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ANALYSIS OF THE SALES POTENTIAL OF BUMDES PRODUCTS USING THE K-MEANS CLUSTERING ALGORITHM

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ABSTRACT

This research aims to measure the strategy and potential of Village-Owned Enterprises (BUMDes) in Tandam Hulu II Village using Business Intelligence (BI) Tools supported by the K-Means Clustering method. BI Tools is used to analyze the performance and potential of BUMDes, while K-Means Clustering groups community data based on economic, social, and demographic characteristics. The results of the study show that BI Tools helps BUMDes accurately map the economic potential of villages and develop appropriate development strategies. Clustering analysis allows the identification of community groups with similar characteristics, so that BUMDes programs can be tailored to the specific needs of each cluster. This implementation also improves operational efficiency by focusing resources on high-potential sectors. In conclusion, the implementation of BI Tools and K-Means Clustering supports data-based decision-making in BUMDes, maximizes the economic potential of villages, and encourages sustainable economic growth.

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1. INTRODUCTION

Village-Owned Enterprises (BUMDes) is an institution established based on Law No. 6 of 2014 concerning Villages, aiming to manage and develop village economic enterprises to improve community welfare. BUMDes play a strategic role in empowering the village economy, increasing income, and providing better public services. However, many BUMDes, including BUMDes Adil Sejahtera in Tandam Hulu II Village, have not been optimal in managing their strategies and potential, so they have not been able to make a significant contribution to the

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Village Original Income (PAD). In the era of information technology, Business Intelligence (BI) is an important tool to optimize data-driven decision-making. BI can help BUMDes identify opportunities, evaluate performance, and design effective strategies. The implementation of BI in BUMDes Adil Sejahtera is expected to improve the management of financial, marketing, and operational data, so that it has a positive impact on the village economy. This research focuses on analyzing the sales potential of BUMDes Adil Sejahtera products using the K-Means Clustering algorithm with Visual Studio technology. The goal is to measure the strategy and potential of BUMDes so that they can develop and make a real contribution to the welfare of the people of Tandam Hulu II Village. By utilizing data and information effectively, BUMDes are expected to be more competitive, innovative, and adaptive to market changes and community needs.

2. RESEARCH METHOD

2.1. *Dataset*

The variables used in this study are derived from 8 variables that can be seen in table 1 which determine the results of K-Means Clustering of High Buyer Areas of Female Goats and Male Goats.

Tabel 1. Independent Variable (Input Feature)

VARIABEL				
NO	**VARIABEL**	**KODE VARIABEL**	**ALTERNATIVE**	**RANGE**
1	BERAT KAMBING BETINA	BERAT	KURUS	<35
			GEMUK	36-45
2	BERAT KAMBING JANTAN	BERAT	KURUS	>35
			GEMUK	<36
3	JUMLAH JANTAN	JTN	SEDIKIT	<10
			SEDANG	11-20
			BANYAK	21-30
4	JUMLAH BETINA	BTN	SEDIKIT	<7
			SEDANG	8-13
			BANYAK	>13
5	HARGA KAMBING BETINA	HARGA	MURAH	<1JT
			SEDANG	1JT-2JT
			MAHAL	>2JT
6	HARGA KAMBING JANTAN	HARGA	MURAH	<1JT
			SEDANG	1JT-2,5JT
			MAHAL	>2,5JT
7	DAERAH PEMBELI KECAMATAN	**KEC**	AEK KANOPAN	1
			BAHOROK	2
			BALE ATU	3
			BEBESEN	4
			BESITANG	5
			BINJAI	6
			BINJAI SELETAN	7
			BINJAI TIMUR	8

E-ISSN 2962-4274

			BINJAI UTARA	9
			BUKIT LAWANG	10
			GUNUNG SITOLI	11
			HAMPARAN PERAK	12
			HINAI	13
			JEUMPA	14
			KABANJAHE	15
			KEJURUAN MUDA	16
			KISARAN	17
			KUALA	18
			KUALA SIMPANG	19
			KWALA BEGUMIT	20
			KUTAMBARU	21
			LABUHAN DELI	22
			LANGSA BARU	23
			LANGSA LAMA	24
			LHOKSUKO	25
			LUBUK PAKAM	26
			LUT TAWAR	27
			MAKMUR	28
			MEDAN	29
			MEDAN AMPLAS	30
			MEDAN BARU	31
			MEDAN DELI	32
			MEDAN HELVETIA	33
			MEDAN KOTA	34
			MEDAN LABUHAN	35
			MEDAN MAIMUN	36
			MEDAN MARELAN	37
			MEDAN PETISAH	38
			MEDAN POLONIA	39
			MEDAN SUNGGAL	40
			MEDAN TIMUR	41
			MEDAN TUNTUNGAN	42
			PAMATANG SIANTAR	43
			PANCUR BATU	44
			PANGURURAN	45
			PATUMBAK	46
			PELABUHANRATU	47
			PERCUT SEI TUAN	48
			RANTAU PERAPAT	49
			SAWIT SEBERANG	50

E-ISSN 2962-4274

			SECANGGANG	51
			SEI LEPAN	52
			SEI RAMPAH	53
			SEKERAK	54
			SELESAI	55
			SIBOLGA	56
			SIBOLGA SAMBAS	57
			SIDIKALANG	58
			STABAT	59
			SUNGGAL	60
			TANAH JAMBO AYE	61
			TANAH MERAH	62
			TARUTUNG	63
			TEBING TINGGI	64
			TJ. PURA	65
			TJ.BERINGIN	66
			TJ.MORAWA	67
			TJ.PURA	68
			WAMPU	69
8	DAERA PEMBELI KABUPATEN	KAB	ACEH TAMIANG	1
			ACEH TENGAH	2
			ACEH UTARA	3
			BINJAI	4
			BIREUEN	5
			DAIRI	6
			DELI SERDANG	7
			GUNUNGSITOLI	8
			KABANJAHE	9
			KARO	10
			KISARAN	11
			LABUHANBATU UTARA	12
			LANGKAT	13
			LANGKAT	14
			LANGSA	15
			LUBUK PAKAM	16
			MEDAN	17
			NIAS	18
			PAMATANG SIANTAR	19
			RANTAU PERAPAT	20
			SAMOSIR	21
			SERDANG BEDAGAI	22
			SIBOLGA	23
			STABAT	24
			SUKABUMI	25

E-ISSN 2962-4274

			TAPANULI UTARA	26
			TEBING TINGGI	27
9	NAMA PEMBELI	NAMA		

2.2. Clustering

Clustering is one of the techniques in data mining that aims to group data into groups that have similarities based on certain characteristics. This technique looks for structure in the data without the need for predefined class labels. Using various methods such as K-Means, HierarchicalClustering, or DBSCAN, clustering allows for the grouping of similar data based on specific attributes or features, allowing further analysis of these groups to uncover hidden patterns or significant relationships between the data. (Hendrastuty, N. (2024))

Clustering is a method of data analysis, which is often included as one of the data mining methods, which aims to group data with the same characteristics into the same 'region' and data with different characteristics of other 'regions'. (Della Tri Cahaya. 2024)

2.3. K-Means

K-Means Clustering is one of the most commonly used clustering techniques in data analysis. This algorithm works by dividing the data into predetermined groups K, where K is the desired number of groups. The process starts by randomly selecting K centroids in the data space, then grouping each data point into a group that has the nearest centroid. (Hendrastuty, N. (2024))

K-Mean is a method used to group data into several parts, where the K-Means method which is distance-based which divides data into several clusters which can only work on numeric attributes, K-Means can be classified as partitioning clustering which separates data into k different parts. (Della Tri Cahaya. 2024)

To determine the number of clusters is done with several considerations such as theoretical and conceptual considerations that may be proposed to determine how many clusters. This study will use the elbow criterion method where this method is very practical to select the number of clusters k to be used for data grouping in the K-Means algorithm. (Madhulatha, 2012). This elbow method can be produced from comparing the SSE (Sum of Squared Erorr) results with the SSE formula as below (Irwanto, et. al, 2012):

$$SSE = \sum_{K=1\ xi\ eSk} \sum \|Xi - Ck\|2$$

Where it states that the norm of euclid (L2) and Ck is the center of the Sk cluster

which is calculated based on the average distance of the cluster points to the center of the

cluster.

$$v = \frac{\sum_{i-1}^{n} x_i}{n} \quad ;i = 1,2,3,\ldots n$$

E-ISSN 2962-4274

Dimana; v : centroid pada cluster

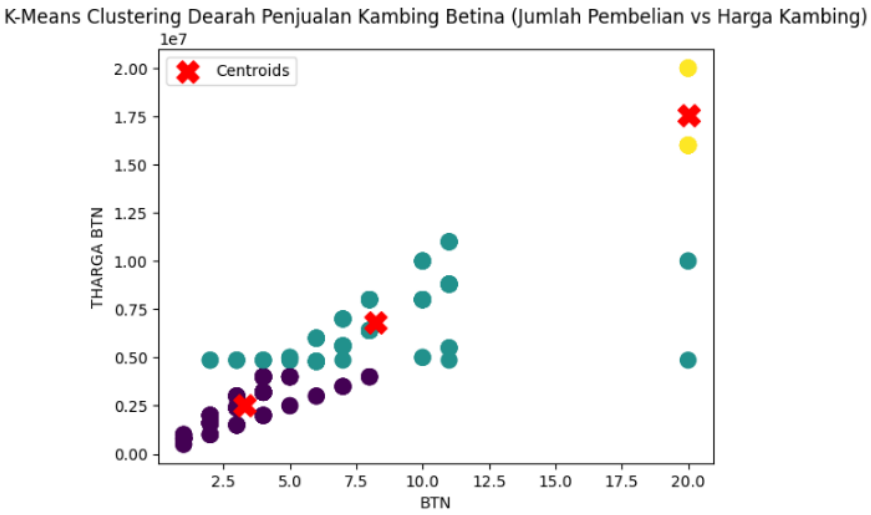
Xi : objek ke-i

n : Banyaknya Objek/jumlah objek yang menjadi anggota *cluster* Hitung jarak setiap objek ke masing-masing centroid

$$d(x,y) = \|x-y\| = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \quad ;i = 1,2,3,\ldots,n$$

3. RESULTS AND DISCUSSIONS

K-Means Clustering Chart of Female Goat Sales Area



Description of the K-Means Clustering Graph of the Female Goat Sales Area above
- Cluster 0 : Purple Color : Areas With Little Female Goat Sales
- Cluster 1 : Green Color : Areas With Moderate Sales Of Female Goats
- Cluster 2 : Yellow Color : An Area With A Lot Of Female Goat Sales
- Centroids : Cross X red : Center of the Cluster

From the cluster table above, the division of regions based on clustering from the variables Number of Female Goats and Total Price of Female Goats is obtained, namely:

Cluster 0 : 53 Daerah
Cluster 1 : 38 Daerah
Cluster 2 : 13 Daerah

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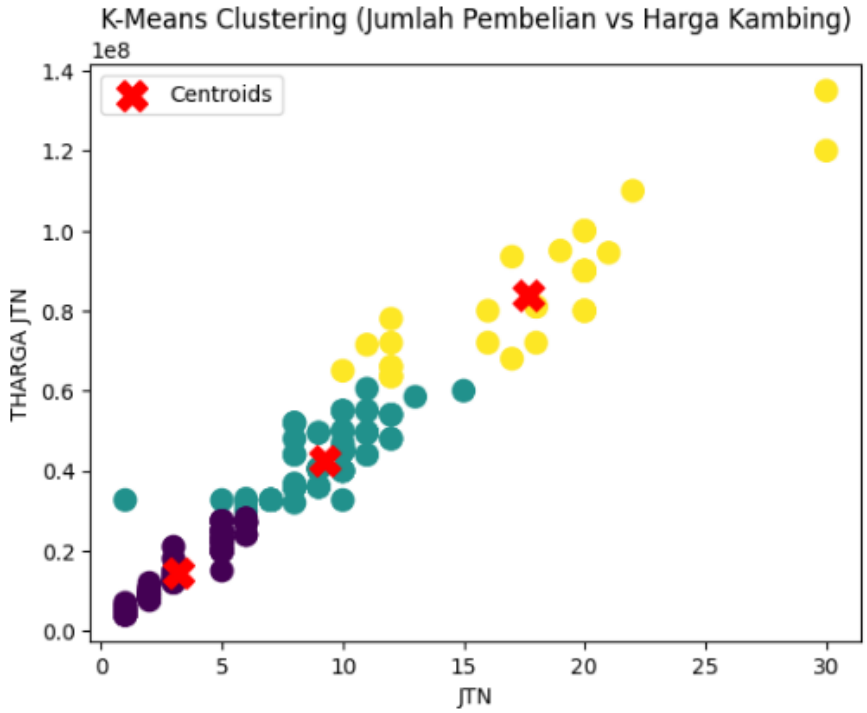
Dari cluster 0, cluster 1 dan cluster 2 didapat 3 daerah yang potensinya tinggi untuk penjualan kambing betina yaitu

1. Hamparan Perak Nilai 9
2. Secanggang Nilai 13
3. Stabat Nilai 30

As such, these visualizations provide a clear picture of market segmentation based on purchase volume and price, which can be used for more effective business decision-making.

Gambar 2 K-Means Clustering Chart of Male Goat Sales Areas



Description of the K-Means Clustering Graph of the Male Goat Sales Area above

- Cluster 0 : Purple Color : Areas With Little Male Goat Sales
- Cluster 1 : Green Color : Areas With Moderate Sales Of Male Goats
- Cluster 2 : Yellow Color : An Area With A Lot Of Male Goat Sales
- Centroids : Cross X red : Center of the Cluster

From the cluster table above, the division of regions based on clustering of the variables Number of Male Goats and Total Price of Male Goats is obtained, namely:

Cluster 0 : 53 Daerah
Cluster 1 : 37 Daerah
Cluster 2 : 13 Daerah

From cluster 0, cluster 1 and cluster 2, 3 areas with high potential for female goat sales were obtained, namelyHamparan Perak Nilai 9,8,1

1. Secanggang Nilai 13,8,1
2. Stabat Nilai 30,22,1

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As such, these visualizations provide a clear picture of market segmentation based on purchase volume and price, which can be used for more effective business decision-making.

4. CONCLUSION

The application of K-Means Clustering in Business Intelligence (BI) allows accurate mapping and segmentation of villages based on economic, social, and demographic data. In Tandam Hulu II Village, this method helps BUMDes group data to understand community patterns and identify economic potentials such as agriculture, fisheries, trade, and services. The results of clustering also make it easier for BUMDes to formulate targeted development strategies, such as micro business development, funding, or skills training according to the needs of community groups. To optimize the application of the K-Means Clustering method and Business Intelligence tools, BUMDes need to:**Meningkatkan Kapasitas Tim**: Melalui pelatihan intensif dalam analisis data, pemahaman metode clustering, dan penggunaan teknologi.

1. **Collect Comprehensive Data**: Ensure data covers economic, demographic, and social aspects that are complete and accurate for effective analysis results.
2. **Conduct Periodic Evaluations**: Monitoring and evaluating clusters regularly to remain relevant to village dynamics, so that development strategies can be adjusted to the needs of the community.

With these steps, BUMDes can be more effective in strategic planning and decision-making.

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