Application of Data Mining for Clustering of Foreign Tourist Visits Based on Arrival Entrance

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Abstract: Indonesia is a country with unique tourist destinations from each region. The tourism sector has an impact on the Indonesian economy which can encourage economic growth and increase the country's foreign exchange from foreign tourist visits. Tourism growth in Indonesia was disrupted due to the Covid-19 pandemic with the imposition of major social restrictions which resulted in a decrease in tourist visits and the paralysis of the tourism sector. Based on the problems described above, the authors are interested in conducting research in order to classify data on foreign tourist arrivals based on the entrance of foreign tourist arrivals. This research uses data mining method and K-Means Algorithm to form 5 clusters. The 5 clusters are divided into groups of tourist entrances which are categorized as very high (C1), high (C2), moderate (C3), low (C4) and very low (C5). In forming the 5 clusters, the researchers used Ms. Excel and Rapidminer 9.1 to process data. The results of this study obtained that the tourist entrance group was categorized as very high (C1) with 1 data, high (C2) with 1 data, moderate (C3) with 1 data, low (C4) with 1 data and very low (C5).) that is with 21 data. This study aims to provide suggestions and future considerations to the Ministry of Tourism and Creative Economy of the Republic of Indonesia (Kemenparekraf) to carry out policies so that the Indonesian tourism sector can return to normal.

Keywords: Tourism; Covid-19; Indonesia; Data Mining; K-means; Clustering

INTRODUCTION

Indonesia is an archipelagic country located on the equator with exotic natural and cultural wealth (Kadarisman, 2021). Indonesia's abundant and attractive natural and cultural wealth makes domestic and foreign tourists interested in traveling in Indonesia to relax and unwind (Kadarisman, 2021). The tourism sector has an impact on the Indonesian economy which can encourage economic growth and become an invisible export commodity because of its ability to bring in foreign exchange which is equivalent to the real sector of other commodities. (Rizki Munanda, 2019).

Tourism growth in Indonesia was disrupted due to the Covid-19 pandemic announced by the World Health Organization (WHO) on March 11, 2020 (Suprihatin, 2020). Global tourism is also paralyzed and has experienced a significant decline due to the Covid-19 pandemic, as a result of this many countries have implemented large-scale lockdowns and restrictions to stem the spread of the Covid-19 virus. (Suprihatin, 2020). In accordance with the Decree of the Head of the National Disaster Management Agency Number 9.A of 2020 concerning the determination of the status of certain emergency situations due to the Covid-19 disease outbreak in Indonesia, many people cannot carry out their daily routines as usual and many restrictions are placed between cities as a form of control. against the spread of Covid-19 (Ferdiansyah, Suganda, Novianti, & Khadijah, 2020). It is currently estimated that 75 million jobs in the tourism sector are experiencing shocks and the tourism industry is at risk of losing its turnover of more than US\$2.1 trillion. (Zenker & Kock, 2020). Based on the problems described above, the authors are interested in conducting research in order to classify data on foreign tourist visits based on the entrance. This research uses data mining method and K-Means Algorithm to form 5 clusters. The 5 clusters are divided into groups of tourist entrances which are categorized as very high (C1), high (C2), moderate (C3), low (C4) and very low (C5). In forming the 5 clusters, the researchers used Ms. Excel and Rapidminer 9.1 to process data. The results of this study aim to provide suggestions and future

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considerations to the Ministry of Tourism and Creative Economy of the Republic of Indonesia (Kemenparekraf) to carry out policies so that the Indonesian tourism sector can return to normal.

LITERATURE REVIEW

Related Research

Research conducted by (Kario & Amalia, 2021) explains the grouping of the number of foreign tourist visits in ASEAN using the K-Means Algorithm for clustering. The data is processed using RapidMiner by classifying tourist visits based on 3 clusters, namely C1 with high visits, C2 with moderate visits, C3 with low visits. The result of this research is to provide information that can be used as a reference in improving the tourism sector and a comparison to other countries.

Research conducted by (Herliyani Hasanah, Nugroho Arif Sudibyo, 2021) explains the grouping of foreign tourist visits based on nationality to Indonesia using the K-Means Algorithm using 2 clusters. C1 consists of countries that have a high level of visits and C2 countries that have a low level of visits to Indonesia. The results of this study become input data for tourism marketing strategies.

Data Mining

Data mining known as pattern recognition is a data processing method used to obtain hidden patterns from the data to be processed. Data that is processed with data mining techniques will create a new scientific knowledge that comes from old data, the results obtained from processing the data can be used to determine decisions in the future. (Alkhairi & Windarto, 2019). Data mining is a process that can be used to identify and extract useful information and knowledge from various sciences in large databases with artificial intelligence, statistical techniques, mathematics, and machine learning. (Gustientiedina, Adiya, & Desnelita, 2019). Data mining, also known as knowledge discovery in database (KDD) can be used interchangeably by explaining the process of extracting hidden information (Toresa, 2020). Data Mining can be divided into four groups, namely prediction modeling, cluster analysis, association analysis and anomaly detection. (Fatmawati & Windarto, 2018).

Clustering

Clustering is the process of dividing data in a set into several groups whose data similarity in one group is greater than the similarity of the data with data in other groups (Sari, Wanto, & Windarto, 2018). Clustering is a technique for grouping data based on the similarity of data characteristics (Aditya, Jovian, & Sari, 2020). In data mining there are two types of clustering methods used in data grouping, namely hierarchical clustering and non-hierarchical clustering. (Saragih, Sembiring, & Sayuthi, 2018).

K-Means Algorithm

The K-means algorithm is one of the partitioning algorithms, because K-Means is based on determining the initial number of groups by defining the initial centroid value. The K-means algorithm uses an iterative process to get a cluster database (Indraputra & Fitriana, 2020). The K-Means algorithm can be said to be a non-hierarchical clustering that groups data into one or more groups that have the same characteristics. (Darnita, Toyib, & Kurniawan, 2020). The K-Means algorithm starts with the formation of a cluster partition at the beginning then iteratively improves the cluster partition until there is no significant change in the cluster partition. (Sibuea & Safta, 2017). The steps for performing Clustering with the K-Means method are as follows (Rusdiansyah, Rasyid, & Sosrowidigdo, 2021):

1. Inputting or entering the number of clusters (k) in the data set that has been collected
2. Determine the center value (centroid)
3. Determination of the value of the centroid at the initial stage is carried out randomly, while in the iteration stage the formula is used as in the equation (1) the following:

$$\bar{V}_{ij} = \frac{1}{N_i} \sum_{k=0}^{N_i} X_{kj} \quad (1)$$

Information:

V_{ij} = centroid the I-th cluster average for the j-variable

N_i = The number of members of the ith cluster

i, k = index of the cluster

j = the index of the variable

X_{kj} = the k-th data value of the j-th variable for the cluster

4. On each record, calculate the distance closest to the centroid. The centroid distance used is Euclidean

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Distance, with the formula as in the equation:

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

Information:

D_e = Euclidean Distance

i = The number of objects

(x, y) = Object coordinates

(s, t) = Koordinat centroid

5. calculating the cluster center (centroid) from the data point and calculating the distance of each data to the nearest cluster center (centroid)

6. Recalculate each object that uses the new cluster center (centroid). If this process cluster center is not changed then the Clustering process is complete. And if there is still a change then it is repeated back to step 3 until the center of the cluster does not change.

Rapidminer

Rapidminer is a tool for analyzing data mining, text mining and predictive analysis. RapidMiner uses a variety of descriptive and predictive techniques to provide users with insights so they can make the best decisions. Rapidminer has approximately 500 data mining operators, including operators for input, output, data preprocessing and visualization. RapidMiner is written using the Java language so that it can work on all operating systems (Sibuea & Safta, 2017).

METHOD

Research method is the process of gathering information with the aim of improving, modifying or developing an investigation or group of investigations (Nana & Elin, 2018). The following is the method used by the author in this research:

Figure 1. Research Method

Identify and Analyze Problem

At this stage the researchers identified the existing problems to be investigated. This stage is also carried out to determine the object of research and find solutions to overcome these problems.

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Collecting Data

After identifying the problem, the researcher collects data sourced from the Central Statistics Agency (BPS) until the data collected is sufficient to continue the next process. The following is a data set of foreign tourist visits based on the arrival of the entrance until 3rd quarter 2021:

Table 1. Data of Foreign Tourist Visits Based on Entrance Arrival

Pintu Masuk	Bulan								
	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September
Ngurah Rai, Bali	2	12	3	9	8	1	0	0	0
Soekarno-Hatta, Banten	1238	5958	10188	15471	12775	13448	5466	1071	4081
Juanda, Jatim	20	69	52	106	160	181	52	10	2
Kualanamu, Sumut	11	17	45	22	50	38	28	4	3
Husein Sastranegara, Jabar	0	0	0	0	0	1	0	0	0
YIA, DIY	0	0	0	0	0	0	0	0	0
BIL, NTB	1	0	2	0	0	0	0	26	0
Sam Ratulangi, Sulut	433	1027	2513	2685	1015	2435	695	5	593
Minangkabau, Sumbar	0	0	0	0	0	0	0	0	0
S. Syarif Kasim II, Riau	1	3	8	1	0	88	0	0	0
S. Iskandar Muda, NAD	0	0	0	1	4	3	1	0	0
Ahmad Yani, Jateng	0	0	2	2	1	3	0	0	0
Supadio, Kalbar	0	0	0	0	0	0	0	0	0
Sultan Hasanuddin, Sulsel	0	0	0	0	0	0	0	0	0
Sultan M. Badaruddin II, Sumsel	0	0	0	0	0	0	804	477	0
Batam, Kep. Riau	260	157	343	191	245	250	153	149	129
Tj. Uban, Kep. Riau	0	0	81	10	20	20	0	0	0
Tj. Pinang, Kep. Riau	0	0	0	0	0	0	0	0	0
Tj. Balai Karimun, Kep. Riau	0	15	0	0	0	0	0	0	0
Tj. Benoa, Bali	8	0	0	0	0	0	0	0	0
Jayapura, Papua	2	2	0	3	0	0	0	0	3
Atambua, NTT	4	26	0	3	13	152	12	12	73
Entikong, Kalbar	6	11	14	2	0	0	1	0	0
Aruk, Kalbar	3	2	13	1	1	0	1	0	0
Nanga Badau, Kalbar	0	0	0	0	0	0	0	0	0

Data Processing

The data set that has been obtained before processing is carried out by cleaning the data and selecting attributes before testing the results using the K-means Algorithm.

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K-Means Clustering

The processed data is then clustered using the K-means Algorithm manually using Ms. Excel.

Test Result

To get better results, a clustering process is carried out using rapidminer 9.1 to get more detailed test results.

RESULT

This study forms 5 clusters of 25 data on foreign tourist visits based on the entrance to be processed using the K-means algorithm. The calculation starts by randomly determining the centroid value in the first iteration and then calculating the closest distance to get the cluster value because the k-means method allocates data into clusters from data that has the closest distance to the center point of each cluster by calculating the distance of each data using the Euclidean formula. distance. The next step is to do the second iteration by recalculating the closest distance to the centroid value that has been determined from the average value in the first iteration to get the cluster value in the second iteration. This research stops at the second iteration because there is no more data moving from each cluster. For more details, the steps in clustering in the application of the K-means algorithm are as follows:

Determine the centroid value

Calculations on the K-means algorithm begin by determining the value of the center point or centroid at random, here are the randomly selected centroid values:

Table 1. Centroid Values

Pintu Masuk Kedatangan	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September
Soekarno-Hatta, Banten	1238	5958	10188	15471	12775	13448	5466	1071	4081
Sam Ratulangi, Sulut	433	1027	2513	2685	1015	2435	695	5	593
Batam, Kep. Riau	260	157	343	191	245	250	153	149	129
Sultan M. Badaruddin II, Sumsel	0	0	0	0	0	0	804	477	0
Nanga Badau, Kalbar	0	0	0	0	0	0	0	0	0

Calculate the distance of each data using the Euclidean distance formula

After determining the 5 center points or centroids, the next step is to calculate the distance of each data using the Euclidean formula and the following is the result of the calculation:

Table 2. The Result of The Calculation on Iteration 1

Pintu Masuk	Januari	Februari	Maret	...	September	C1	C2	C3	C4	C5	Shortest Distance
Ngurah Rai, Bali	2	12	3	...	0	27770,26	4738,161	645,5494	935,0123	17,4069	17,40689519
Soekarno-Hatta, Banten	1238	5958	10188	...	4081	0	23302,34	27219,39	27621,89	27783,19	0
Juanda, Jatim	20	69	52	...	2	27517,49	4513,357	463,5591	927,9326	283,3196	283,3196075
Kualanamu, Sumut	11	17	45	...	3	27702,84	4674,463	578,326	912,5662	87,58995	87,58995376
Husein Sastranegara, Jabar	0	0	0	...	0	27782,71	4749,304	656,2439	934,8508	1	1
YIA, DIY	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0
BIL, NTB	1	0	2	...	0	27781,42	4748,712	649,7661	921,8579	26,09598	26,0959767
Sam Ratulangi, Sulut	433	1027	2513	...	593	23302,34	0	4196,747	4723,598	4749,817	0
Minangkabau, Sumbang	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0
S. Syarif Kasim II, Riau	1	3	8	...	0	27736,52	4699,725	622,609	939,0229	88,42511	88,42510956
S. Iskandar Muda, NAD	0	0	0	...	0	27779,15	4746,714	653,4784	934,0043	5,196152	5,196152423
Ahmad Yani, Jateng	0	0	2	...	0	27779,43	4745,877	653,4883	934,8599	4,242641	4,242640687

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Supadio, Kalbar	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0
Sultan Hasanuddin, Sulsel	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0
Sultan M. Badaruddin II, Sumsel	0	0	0	...	0	27621,89	4723,598	957,5646	0	934,8503	0
Batam, Kep. Riau	260	157	343	...	129	27219,39	4196,747	0	957,5646	656,6239	0
Tj. Uban, Kep. Riau	0	0	81	...	0	27729,12	4687,154	599,5248	938,8323	86,37708	86,37708029
Tj. Pinang, Kep. Riau	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0
Tj. Balai Karimun, Kep. Riau	0	15	0	...	0	27779,98	4746,596	653,1998	934,9706	15	15
Tj. Benoa, Bali	8	0	0	...	0	27782,84	4749,094	653,4975	934,8845	8	8
Jayapura, Papua	2	2	0	...	3	27780,56	4747,134	653,906	934,8642	5,09902	5,099019514
Atambua, NTT	4	26	0	...	73	27683,02	4652,673	583,8698	934,2334	172,0203	172,0203476
Entikong, Kalbar	6	11	14	...	0	27774,13	4738,231	643,6342	934,1815	18,92089	18,92088793
Aruk, Kalbar	3	2	13	...	0	27776,65	4741,32	647,3453	934,0889	13,60147	13,60147051
Nanga Badau, Kalbar	0	0	0	...	0	27783,19	4749,817	656,6239	934,8503	0	0

Based on the data in iteration 1, the results of clustering are as follows:

Table 3. Result of Iteration 1 Clustering

Cluster	Data
C1	1
C2	1
C3	1
C4	1
C5	21

From the cluster mapping data that has been obtained, new centroids are generated as follows:

Table 4. New Centroid Value

C1	1238	5958	10188	15471	12775	13448	5466	1071	4081
C2	433	1027	2513	2685	1015	2435	695	5	593
C3	260	157	343	191	245	250	153	149	129
C4	0	0	0	0	0	0	804	477	0
C5	2,76190476	7,476190	10,4761	7,61904761	12,23809	23,19047	4,523809	2,476190	3,857142
	6	5	9	9	5	6	5	5	9

Calculating 2nd Iteration with new centroid

The next step is to calculate the closest distance again based on the new centroid, following the results of the calculation using the new centroid:

Table 5. Iteration 2

C1	C2	C3	C4	C5	JARAK TERDEKAT
27770,25634	4738,160614	645,5493784	935,0122994	25,11324953	25,11324953
0	23302,33716	27219,38594	27621,88558	27754,97922	0
27517,49331	4513,356955	463,5590577	927,9326484	254,0414323	254,0414323
27702,83744	4674,462643	578,3260326	912,566162	61,29253871	61,29253871
27782,70658	4749,30437	656,2438571	934,8507902	30,24819502	30,24819502

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27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494
27781,42259	4748,711825	649,7661118	921,8579066	38,27732099	38,27732099
23302,33716	0	4196,747074	4723,597781	4722,471955	0
27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494
27736,51883	4699,724886	622,6090266	939,0228964	66,81810609	66,81810609
27779,14587	4746,714443	653,4783853	934,0042826	26,94444844	26,94444844
27779,43167	4745,876842	653,488332	934,8598825	27,24586761	27,24586761
27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494
27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494
27621,88558	4723,597781	957,5646192	0	930,198171	0
27219,38594	4196,747074	0	957,5646192	630,4964055	0
27729,12449	4687,154361	599,5248118	938,8322534	71,79638781	71,79638781
27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494
27779,97777	4746,596254	653,1998163	934,9705878	31,0008597	31,0008597
27782,83528	4749,094335	653,4975134	934,8844848	31,30720847	31,30720847
27780,56173	4747,133767	653,9059565	934,8641613	29,60617	29,60617
27683,02131	4652,672995	583,8698485	934,2333756	148,3094781	148,3094781
27774,12512	4738,23121	643,6342129	934,1814599	28,06893838	28,06893838
27776,65014	4741,319648	647,3453483	934,0888609	27,88761915	27,88761915
27783,1906	4749,816944	656,6239411	934,8502554	30,98924494	30,98924494

Based on the data in iteration 1, the results of clustering are as follows:

Table 6. Result of iteration 2 clustering

Cluster	Data
C1	1
C2	1
C3	1
C4	1
C5	21

Based on the results of clustering from tables 4 and 6 there is no change and the process ends until the second iteration.

Calculation using rapidminer 9.1

Rapidminer 9.1 is then used for clustering to describe the results and visualize the data. The process begins by entering the data set and selecting the K-means algorithm on the rapidminer operator, the following is the process:

Figure 2. Rapidminer Clustering Process

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The screenshot shows the RapidMiner Studio interface. At the top, the title bar reads "<new process> - RapidMiner Studio Trial 9.10.001 @ DESKTOP-QIGVLMQ". Below the title bar is a menu bar with options: File, Edit, Process, View, Connections, Settings, Extensions, and Help. A toolbar contains icons for file operations (New, Open, Save, Print) and execution (Run, Stop). The main workspace is titled "Cluster Model (Clustering)". On the left sidebar, the "Description" tab is selected, showing the following output:

```

Cluster 0: 21 items
Cluster 1: 1 item
Cluster 2: 1 item
Cluster 3: 1 item
Cluster 4: 1 item
Total number of items: 25

```

The top right of the workspace has tabs for "Design", "Results" (which is active), "Turbo Prep", "Auto Model", and "Deployments".

Figure 4. Visualisation Result

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DISCUSSIONS

In this study, the K-means algorithm is used to classify categories of foreign tourist visits based on air, sea and land arrivals. This study was conducted to find out which entry gates have the highest to lowest foreign tourist arrivals during the COVID-19 pandemic in the 3rd quarter of 2021. In the clustering process, the existing datasets are grouped into 5 clusters with the provisions of C1 with a very high category, namely the incoming arrivals category, C2 high category, C3 medium, C4 low and C5 very low. The clustering process in the K-means algorithm has a weakness, namely determining the initial center of the cluster or centroid. The result of the cluster formed from the k-means algorithm is very dependent on the initial value of the specified cluster center, this makes it very difficult to get a unique initial centroid result. (Hablum, Khairan, & Rosihan, 2019).

CONCLUSION

Based on the results of this study, it can be concluded that in the research conducted using the datamining method and the K-Means Algorithm to perform clustering using a manual process and reinforced using rapidminer 9.1 to describe the data in more detail and of course to visualize the data. The results obtained in the clustering process in forming 5 clusters by grouping the data on foreign tourist visits based on the entrance, the group of tourist entrances is categorized as very high (C1) with 1 data, high (C2) with 1 data, moderate (C3) with 1 data, low (C4) with 1 data and very low (C5) with 21 data. The results of this study aim to provide an overview of the number of foreign tourist visits based on entrances in the 3rd quarter of 2021 so that it can be compared with the previous year's data whether there was an increase or decrease as a result of the Covid-19 pandemic. Furthermore, this research provides suggestions and future considerations to the Ministry of Tourism and Creative Economy of the Republic of Indonesia (Kemenparekraf) to be able to make decisions based on the results of this study to establish specific policies to restore the tourism sector.

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