

## Data Mining on Women's Clothing Sales in Market Places with the K-Means Clustering Algorithm

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### ABSTRACT

Clothing is a necessity that must be used to cover the body with the main material made of fiber or textile so that the body is completely covered without gaps. Marketplace is an application or website that provides online buying and selling facilities from various sources. On the Shopee marketplace, there are many shops selling women's clothing from various groups and types of clothing. The K-Means Clustering algorithm in the research was applied to make it easier for sellers and buyers to find out what kind of women's clothing is currently selling well in the marketplace by grouping it into 3 clusters, namely the best-selling, best-selling, and least-selling. Research data was obtained from the Shopee marketplace with 3 variables, namely product price, number of sales, and buyer assessments of 4 types of women's clothing in the form of tunics, dresses, abayas/gamis, and shirts totaling 1200 data. The results of this research make it easier for buyers to make decisions and sellers to develop shop ideas.

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## 1. INTRODUCTION

In the current era of technology, people use technology to simplify various tasks, one of which is utilizing the internet for conducting transactions without leaving their homes. marketplace is a location where vendors and buyers can conduct transactions for goods or services [1]. It is an electronic product marketing platform that brings together many sellers and buyers to transact with each other [2]. Selling Muslim fashion online allows sellers to market, promote, and transact with customers without meeting face-to-face or being limited by time constraints. It can be done without having a physical shop [3]. Consumers prefer online shopping because it is practical, modern, and can be done at any time without the hassle of leaving the house to get the desired goods [4].

One marketplace that sells clothes is Shopee. The advantage of this marketplace is its easy payment access, which appeals to consumers, especially housewives [5]. Additionally, through its programs, campaigns, and promotions, Shopee has succeeded in ranking among the top five e-commerce sites with the highest number of visitors. the online marketplace became the online shopping platform with the highest number of transactions worldwide [6]. As a result, people have started to take advantage of this opportunity by setting up shops selling various types of women's clothing. The optimum thermal insulation of the clothing should be selected on the basis both of the expected conditions in the thermal environment where it is to be used and of the level of the worker's physical activity [7]. However, this marketplace lacks an algorithm to determine the best-selling clothes, particularly for women's clothing. By implementing such an algorithm, buyers can receive recommendations from trusted stores and stay updated with the best-selling women's clothing. This feature benefits not only buyers but also sellers who want to open a shop on the platform. Sellers can understand consumer preferences, identify effective marketing strategies, make informed decisions, and keep up with changing trends for their shop's benefit. Some sellers waste money by continuously buying products that suit

trends but do not adapt themselves. The fashion system, based on an ephemeral notion of style, encourages consumers to value the new and to pursue changes in personal style via the discard of useable garments in favour of the latest fashion [8].

The use of data mining supports every businessman in making quick and accurate decisions. Data mining is a process that employs artificial intelligence, statistical techniques, mathematics, and machine learning to identify and extract useful information and related knowledge from large databases [9]. It involves exploring added value in the form of information produced by extracting and recognizing patterns contained in databases [10]. According to the Gartner Group in Larose, data mining is a process of finding meaningful relationships, patterns, and trends by examining large sets of data stored in storage using pattern recognition techniques such as statistical and mathematical techniques [11]. Analyzing consumer purchasing trends to determine sales patterns, and processing them correctly can help identify which products are the best sellers, best sellers, or slowest sellers. This aids in inventory management and provides valuable input for businesses when formulating their marketing strategies [12]. Data mining is suitable for addressing this problem, as it is useful for extracting data about sales and best-selling women's clothing on the Shopee marketplace. This data mining can be assisted by programming languages to determine the results.

Data mining is defined as a set of rules, processes, and algorithms designed to generate actionable insights, extract patterns, and identify relationships from large data sets [13]. For this problem, the K-Means Clustering algorithm is particularly suitable. K-Means clustering is a data mining technique that provides a cluster description of a product. It can also be interpreted as a data segmentation method applied in several fields, including marketing, business problem analysis, market segmentation and predictions, computer vision patterns, regional zoning, object identification, and image processing [14]. The K-Means clustering method aims to group existing data into several clusters, where data within a cluster share similar characteristics and differ from data in other clusters. Clustering is a classic research problem with applications in many fields, in particular where huge amounts of data are available [15]. The goal of this grouping is to minimize the objective function set in the clustering process [16]. The K-Means algorithm is a distance-based, non-hierarchical clustering method that divides data into clusters and works on numeric attributes [17]. Similar objects are placed in adjacent clusters, while dissimilar objects are placed in separate clusters. When the clustering analysis is conducted using the similarity ratio, the case projects are provided in categories [18]. This K-Means Clustering method can be used to group best-selling women's clothing, analyzed using data obtained from the Shopee marketplace.

This research is very necessary for buyers and sellers in a marketplace in making decisions and developing shop ideas for a product. For example in this research in terms of women's clothing which is very many types. This can confuse buyers to find the right choice and sellers who want to increase or decrease the stock of several types of women's clothing in their shop.

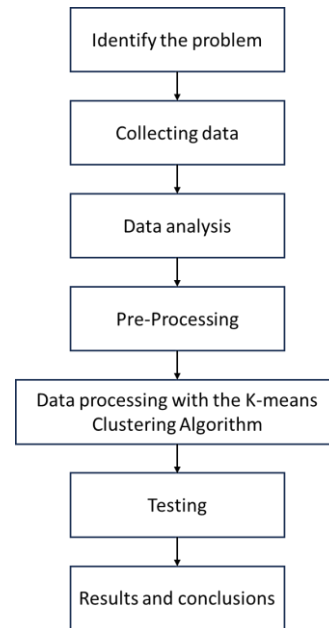
Based on previous research conducted by Normah & et al (2019) on the sale of hijab shops, the Application of Data Mining K-Means Clustering Method is very helpful for stores to develop their sales strategies. Previous research also conducted by Haditsah (2019), in his case he examined the sales strategy of car variations. The research was conducted by grouping the sold product data to find out the data that has the potential or tendency of customers to buy these items. The results of this study can be used to provide suggestions for consideration in determining sales strategies. The research conducted here uses a large and more recent dataset according to the time period with the data source coming from online sales in the marketplace. Unlike previous research, this research may also be able to provide product recommendations to customers based on clustering results.

## 2. RESEARCH METHOD

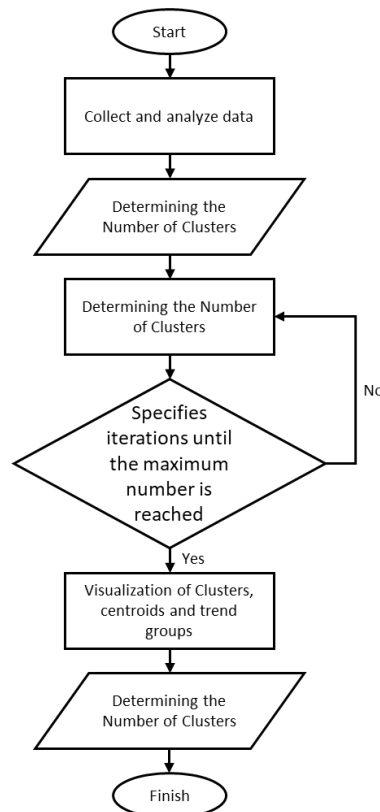
The method used in this research is quantitative, where this research begins with the data collected consisting of variables that measure numbers or numbers to the processed data and its output. In this research, data mining analysis was carried out using a programming language for business strategy and decision-making at the Shopee Market Place in determining the best sellers from women's clothing sales data. The following is the research framework shown at figure 1.

This research starts with identifying the problems, where researchers must find what problems can be solved in the study. Then collecting data, in this study the data collected is sales data for women's clothing on Shopee which amounts to 1200 data from 4 types of women's clothing. After collecting the data, then analyze the data. In this data analysis step, it is useful to explore the data which aims to see whether there is empty or double data. The next step is pre-processing, where in this step data transformation, data selection or cleaning is carried out so that unused data can be removed and according to their needs only. After pre-processing, enter the data processing stage with the K-Means clustering algorithm (figure 2). where at this stage it is carried out in accordance with the algorithm steps such as determining the number of clusters, finding the centroid point then determining the iteration to the limit and so on. The next step is testing, in this process testing is carried

out by utilizing the python programming language, namely google colab to make visualization of the data, after which the results of data visualization are obtained and researchers can make conclusions based on these results.



**Figure 1.** Research Framework



**Figure 2.** Flowchart of the stages of the K-Means Clustering algorithm

To help buyers and sellers in marketplace shops with data mining using the K-Means clustering algorithm, the author wants to create data visualizations so that buyers or sellers can more easily determine the best-selling women's clothing to help make decisions and develop shop ideas. This research collected 1200

shopee women's clothing sales data with 4 categories, namely tunics, dresses, abayas/gamis, and shirts. The design in the form of a flowchart can be seen in the Figure 2.

In the flow chart above, it is shown that the stages start with data collection. This data collection was carried out using a web scraper, obtaining data on 1200 sales data for women's clothing on the Shopee marketplace. The collected data is exported in Excel (.xlsx) or CSV (.csv) format. The following is an example of the data collected at table 1.

**Table 1.** Example of collected data

No	Product name	Price	Sale	Rating
1	ATASAN WANITA TUNIK OVAL BAHAN CRINGKLE AIRFLOW PREMIUM//TUNIK OVERSIZE	Rp 36.500	4.800	04.08
2	MIDI DRESS MOTIF BUNGA SOKA BALI	Rp 36.000	10.000	04.08
3	gamis simer silky mdl lengan gantung	Rp 72.000	3.700	04.05
1200	Kemeja Wanita Premium Kerut Depan Oversize UNGGUL FASHION	Rp 44.999	8.800	04.04

After the data is collected, the number of clusters is determined. In this problem, researchers grouped 3 clusters, namely less popular, best selling, and best selling with the attributes of price, sales, and valuation. Then initialize the centroids randomly. In this section the researcher takes some data randomly to determine the initial centroid using the Euclidean Distance formula as equation 1 [19]:

$$d(xi, \mu_j) = \sqrt{\sum (xi, \mu_j)^2} \quad (1)$$

Where:

$xi$  = criteria data

$\mu_j$  = centroid of cluster js

After determining the initial centroid, the researcher then proceeds with iterations to determine which cluster the data belongs to. For example, the groupings of least-selling, best-selling, and most popular items are marked with C1, C2, and C3, respectively. After the iterations reach the maximum number, the researcher creates a visualization of the data using the Python programming language with Google Colab. In this research, the necessary libraries include Keras, TensorFlow, NumPy, Pandas, and other supporting libraries, such as Matplotlib for creating graphs. With the guarantee of stable server capabilities, almost all processing runs smoothly on Google Colab as long as the internet connection is stable [20]. The data visualization, in the form of graphs, facilitates comparisons to help make decisions regarding the problem. Additionally, the interpretation of grouping results and conclusions from the clustering modeling will be discussed.

### 3. RESULTS AND ANALYSIS

#### 3.1. Data Analysis

This data analysis stage includes the results of data collection and exploration. Data collection was carried out using a web scraper by creating keywords representing four types of women's clothing: Tunics, Dresses, Abayas/Gamis, and Shirts in the product search feature on Shopee. For each type of clothing, 300 pieces of data were sequentially collected and then combined into an MS Excel file. For example, data entries 1-300 represent sales of Tunic-type clothing, while entries 301-600 represent sales of Dress-type clothing, continuing this pattern until the total data reached 1200 entries, encompassing women's clothing sales from various stores.

Data exploration was conducted to analyze the collected data, aiming to identify and remove any duplicate or empty entries. The data used in this research was obtained from the Shopee marketplace, consisting of sales data for women's clothing. The dataset included 1200 entries, with a sample of 20 entries manually examined by researchers for the analysis.

#### 3.2. Pre-Processing

When using the K-Means algorithm, the initial process that must be carried out by the Clustering method is the formation of clusters by transforming data into numerical form in the form of integers based on the initial data that has been collected. This aims to make it easier for researchers to get more accurate results. After that, the researcher can determine the number of clusters, calculate the centroid, calculate the centroid distance of the moving object or group, and then the calculation to find the iteration value is complete. In this method, the first step in determining a group or cluster of an object is to measure the Euclidean distance

between two object points from the transformed attribute. The following are the provisions made for data transformation.

**Table 2.** Women's Clothing Sales Transformation Data

No	PN	PP	TS	BR
1	P1	38000	10000	46
2	P2	92490	2200	48
3	P3	36500	4800	48
4	P4	78500	1400	49
5	P5	37900	2100	46
6	P6	62000	10000	49
7	P7	11500	10000	48
8	P8	129900	10000	49
9	P9	42900	5100	46
10	P10	62900	10000	47
11	P11	31900	9000	46
12	P12	29250	6000	47
13	P13	24900	10000	46
14	P14	57000	10000	46
15	P15	89000	10000	49
16	P16	24999	10000	47
17	P17	61999	2300	48
18	P18	49800	2300	48
19	P19	88000	10000	48
20	P20	44999	10000	47

PN = Product Name  
 PP = Product Price  
 TS = Total Sales  
 BR = Buyers Rating

Example:  
 The product price is IDR 38,000 = 38000  
 Buyer Valuation is  $04.06 = 46$

### 3.3. Data processing with the K-Means Clustering Algorithm

After the data has been successfully transformed, clusters are formed into three groups ( $K=3$ ) and the centroid center point is determined. The following is the clustering calculation process below.

$K = 3$  centroid  
 $C1 = (38000, 10000.46)$  taken from data 1  
 $C2 = (92490, 2200.48)$  taken from data 2  
 $C3 = (36500, 4800.48)$  taken from data 3

After determining the centroid point, then an iterative search is carried out to the maximum limit. The table below shows the results of the 1st iteration search that the researcher has carried out according to the formula.

**Table 3.** Results from Iteration 1 calculations

No	PN	PP	TS	BR	C1	C2	C3	Cluster
1	P1	38000	10000	46	0	55045,44	5412,02	1
2	P2	92490	2200	48	55045,44	0	56050,34	2
3	P3	36500	4800	48	5412,02	56050,33	0	3
4	P4	78500	1400	49	41403,02	14012,85	42137,39	2
5	P5	37900	2100	46	7900,633	54590,09	3041,382	3
6	P6	62000	10000	49	24000	31471,89	26024,8	1
7	P7	11500	10000	48	26500	81364,73	25535,07	3
8	P8	129900	10000	49	91900	38214,5	93544,64	2
9	P9	42900	5100	46	43202,11	49674,72	6407,028	3
10	P10	62900	10000	47	24900	30600,79	26907,25	1
11	P11	31900	9000	46	33145,32	60970,39	6228,965	3
12	P12	29250	6000	47	9620,941	63354,07	7348,639	3
13	P13	24900	10000	46	68038,58	68038,58	12712,2	3
14	P14	57000	10000	46	19000	36337,03	21149,23	1
15	P15	89000	10000	49	51000	8545,18	52756,9	2
16	P16	24999	10000	47	13001	67940,23	12621,93	3
17	P17	61999	2300	48	62041,67	30491,16	25621,26	3
18	P18	49800	2300	48	14090,07	42690,12	13532,92	3
19	P19	88000	10000	48	50000	9000,006	51761,86	2
20	P20	44999	10000	47	0	55045,44	5412,024	1

### 3.4. Testing

#### 3.4.1. K-Means Clustering Visualization

Data import was carried out using the Python programming language using Google Colab. This initial step is important in the K-Means Clustering visualization process. To import data, you can upload data to the Google Colab directory. After that, make sure the file has been uploaded to the Google Colab directory. Then make sure Pandas is installed so we can display the data on the Google Colab worksheet. In this research, researchers used the format (.xlsx) as a dataset.

This transformation stage is a process that is also important to carry out when visualizing K-Means Clustering, where this stage is related to data analysis to change, adjust, or analyze so that it can meet the requirements for K-Means Clustering. Data is identified by deleting empty rows or columns and then taking the form of integer numbers. The results of the transformations carried out in the program can be illustrated in the table below.

**Table 5.** Transformation results with the program

Product Name	Price Product	Total Sale	Buyers Rating
P1	38000	10000	46
P2	92490	2200	48
P3	36500	4800	48
P4	78500	1400	49

The data selection stage involves analyzing the data to identify and select a subset that is relevant and suitable for the intended analysis. Researchers must choose which attributes are directly related to the grouping objectives. In this study, the researchers deleted the Product Name column because this attribute was not needed. The attributes produced after selection in the program can be illustrated as in the following table 6.

**Table 6.** Data selection with the program

Price Product	Total Sale	Buyers Rating
38000	10000	46
92490	2200	48
36500	4800	48
78500	1400	49

At this stage, it was carried out on Google Colab with the Python programming language. This clustering process is carried out by starting with determining the number of clusters. If successful, then the program results look like the following.

Kmeans(n\_clusters = 3)

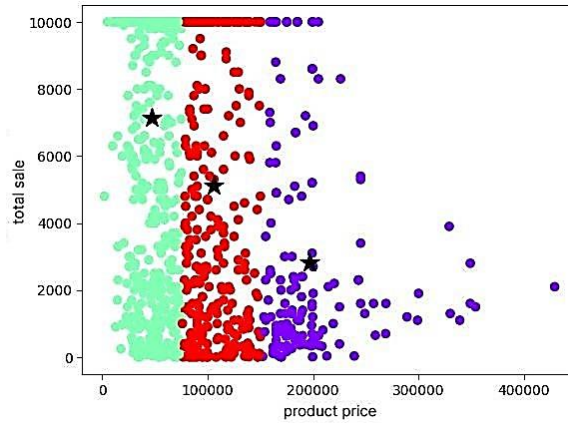
Next, we can see on the label that the grouping has been carried out marked with numbers (0, 1, 2) with the initial centroid point randomly determined as follows. The dataset that has been successfully downloaded from Google Colab is the result of data that has been grouped based on clusters. The data set consists of 1200 rows of data. The data format can be seen in Table 7.

**Table 7.** Cluster results dataset on the downloaded program

Product Name	Price Product	Total Sale	Buyers Rating	Cluster
P1	38000	10000	46	0
P2	92490	2200	48	1
P3	36500	4800	48	0
P4	78500	1400	49	1
P5	37900	2100	46	0
P1200	259000	652	49	2

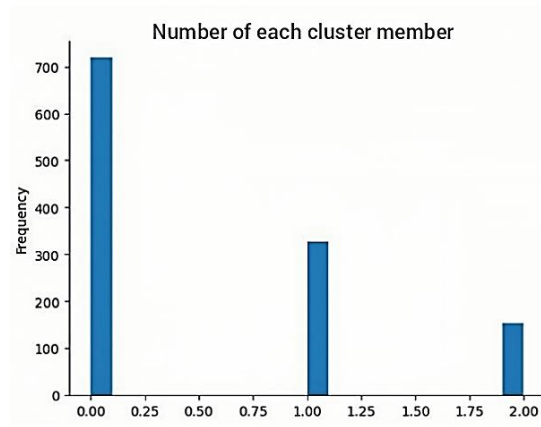
After that, the researcher visualized the data that had been determined by searching for clusters and centroids into a graph marked with a round 'rainbow' color and black centroids with a star shape. The following are the results of Clustering where the centroid center point has been determined show as figure 3.

On the program, the results of determining the final centroid point are in cluster 0 (4.6531, 7.1391, 4.6447), in cluster 1 (1.0536, 5.1166, 4.6875) and cluster 2 (1.9691, 2.8114, 4.8418) from the three variables, namely product price, number of sales and buyer ratings. then to determine the amount of data for each cluster is cluster 0 has 719 data, cluster 1 has 328 data, and cluster 2 has 153 data from 4 types of women's clothing, namely tunics, dresses, abaya/gamis, and shirts.



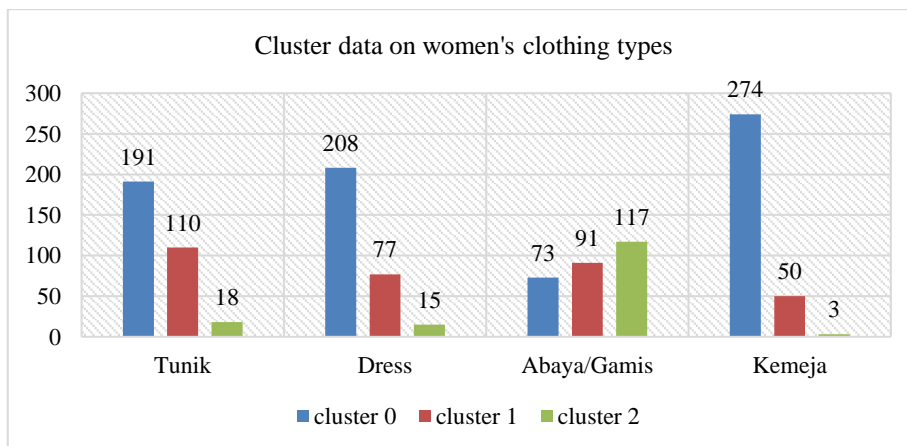
**Figure 3.** K-Means Clustering Visualization Results

These results were obtained from calling the final centroid point program and the number of clusters in the Python programming language using Google Collab. For a clearer explanation, you can see the graph of the results of the cluster grouping program as figure 4.



**Figure 4.** Cluster diagram

The diagrams were created using MS Excel with data obtained from downloading previous data for grouping by type of women's clothing according to the cluster as figure 5.



**Figure 5.** Cluster diagram of women's clothing types

After carrying out calculations using Google Collab with the Python programming language, the calculation results are as follows:

- 1) Cluster 0 with centroid 4.64315, 7.13912, 4.64478 (there are 719 data, consisting of 191 Tunic data, 208 Dress data, 73 Abaya/Gamis data, and 274 Shirt data) it can be decided that Cluster 1 is the best-selling group with the number of sales in an average of 7000 products with a price of around > Rp 80.000.
- 2) Cluster 1 with centroid 1.05360, 5.11664, 4.6875 (there are 328 data, consisting of 110 Tunic data, 77 Dress data, 91 Abaya/Gamis data, and 50 Shirt data) it can be decided that Cluster 2 is the best-selling group with average sales. -an average of 50,000 products with a price of around Rp 80.000 - Rp 150.000.
- 3) Cluster 2 with centroid 1.96913, 2.81147, 4.84183 (there are 153 data, consisting of 18 Tunic data, 15 Dress data, 117 Abaya/Gamis data, and 3 Shirt data) it can be decided that Cluster 0 is the least popular group with the number of sales in an average of 3000 products with a price of around > Rp 150.000.

#### 4. CONCLUSION

The conclusions that can be drawn from the application of the K-Means Clustering algorithm for women's clothing sales data in the marketplace on Shopee can be described as follows. Based on calculations carried out by researchers using the K-Means Clustering algorithm, the characteristics of each group of women's clothing sales data can be identified. Cluster 0 is the best-selling group with the most found women's clothing being shirts. Cluster 1 is the best-selling group with the most commonly found women's clothing being tunics. Cluster 2 is the least selling group with the most common type of women's clothing found is Abaya/Gamis.

The K-Means Clustering algorithm is a centroid-based algorithm or distance-based algorithm, where we calculate the distance to assign a point to a cluster. This research aims to group data on sales of the best-selling women's clothing in the marketplace based on clusters with 3 attributes, namely product price, number of sales, and buyer assessment. The clustering results of several attributes provide information about the characteristics of each group in the women's clothing sales data in that marketplace. Data visualization is the process of using visual elements such as diagrams, graphs, or maps to represent data. In this research, visualization of clustering data on sales of the best-selling women's clothing in this marketplace uses the K-Means algorithm by utilizing Google Collab, carrying out several steps, namely, data preparation, data transformation, data selection, determining centroid and clustering, creating graphs of clustering results and displaying points. Final centroid and number of members of each cluster.

The application of the K-Means Clustering algorithm carried out by this researcher can provide benefits in grouping women's clothing sales data, helping sellers and buyers identify women's clothing that will be of interest and For further research development, it is recommended that it be developed into an application that is useful for online shopping enthusiasts and sellers.

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