned by each district/city in West Java, a technique that can group data correctly is needed. One method of data processing in data mining is clustering. The application of clustering to this problem can use the K-Means algorithm method to group the most frequently used data. The purpose of this algorithm is to divide the data into several groups.

Wellbeing administrations for the local area is a common liberty that should be executed by the state. The public authority should have the option to give equivalent treatment to its residents in wellbeing administrations and other public administrations (Fadillah Rijal, H. Muhammad Siridangnga, Usman, & Niar Novita Sari, 2019). The right to a satisfactory way of life for the wellbeing and prosperity of himself and his family is a common freedom and is perceived by all countries on the planet, including Indonesia (Usman & Kara, 2016). This acknowledgment is contained in the 1948 United Nations Declaration on Human Rights. Article 25 section (1) of the Declaration states, "Everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including the right to food, clothing, housing, and medical care as well as necessary social services and the right to security in the event of unemployment, suffering illness, disability, being a widow/widower, reaching old age or other conditions that result in a lack of livelihood, which is beyond his control." (Yasira & Jamhir, 2019).

Wellbeing offices are places used to do wellbeing endeavors (Pajow, Mandagi, Rumayar, Masyarakat, & Ratulangi, 2017). Health is very meaningful for the development of the welfare of the Indonesian people and as a capital for the implementation of national development which is essentially the development of the whole Indonesian people and the development of the entire Indonesian society. (Nahar, 2017). Puskesmas is one of the health service facilities that organizes public health efforts and first-level individual health efforts, by prioritizing promotive and preventive efforts to achieve the highest degree of public health in its working area. (Susanti & Widodo, 2017). *World Health Organization (WHO)* states that Indonesia is included in the group of countries with the most serious shortage of health workers, both in terms of number and distribution (Susanti & Widodo, 2017). Health facilities are the most important infrastructure in an area, especially in urban areas where the population is larger than in rural areas (Naibaho, 2016). Puskesmas, clinics, hospitals, and medical centers are places for treatment and health care services that are commonly used by the community (Naibaho, 2016) (Semendawai & Wahyono, 2013).

S.Defiyanti, M.Jajuli (Defiyanti & Jajuli, 2015) suggested that in the codification dataset the overall purity value of the k-means algorithm cluster results was 0.806 or 80.56%. For the original data dataset, the purity value of the k-means algorithm cluster results is 0.750 or 75%. The comparison criteria for data mining algorithms, especially for the clustering method, which was carried out in this study were only on the measurement of clustering results. U.Marifatin (Marifatin, 2020) said that based on the description of the problem above, it can be concluded that the initialization of the number of clusters is 2 by the definition of the value of k with the number of acute clusters being 376 items, non-acute clusters having 624 items with a total number of data being 1000.

Using a variety of other methods for Grouping Diseases of Patients in Puskesmas Warujayeng U.Rosiani, C.Rahmad, M.Rahmawati et al. (Rosiani, Rahmad, Rahmawati, & Tupamahu, n.d.) stated that the results of the image detection test for corn leaf disease, namely leaf blight and leaf spot that had been carried out, obtained a percentage of system testing of 90%. Conduct research on datasets with the same provisions as distance, leaf position, and light.

Cluster analysis is a multivariate technique with the main objective of grouping objects based on their characteristics. Currently, cluster analysis has been widely applied in various fields written in various studies and journals (Windarto, 2017). With the data that has been grouped using the K-Means Algorithm method, it is hoped that it will make it easier for the Government, especially in West Java, to get the results needed in the management of health facilities. Based on the description above, this research will utilize data on health facilities obtained from the website of the Central Statistics Agency.

The purpose of this study is to cluster data on health facilities from the highest health facilities, medium health facilities, and low health facilities so that districts/cities that fall into the low cluster get more attention from the government to improve/provide health facilities.

MATERIALS AND METHODS

Case Study Method

In the case of studies, there is no single definition included in the social sciences, there are broad definitions and are divided into four categories. Teaching cases do not need to accurately describe certain individuals, events or processes, because the main goal is to improve learning. Teaching cases can be in the form of illustrations and although they come from observations of case studies, they are not always by a particular research methodology (Prihatsanti, Suryanto, & Hendriani, 2018). Research considers what type of case study is carried out, it depends on the study as a whole.

Contextual investigations are logical exercises in a program, occasions, and exercises completed seriously and exhaustively (Hidayat, 2019). Contextual analysis research plans to uncover the

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uniqueness or uniqueness of the attributes contained for the situation under study. the actual case is the reason for leading contextual analysis research, hence the primary reason and focal point of contextual investigation research are looking into it that is the object of examination. Cases can exist and are found in practically all fields, hence everything connected with the case like the idea of the case, exercises, capacities, history, ecological conditions, and different issues relating and impacting the case should be explored to clarify and comprehend the presence of the case. the case completely and exhaustively (Hidayat, 2019).

Data Collection

In classifying the number of villages/sub-districts that have health facilities according to districts/cities in West Java in utilizing the K-means Clustering algorithm, related data are needed. The source of research data is obtained from data collected based on health information documents produced by the Directorate General through the website https://www.bps.go.id. The data used is data on the number of villages/sub-districts that have health facilities according to districts/cities in West Java in 2018-2019 which consists of 27 districts/cities. This study uses 6 variables, namely: Hospital, Maternity Hospital, Polyclinic, Public health center (Puskesmas), Auxiliary Health Center (Puskesmas Pembantu), and Pharmacy. The data will be processed by dividing into 3 clusters, namely the high health facility cluster, the medium health facility cluster, and the low health facility cluster. The data that has been processed will be processed first to be clustered. In the previous stage, the data for each province will be summed for each aspect so that at this stage a value calculation has been obtained which will be processed at the clustering stage.

K-Means method

The method used in K-Means. This K-Means method is for grouping non-hierarchical or partitioned data (Wanto et al., 2020). The K-Means algorithm attempts to divide the existing data into several groups, where the data in one group has the same characteristics as each other, but the data in other groups have different characteristics. (Wanto et al., 2020).

The data that has been accumulated will be processed by data mining to find the 3 desired clusters in the data using the K-Means algorithm for grouping, namely:

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(xi - yi)^2} \quad \text{..... (1)}$$

Where D is the distance from the result of subtraction between xi (data value) and y (central value) derived from the calculation of Euclidean Distance. After manual calculations have found results until each value in a cluster does not change, the authors use tools in the form of Rapidminer software to get a comparison of the results of data calculations by Data Mining calculations with the K-Means Algorithm method manually with the data generated by the K-Means Algorithm calculations. Means computerized.

RESULTS AND DISCUSSION

The K-Means calculation endeavors to partition the current information into a few gatherings, where the information in one gathering has similar attributes as one another, however the information in different gatherings have various qualities (Wanto et al., 2020).

1. Data Transformation

Transforming the data, the data is then accumulated and the average value of each criterion (6) is taken, namely Hospitals, Bersalin Hospitals, Polyclinics, Community Health Centers, Supporting Health Centers, Pharmacies. To facilitate data processing as shown in Table 1 below:

Table 1. Data Transformation

No	County/City	Hospital	Maternity Hospital	Polyclinic	Puskesmas	Puskesmas Pembantu	Pharmacy
1	Bogor	23,5	11	166,5	102	124	136,5
2	Sukabumi	8	5	53,5	61	176	56
3	Cianjur	6,5	0,5	42,5	48,5	112	71,5
4	Bandung	9,5	11	129,5	64,5	102	131,5
5	Garut	8	0	90	72,5	144,5	77,5
6	Tasikmalaya	2,5	0,5	54,5	44	156,5	66,5
7	Ciamis	4	0,5	43	36,5	96,5	53
8	Kuningan	9	0,5	37	39,5	62,5	56
9	Cirebon	11,5	2,5	70,5	61	90,5	129,5
10	Majalengka	3	1,5	29	34,5	68,5	65
11	Sumedang	3,5	2	54,5	38,5	62	59,5
12	Indramayu	10	4	50,5	50,5	71,5	85
13	Subang	7	2,5	71,5	44,5	49,5	75,5
14	Purwakarta	8,5	4	55,5	20,5	50	38

No	County/City	Hospital	Maternity Hospital	Polyclinic	Puskesmas	Puskesmas Pembantu	Pharmacy
15	Karawang	18,5	3	150,5	49	66	123
16	Bekasi	30,5	21	137,5	50,5	61	77,5
17	Bandung Barat	7,5	4	52,5	32,5	51,5	55
18	Pangandaran	0	0	16,5	19	34	23
19	Kota Bogor	18	6,5	41,5	25,5	32,5	48,5
20	Kota Sukabumi	6	2	9	16	19	15
21	Kota Bandung	27,5	20	111,5	70,5	11,5	129,5
22	Kota Cirebon	9	3	11,5	21	9	19,5
23	Kota Bekasi	26	11	53	39,5	11,5	54,5
24	Kota Depok	18	7	51,5	35	7,5	54
25	Kota Cimahi	5	0	14	12,5	4	15
26	Kota Tasikmalaya	7	7	33,5	22	26	41
27	Kota Banjar	3	0	7	9,5	8,5	8,5

After being accumulated and looking for the average value, the value of each variable will be obtained. Then the data will enter the clustering stage by applying the K-Means algorithm to cluster the data into three clusters. In the application of the K-means algorithm, the midpoint or centroid value is obtained from the data obtained with the provision that the desired clusterization is 3. The cluster determination is divided into three parts, namely low population level clusters (C1), medium population-level clusters (C2), and high-level clusters. high population (C3). then the value of the midpoint or centroid also has 3 points.

2. Initialize

Determination of the initial cluster point or centroid is done by taking the smallest (minimum) value for the low population level cluster (C1), the average value for the medium population-level cluster (C2), and the largest (maximum) value for the high population level cluster (C3). Here is the initial Centroid Table 2:

Table 2 Initial Centroid Value

	A	B	C	D	E	F	Description
C1	0	0	7	9,5	4	8,5	(Lowest Cluster)
C2	10,75925926	4,814814815	60,64815	41,5	63,25925926	65,37	(Medium Cluster)
C3	30,5	21	166,5	102	176	136,5	(Highest Cluster)

3. K-Means Application Process

a. Iteration 1

The iteration process 1 calculates the distance between each data to the nearest Centroid to determine the new K-Means member according to the minimum or closest distance from the Centroid. After getting the results of the iteration centroid distance 1, then determine the shortest distance. The shortest distance is the smallest value between C1, C2, and C3 in each data. After getting the Centroid results from each data, then calculate the number of each new K-Means based on the data that is incorporated in each K-Means. The calculation of the K-Means Algorithm will continue until the umpteenth iteration until each Cluster within the Centroid distance has not changed. The average results obtained for each result of the Cluster 1 iteration calculation process are taken as the new centroid as shown in Table 3 below:

Table 3 New Centroid iteration 1

Centroid iteration 1	A	B	C	D	E	F
C1	5	2	15,25	16,66666667	16,75	20,33333333
C2	11,97368421	5,052631579	65,78947368	44,94736842	72,71052632	72,36842105
C3	16,5	11	148	83,25	113	134

b. Iteration 2

The process of recalculating the distance between each data to the nearest Centroid to determine new Cluster members according to the minimum/closest distance from the Centroid. After getting the results of iteration 2 centroid distance, then determine the shortest distance. The shortest distance is the smallest value between C1, C2, and C3 in each data. After getting the Centroid results from each data, then calculate the number of each new K-Means based on the data that is incorporated in each K-Means. The average results obtained for

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each result of the Cluster 2 iteration calculation process are taken as the new centroid as shown in Table 4.

Table 4 New Centroid iteration 2

Centroid iteration 2	A	B	C	D	E	F
C1	10,22222222	4,055555556	26,38888889	22,22222222	16,88888889	31
C2	9,8	4,566666667	63,56666667	47	84,26666667	73
C3	17,16666667	8,333333333	148,8333333	71,83333333	97,33333333	130,3333333

c. Iteration 3

The process of recalculating the distance between each data to the nearest Centroid to determine new Cluster members according to the minimum/closest distance from the Centroid. After getting the Centroid results from each data, then calculate the number of each new K-Means based on the data that is incorporated in each K-Means. The average results obtained in each of the results of the iteration 3 Cluster calculation process above are taken as the new centroid as shown in Table 5.

Table 5 New Centroid iteration 3

Centroid iteration 3	A	B	C	D	E	F
C1	10,05	4,05	29,3	22,05	20,2	31,7
C2	6,708333	1,958333	54,08333	46,95833	95,125	70,83333
C3	21,9	13,2	139,1	67,3	72,9	119,6

d. Iteration 4

The resulting process recalculates the distance between each data to the nearest Centroid to determine new Cluster members according to the minimum/closest distance from the Centroid. After getting the results of the iteration centroid distance 4, then determine the shortest distance. The shortest distance is the smallest value between C1, C2, and C3 in each data. After getting the results of the Centroid from each data, then calculate the number of each new K-Means based on the data that is incorporated in each K-Means. The average results obtained for each result of the Cluster 4 iteration process are taken as the new centroid as shown in Table 6.

Table 6 New Centroid iteration 4

Centroid iteration 4	**A**	**B**	**C**	**D**	**E**	**F**
C1	9,818181818	4,045454545	31,40909091	23	23,04545455	33,81818182
C2	6,636363636	1,772727273	54,22727273	48,27272727	99,09090909	72,27272727
C3	21,9	13,2	139,1	67,3	72,9	119,6

e. Iteration 5

The resulting process recalculates the distance between each data to the nearest Centroid to determine new Cluster members according to the minimum/closest distance from the Centroid. After getting the results of the iteration centroid distance 5, then determine the shortest distance. The shortest distance is the smallest value between C1, C2, and C3 in each data. After getting the Centroid results from each data, then calculate the number of each new K-Means based on the data that is incorporated in each K-Means.

Based on the calculation of iteration 4 and iteration 5 in each cluster within the centroid distance there is no change, then the calculation is stopped at iteration 5. With the results of the final Centroid of iteration 5 Cluster 1 has 11 data, Cluster 2 has 11 data, and Cluster 3 has 5 data in table 7.

Table 7 New Centroid iteration 5

Centroid iteration 5	A	B	C	D	E	F
C1	9,818181818	4,045454545	31,40909091	23	23,0454545	33,81818182
C2	6,636363636	1,772727273	54,22727273	48,27273	99,0909091	72,27272727
C3	21,9	13,2	139,1	67,3	72,9	119,6

K-Means Results

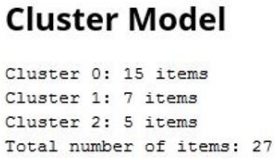

Figure 1. Clustering Model

In Figure 1 it can be seen that after processing, the Clustering Model (Clustering) menu will display the results of the sum of each data in 3 clusters in the description display.

The results of these calculations, the results of low clusters (Cluster 0) consisting of regencies/cities, which include Kuningan, Majalengka, Sumedang, Subang, Purwakarta, West Bandung, Pengandaran, Bogor City, Sukabumi City, Cirebon City, Bekasi City, City Depok, Cimahi City, Tasikmalaya City and Banjar City. The results of the medium cluster (Cluster 1) consisting of regencies/cities, which include Sukabumi, Cianjur, Garut, Tasikmalaya, Ciamis, Cirebon and Indramayu. The results of the highest cluster (Cluster 2) consisting of regencies/cities, which include Bogor, Bandung, Karawang, Bekasi and Bandung City

To assess the results of villages with sanitation facilities according to Regency/City, the K-Means clustering method can be used. The data is processed to get the value of the village with sanitation facilities by Regency/City. The results of the data processing determine the centroid value in 3 clusters, namely (1) low-level clusters, (2) medium-level clusters, and (3) high-level clusters. Assessment based on the index of villages that have health facilities as many as 15 low-level regencies/cities, 17 medium-level regencies/cities, and 5 high-level regencies/cities.

In Figure 2, it can be seen that there are still health facilities that are not owned by the regions in the Cluster 0 area, including hospitals, maternity hospitals, polyclinics, health centers, auxiliary health centers, and pharmacies. And in Cluster 1 there are still health facilities that are still lacking. Hospitals, Maternity Hospitals.

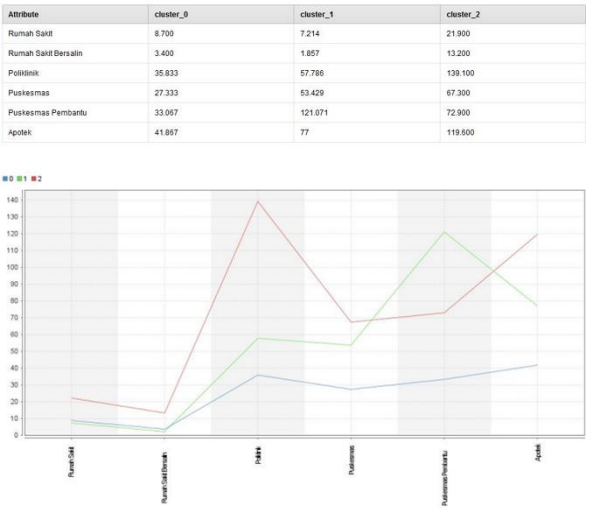

Figure 2. Cluster Results Using K-Means

CONCLUSIONS AND SUGGESTIONS

Conclusion

The results of clustering using the K-Means method obtained 3 clusters, namely high, medium and low. Bekasi and Bandung are included in the high cluster. Sukabumi, Cianjur, Garut, Tasikmalaya, Ciamis, Cirebon and Indramayu are included in the medium cluster. Meanwhile, Bogor, Bandung, Karawang,. Kuningan, Majalengka, Sumedang, Subang, Purwakarta, West Bandung, Pengandaran, Bogor City, Sukabumi City, Cirebon City, Bekasi City, Depok City, Cimahi City, Tasikmalaya City and Banjar City are included in the low cluster. The results obtained from the study show that there are still many cities/districts that are still included in the low cluster. This can be an input for the government to continue to improve and carry out an even distribution of good health facilities in all cities/districts. This is very important considering that during the Covid-19 pandemic, health facilities are very much needed by the community. The local government must fulfill the development of health facilities, especially in the low cluster, namely in the province of West Java.

Suggestion

The results obtained from the study show that there are still many cities/districts that are still included in the low cluster. This can be an input for the government to continue to improve and carry out an even distribution

of good health facilities in all cities/districts. This is very important considering that during the Covid-19 pandemic, health facilities are very much needed by the community. The local government must fulfill the development of health facilities, especially in the low cluster, namely in the province of West Java.

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