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Product Layout Analysis Based on Consumer Purchasing Patterns Using Apriori Algorithm

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ABSTRACT

In every self-service store, it is certain to have a sales transaction data, where the data will continue to grow every day. But in self-service stores the data is only a record of sales at the store. Whereas transaction data can be used as information on how consumer purchasing patterns when shopping at the store, but not all supermarkets know this. So this research aims to find information on these purchasing patterns, where to do this research using the apriori algorithm which is part of the association technique which is also part of data mining, where in its application it will calculate the support value, confindence value and will be tested using the lift ratio. And after the calculation is carried out, optimization will be carried out using the high utility itemset mining variable which will calculate the highest profit value on the product, so that based on the calculation, the final result is obtained with a support value of 85%, a confidence value of 86%, a lift ratio test of 1.01 and the high utility gets the highest result of Rp. 567,000.

Keywords: Apriori algorithm; Data mining; Association analysis; High utility itemset mining

1. INTRODUCTION

Supermarket stores are a sales business sector that sells various types of goods or materials for household needs, where supermarkets are almost everywhere in the region, so supermarkets are the second choice for some people to shop for home needs besides the market.

Therefore, in a supermarket store, it is certain to have a lot of sales transaction data due to the large number of consumers who shop at the same time or someone who shops with many products in one transaction, with that each transaction data has thousands or millions of rows of transaction data, where sales transaction data will usually be used as a recap of the results of sales only, and the data will only be archived after the recap results are complete. Whereas in a sales transaction data can be used as a reference or suggestion in helping sales activities in a convenience store, where sales transaction data will be processed and the results of the data process can be used as a reference or suggestion in making a decision (Herlina, 2024). but not all convenience stores will do that, because each sales transaction data has thousands or millions of lines so it takes a long time to process. Therefore, the data process requires a method that can be used in processing the data, so that when processing transaction data it can be done in a short time (Pandawana et al., 2022; Suryadana & Sarasvananda, 2024). And the method that can be used is the apriori algorithm method.

The apriori algorithm is the most frequently used method because the processing of frequent itemsets in the database is very simple, easy and the application of the apriori method is most widely proposed by several researchers in various fields because it has the ability to find all items of association rules in the transaction database that meet the minimum requirements and minimum restrictions (Andini et al., 2022; I. M. D. P. Asana et al., 2022) The apriori algorithm is also one of the methods of association analysis which is also part of data mining techniques, where the apriori algorithm method can process transaction data that will become candidates for itemset combinations (I. M. D. P. Asana et al., 2020; Saputra et al., 2022).

So in this study, the application of the apriori algorithm method will be carried out to analyze sales transaction data, where the sales transaction data to be processed is 38 thousand rows of data, with the initial process of

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determining the product that will be a candidate in combining itemsets so that in the next process there is no same product, after that the candidate itemset will go through a calculation process using the formula in the apriori algorithm method and the results of the calculation can be used as advice in arranging products or stocking products (I. Asana et al., 2020; Atmaja et al., 2022).

Based on the background of the problems described above, the research will analyze consumer purchasing patterns through sales transaction data with the apriori algorithm optimization method where the results can be used as advice in a supermarket. The purpose of this research is to find out consumer purchasing patterns based on sales transaction data with the apriori algorithm. The implication of the research is to help convenience stores in knowing consumer purchasing patterns and suggestions can be given in changing product layouts.

2. LITERATURE REVIEW

The first previous research conducted by (Indah et al., 2021)In this study, it results in optimizing the performance of the Apriori algorithm in the process of finding the frequency of Itemset. The second research conducted by (Darma et al., 2021) in this study using the Apriori Algorithm method in organizing the placement of goods and can find out the stock needs of the cooperative. The third research conducted by (Sari, 2019) while the purpose of this study is to determine consumer purchasing patterns at Toko Pojok. So that in this study use an Association Rule Mining method using the Apriori algorithm. And produce a consumer purchasing pattern and determine a sales strategy by stocking more goods for items that often appear in sales transaction data. The fourth research conducted by (Safitri & Bella, 2022). In this study, an apriori algorithm method is used or known as association rule mining (ARM). The purpose of this research is to be able to assist Diengva stores in linking transaction data to consumer purchasing patterns. So that this research produces an analysis of customer purchasing patterns at Diengva Stores. The fifth research conducted by (Irfa'aturrochmah, 2018) This research is to determine the layout of goods at Seramart Minimarket. and in this study produced an analysis of consumer spending habits and customizable barangan layouts.

3. METHOD

The Research Method is the initial process carried out in starting research, where the process begins with an initial study, namely by understanding and studying the main topics in the research. Furthermore, data collection will be carried out using two techniques, namely secondary and primary data collection, after which data analysis will be carried out by analyzing the data obtained. Where the data that has been analyzed will be processed and the optimization of the apriori algorithm method will be applied, and from the application will get results, where these results become conclusions from the results of the analysis in the study.

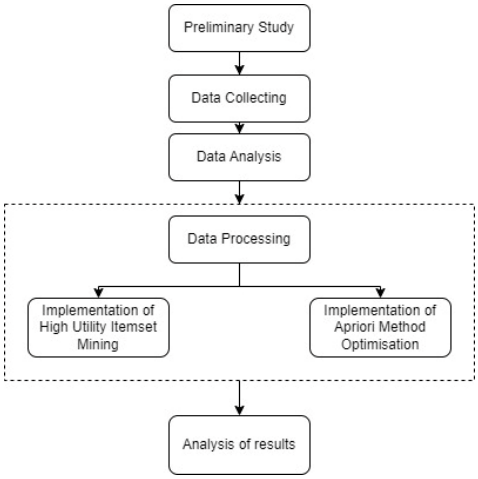

Fig. 1 Research Stage

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Apriori Algorithm

The apriori algorithm is divided into several stages called narratives. The stages are as follows (Kwintiana et al., 2023; Sibarani, 2020):

a) Formation of candidate itemsets. Candidate k-itemsets are formed from a combination of (k-1) itemsets obtained from the previous iteration. The method of the a priori algorithm is pruning candidate k-itemsets whose subsets contain k-1 items not included in high-frequency patterns of length k-1.
b) Calculating the support of each candidate k-itemset. The support of each candidate k-itemset is obtained by scanning the database to count the number of transactions that contain all items in the candidate k-itemset. This is also a feature of the a priori algorithm where it is necessary to count the entire database for the longest k-itemset.
c) Assign a high-frequency pattern. A high-frequency pattern containing k items or k-itemsets is assigned from the k-itemset candidates whose support is greater than the minimum support.
d) If no new high-frequency pattern is obtained, the entire process is stopped.

Where the apriori algorithm is one of the algorithmic methods of association analysis, where association analysis is a Data Mining technique for finding associative rules between a combination of items (Irfa'aturrochmah, 2018; Urva et al., 2023). The association analysis process begins with the formation of associative rules. After all the high-frequency patterns are found, then the associative rules that meet the minimum requirements for Confidence are sought (Tana et al., 2018).

High frequency pattern analysis is the stage of finding a combination of items that meet the minimum requirements of the support value in the database. The Support value of an item is obtained by the following formula (Sari, 2019).

$$\text{Support(A)} = \frac{\text{Number of transactions containing A}}{\text{total transactions}} \quad (1)$$

Meanwhile, to calculate the Support presentation of an item using the formula(Rahmawati & Merlina, 2018):

$$\text{Support(A)} = \frac{\text{Number of transactions containing A}}{\text{total transactions}} \text{x } 100\% \quad (2)$$

After all the high-frequency patterns have been found, the associative rule that meets the minimum requirement for confidence is searched for, as follows.

$$\text{Confidence}(\text{A} \rightarrow \text{B}) = \frac{\text{Number of transactions containing A and B}}{\text{total transactions}} \quad (3)$$

Where the results of the formation of association rules will produce an association rule that has been formed from the support and confidence values (Rahmi & Mikola, 2021). which will carry out a measurement process (parameter) to determine the strength of the association rule, namely by using the lift ratio test. lift ratio is a comparison between the confidence of a rule and the benchmark confidence value. While benchmark confidence is the ratio between the number of all items that become consequent to the total number of transactions (Kurnia et al., 2017). The following is the formula for the Lift Ratio (Tiara Antesia, 2020) :

$$\text{Lift Ratio}(\text{A}, \text{B}) = \frac{\text{Confidence(A,B)}}{\text{Benchmark Confidence}} \quad (4)$$

The following is the formula for the Lift Ratio (Tiara Antesia, 2020) :

$$\text{Benchmark Confidence} = \frac{\text{Number of transactions containing A}}{\text{total transactions}} \quad (5)$$

And in this research, a new calculation process will be carried out using the high utility itemset mining method, which will calculate the profit value on transaction data, where additional information is provided, namely the number of items in the transaction, and weights that indicate the relative importance of each item to the user.(Fournier-Viger et al., 2019). Here is the High Utility Itemset Mining formula (Fournier-Viger, 2022):

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$$u(\{a,b\}) = (\text{number of occurrences of product A x profits}) + (\text{number of occurrences of product B x profits}) \quad (6)$$

4. RESULT

Data Analysis

Data Analysis is a stage in the data processing process, because the data obtained cannot be directly used in research. Where the purpose of this data processing is done to fulfill the requirements in the apriori calculation. Where the a priori algorithm has a transaction type in its calculations, this transaction type is based on association rules from the Association Analysis technique. Therefore, the data analysis process is carried out, so that the data can meet the requirements in the calculation of the apriori algorithm, in analyzing the data must go through two stages where the stages consist of data processing and data cleaning.

Data Processing

Data Processing is the process stage of breaking Data from Transaction Data Copies, where at this stage it will go through the process of grouping each product according to its type.

Table 1
Data Processing

Product Grouping	Product Name
Noodles	91gr Fried Sedaap Noodles,
	Sedaap cup noodles 79 g special curry
	Indomie Kari Ayam 72gr
	.....
Mineral Water	Aqua Mineral Water 1500ml
	Oasis 600ml
	Oasis 1500ml
	.....
.....	.....
Shoe Polish	Solid Kiwi Polish 17.5 ml Black
	Kiwi polish 30 ml Black
	Solid Kiwi polish 45 ml Black
	.....

Data Cleaning

Data Cleaning is a process of cleaning attributes that are not used in the a priori algorithm process, because in the a priori algorithm calculation only product attributes will be used.

Table 2
Data Cleaning

No.	Product Name
1	Noodles, Soft Drinks, Snacks, Bath Soap, Cleaners,
2	Noodles, Mineral Water, Packaged Milk, Soft Drinks, Snacks, Ground Coffee, Bath Soap, Cleaners, Condiments, Pads, Wipes, Shampoo, Laundry Soap, Insect Repellent, Ice Cream, Cigarettes, Oil, Eggs, Bread, Packaged Coffee, Stationery, Rice,
...	.....

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241	Noodles, Mineral Water, Packaged Milk, Soft Drinks, Snacks, Sugar, Ground Coffee, Bath Soap, Cleansers, Condiments, Dental Care, Diterjen, Pads, Wipes, Shampoos, Laundry Soap, Lotions, Face Soap, Packaged Tea, RT Supplies, Brewed Milk, Fragrances, Medicines, Insect Repellent, Ice Cream, Treatments, Hair Polish, Syrup, Hair Care, Alcoholic Beverages, Oils, Eggs, Deodorant, Bread, Packaged Coffee, Stationery, Brewed Tea, Rice,

Tabular Data

The next process is the transformation stage of the apriori algorithm transaction data into tabular data, where tabular data is table data expressed in (numeric) values.

Table 3
Tabular

A	B	C	D	E	...	AU
1	0	0	1	1	...	0
1	1	1	1	1	...	0
...	...	...	...	...	...	...
1	1	1	1	1	...	0

The tabular table is a transformation of transaction data into a tabulated table that will be used in the calculation of itemsets, where the number "1" is a sign of a transaction, while the "0" sign is a sign of no transaction.

5. DISCUSSIONS

In the process of implementing the apriori algorithm, the following data will be used in the calculation.

Table 4
Tabular Data

A	B	C	D	E	...	AU
1	0	0	1	1	...	0
1	1	1	1	1	...	0
...	...	...	...	...	...	...
1	1	1	1	1	...	0

Table 5
Product description

A	B	C	D	E	...	AU
Noodles	Mineral Water	Packaged Milk	Soft Drinks	Snack	...	Shoe Polish

Itemset Formation

In the calculation of the formation of the first Itemset that will be done is the formation of 1 Itemset, for the steps of calculating the formation of 1 Itemset, namely by calculating the total number of transactions A in the tabular table and given a minimum value of 70%.

1) Support(Noodles)
$= \frac{237}{241} \text{ x } 100\% = 98\%$
2) Support (Mineral Water)
$= \frac{240}{241} \text{ x } 100\% = 100\%$
3) Support (Packaged Milk)
$= \frac{235}{241} \text{ x } 100\% = 98\%$

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4) Support (Soft Drinks)
$= \frac{241}{241} \text{ x } 100\% = 100\%$
5) Support (Snack)
$= \frac{241}{241} \text{ x } 100\% = 100\%$
6) .....
47) Support (Shoe Polish)
$= \frac{20}{241} \text{ x } 100\% = 8\%$

The results of the calculation are entered into a table to select itemsets that do not meet the minimum support value.

Table 6
1 Itemset calculation

Itemset 1			
No.	Product Name	Total	Results
1	Noodles	237	98%
2	Mineral Water	240	100%
3	Packaged Milk	239	99%
4	Soft Drinks	241	100%
5	Snack	241	100%
...	.....	...	...
47	Shoe Polish	20	8%
Minimum Support			70%

The next process will be done calculation of 2 Itemset, just like the steps of calculating 1 Itemset. But in this 2 Itemset contains 2 product items combined, namely transactions containing A and B. following the calculation of 2 itemset.

1) Support (Noodles & Mineral Water)
$= \frac{236}{241} \text{ x } 100\% = 98\%$
2) Support (Noodles & Packaging)
$= \frac{235}{241} \text{ x } 100\% = 98\%$
3) .....
171) Support (Kopikemasan&ATK)
$= \frac{168}{241} \text{ x } 100\% = 70\%$

Association Calculation

In the next process, the association calculation process is carried out after the results of itemset formation are found, which at this stage will look for conditional relationships on the results of itemset formation. Where the initial step in the calculation of the association starts from the calculation of the association of 2 itemsets, for how to search for association calculations using the following formula.

1. Confidence (Noodles & Mineral Water)
$= \frac{236}{237} \text{ x } 100\% = 100\%$
2. Confidence (Packaged Noodles & Milk)
$= \frac{235}{237} \text{ x } 100\% = 99\%$
3. .....
108. Confidence(Packaged Coffee&ATK)

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$= \frac{168}{203} x\ 100\% = 83\%$

After the calculation, the results will be entered into a table and the selection stage will be carried out, where at this stage a new minimum value of 80% will be given.

Table 7
Association Calculation

Itemset 2			
No.	Product Name	Total	Results
1	Noodles, Mineral Water	236	100%
2	Noodles, Packaged Milk	235	99%
...	.....	...	....
108	Packaged coffee, stationery	168	83%
Minimum Confidence			80%

The next stage is the stage of calculating the association of 3 itemset where the stages are the same as the calculation of the association of 2 itemset, following the calculation of the association of 3 itemset.

1) Confidence (Noodles, Mineral Water & Packaged Milk)
   $= \frac{235}{237} x\ 100\% = 100\%$
2) Confidence (Noodles, Mineral Water & Soft Drinks)
   $= \frac{236}{237} x\ 100\% = 100\%$
3) .....
78) Confidence(Packaged Coffee, Stationery & Noodles)
   $= \frac{168}{203} x\ 100\% = 83\%$

After the calculation, all calculations will be entered into the table and the selection stage will be carried out.

Lift Ratio Testing

At this stage is the apriori algortima testing stage where testing uses the Lift Ratio test. Which is where the lift ratio is a test that looks for strength in association rules. Here's how this test works using the following formula.

1) $\text{Lift Ratio}(\text{Mie}, \text{Air Minerall}) = \frac{0.98}{1.00} = 1.02$
2) $\text{Lift Ratio}(\text{Mie}, \text{Air Mineral}, \text{Susu Kemasan}) = \frac{0.98}{1.00} = 1.02$
3) .....
4) Lift Ratio(Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snacks, Ground Coffee, Bread)
   $= \frac{0.85}{0.86} = 1.02$
   And the results of the calculation will be entered into a table as follows:

Table 8
Lift Ratio Testing

No.	Product Name	Support	Confidence	Lift Ratio
1	Noodles, Mineral Water	0.98	1.00	1.02
2	Noodles, Packaged Milk	0.98	0.99	1.01
...	.....	...	...	...
169	Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snack, Ground	0.85	0.86	1.01

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No.	Product Name	Support	Confidence	Lift Ratio
	Coffee, Bread			

In the lift ratio test calculation table, it can be seen that the combination pattern that has met the support and confidence values has a result of> 1.00. So that product combinations that exceed 1.00 have a positive relationship or can be called their frequent occurrence together in transactions.

Association Rules

In this section is the final result of the Association Rule, where the rule confindence value will be greater than the support value, which aims to select the right candidate rule, so here are the final results of the association rule.

Table 9

Association Rules

No.	Product Name	Support	Confidence	Lift Ratio
1	If consumers buy noodles, there may be consumers who buy mineral water at the same time.	0.98	1.00	1.02
2	If a consumer buys noodles, there may be consumers who buy packaged milk at the same time.	0.98	0.99	1.01
...	.....	...	...	...
104	If consumers buy noodles, mineral water, packaged milk, soft drinks, there may be consumers buying snacks, ground coffee, bread at the same time.	0.85	0.86	1.01

High Utility Itemset Mining

High Utility Itemset Mining is an optimization stage of the apriori algorithm which at this stage will be calculated to the product in the transaction data, which in this calculation will calculate the product with its profit price. How to calculate high utility itemset mining is by finding the total number of transactions per product as follows:

Table 10
Data Set

No.	Product Name
1	Noodles(9), Mineral Water(9)
2	Noodles(6), Mineral Water(7),Bottled Milk(7)
...	.....
34	Noodles(7), Mineral Water(7), Packaged Milk(7), Soft Drinks(7), Snack(7), Ground Coffee(9)

The next way is to determine the profit of each product.

Table 11

Profit Value

Product Name	Profit Value
Noodles	3,000
Mineral Water	18,000
.....	.....
Shoe Polish	10,000

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After determining the profit to be used, the transaction table will be calculated with the formula.

1) u({Noodles, Mineral Water})
= 27,000+162,000
= 189,000
2) u({Noodles, Mineral Water, Packaged Milk})
= 18,000+126,000+56,000
=200,000
3) .....

34) u({Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snacks, Ground Coffee})
= 21,000 + 126,000 + 56,000 + 70,000 + 70,000 + 14,000 =357,000

After the calculation of high utility, where the results of all emergencies will be entered into the table.

Table 12

High Utility Calculation Result

No.	Product Name	Profit Results
1	Noodles, Mineral Water	189,000
2	Noodles, Mineral Water, Bottled Milk	200,000
...	.....	....
40	Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snacks, Ground Coffee	357,000

The results of high utility there are 2 transactions that have the highest profit value, where the highest profit value is 567,000, where the results of the highest profit value are the same as the final results in the final results of the association rules and the other calculation is with a profit value of 501,000 where the product relation in the itemset calculation has been eliminated, but in the high utility calculation the product has the highest profit value.

Final Calculation Result

In this section are the final results of the research calculations to which the results of product relations will be attached. The following are the results of the final calculation:

Table 13
Final Results

No.	Product Name	Final Results			
		Support	Confindence	Lift Ratio	Profit Value
1	Noodles, Mineral Water, Packaged Milk, Soft Drinks, Snacks, Ground Coffee, Packaged Tea	0.79	0.81	1.02	425,000
2	Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snacks, Ground Coffee, Cigarettes	0.85	0.86	1.02	567,000
3	Noodles, Mineral Water, Bottled Milk, Soft Drinks, Snack, Ground Coffee, Bread	0.85	0.86	1.02	387,000

In the table is the final result of the calculation where 1 relationship has a higher value, namely Noodles, Mineral Water, Packaged Milk, Soft Drinks, Snacks, Packaged Coffee, Packaged Tea where these 7 products get a support value of 85%, a confidence value of 86%, a Lift Ratio of 1.02,

Product Layout Recommendation

This Product Layout is part of the application of the final results of the a priori algorithm, which will create a new floor plan.

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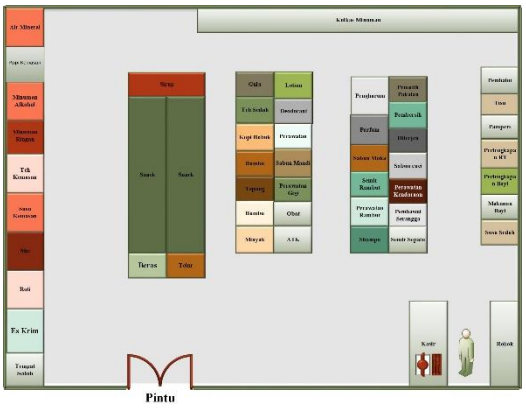

Fig.1 Product Layout

Based on figure 1 above, it can be explained that the plan can be used as a suggestion or reference in the placement of products where the placement is by placing products that have a strong relationship will be placed close together which can make one consumer buy other products besides what is desired or can be called impulse buying.

6. CONCLUSION

Based on the research optimization analysis of the apriori algorithm using high utility itemset mining, the following conclusions can be drawn. 1) In its application, the apriori algorithm can help a store in knowing how consumer purchasing patterns are in buying products at the store so that this can be used as information or strategy at a supermarket. 2) From the results of optimizing the apriori algorithm using high utility itemset mining, we get the results of one transaction that provides a lot of profit or the highest profit value and and get the results of products that appear rarely but provide high profit value. 3)From the research results of the application of the apriori algorithm optimization method, it can be concluded that the support value gets a value of 100%, the confidence value gets a value of 99%, the lift ratio test results in a positive relationship with a value of 1.02 and the results of the high utility get the highest profit value of Rp 567,000.

7. REFERENCES

Andini, Y., Hardinata, J. T., Purba, Y. P., Studi, P., Informasi, S., Utara, S., & Apriori, M. (2022). *PENERAPAN DATA MINING TERHADAP TATA LETAK BUKU*. *XI*(1), 9–15.

Asana, I. M. D. P., Sudipa, I. G. I., Mayun, A. A. T. W., Meinarni, N. P. S., & Waas, D. V. (2022). Aplikasi Data Mining Asosiasi Barang Menggunakan Algoritma Apriori-TID. *INFORMAL: Informatics Journal*, *7*(1), 38–45.

Asana, I. M. D. P., Wiguna, I. K. A. G., Atmaja, K. J., & Sanjaya, I. P. A. (2020). FP-Growth Implementation in Frequent Itemset Mining for Consumer Shopping Pattern Analysis Application. *Jurnal Mantik*, *4*(3), 2063–2070.

Asana, I., Radhitya, M. L., Widiartha, K. K., Santika, P. P., & Wiguna, I. (2020). Inventory control using ABC and min-max analysis on retail management information system. *Journal of Physics: Conference Series*, *1469*(1), 12097.

Atmaja, K. J., Pascima, I. B. N., Asana, I. M. D. P., & Sudipa, I. G. I. (2022). Implementation of Artificial Neural Network on Sales Forecasting Application. *Journal of Intelligent Decision Support System (IDSS)*, *5*(4), 124–131.

Darma, U. B., Islam, U., & Utara, S. (2021). *Vol . 2 No . 1 Juni 2021*. *2*(1), 187–193.

Fournier-Viger, P. (2022). *High Utility Itemset Mining*. Youtube.

Fournier-Viger, P., Chun-Wei Lin, J., Truong-Chi, T., & Nkambou, R. (2019). *A Survey of High Utility Itemset Mining*. 1–45. https://doi.org/10.1007/978-3-030-04921-8_1

Herlina, H. (2024). Utilization of Big Data for SWOT Analysis in Improving Business Sustainability of MSMEs. *TECHNOVATE: Journal of Information Technology and Strategic Innovation Management*, *1*(2), 89–95. https://doi.org/10.52432/technovate.1.2.2024.89-95

* Corresponding author

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Indah, B., Hafsari, B., Anggrawan, A., & Syahrir, M. (2021). *Optimasi Kinerja Algoritma Apriori Dalam Proses Pencarian Frekuensi Itemset Menggunakan Teknik Partisi*. 1–15.

Irfa'aturrochmah. (2018). *Penentuan Tata Letak Barang Dagangan Berdasarkan Data Transaksi Penjualan Harian Menggunakan Algoritma Apriori*. *November*, 155–168.

Kurnia, F., Monalisa, S., & Fahmi, I. (2017). Penerapan Algoritma Fp-Growth dalam Menentukan Pola Kecelakaan Lalu Lintas. *Seminar Nasional Dan Expo Teknik Elektro 2019*, 90–96.

Kwintiana, B., Nengsih, T. A., Baradja, A., Harto, B., Sudipa, I. G. I., Handika, I. P. S., Adhicandra, I., & Gugat, R. M. D. (2023). *DATA SCIENCE FOR BUSINESS: Pengantar & Penerapan Berbagai Sektor*. PT. Sonpedia Publishing Indonesia.

Pandawana, I. D. G. A., Radhitya, M. L., Sandhiyasa, I. M. S., & Bramstya, B. T. (2022). APLIKASI E-SEWA BARANG BERBASIS MOBILE. *Jurnal Krisnadana*, *1*(3), 26–36.

Rahmawati, F., & Merlina, N. (2018). Metode Data Mining Terhadap Data Penjualan Sparepart Mesin Fotocopy Menggunakan Algoritma Apriori. *PIKSEL : Penelitian Ilmu Komputer Sistem Embedded and Logic*, *6*(1), 9–20. https://doi.org/10.33558/piksel.v6i1.1390

Rahmi, A. N., & Mikola, Y. A. (2021). Implementasi Algoritma Apriori Untuk Menentukan Pola Pembelian Pada Customer (Studi Kasus: Toko Bakoel Sembako). *Information System Journal*, *4*(1).

Safitri, N., & Bella, C. (2022). *PENERAPAN DATA MINING UNTUK ANALISIS POLA PEMBELIAN PELANGGAN (STUDI KASUS : TOKO DIENGVA BANDAR JAYA)*. *2*(1), 1–8.

Saputra, I. K. D. A., Satwika, I. P., & Utami, N. W. (2022). Analisis Transaksi Penjualan Barang Menggunakan Metode Apriori pada UD. Ayu Tirta Manis. *Jurnal Krisnadana*, *1*(2), 11–20.

Sari, A. Y. (2019). *Penerapan Association Rule Mining Menggunakan Algoritma Apriori Untuk Menentukan Pola Pembelian Konsumen Pada Data Transaksi Penjualan*.

Sibarani, A. J. P. (2020). Implementasi Data Mining Menggunakan Algoritma Apriori Untuk Meningkatkan Pola Penjualan Obat. *JATISI (Jurnal Teknik Informatika Dan Sistem Informasi)*, *7*(2), 262–276. https://doi.org/10.35957/jatisi.v7i2.195

Suryadana, K., & Sarasvananda, I. B. G. (2024). Streamlining Inventory Forecasting with Weighted Moving Average Method at Parta Trading Companies. *Jurnal Galaksi*, *1*(1), 12–21.

Tana, M. P., Marisa, F., & Wijaya, I. D. (2018). Penerapan Metode Data Mining Market Basket Analysis Terhadap Data Penjualan Produk Pada Toko Oase Menggunakan Algoritma Apriori. *J I M P - Jurnal Informatika Merdeka Pasuruan*, *3*(2), 17–22. https://doi.org/10.37438/jimp.v3i2.167

Tiara Antesia, S. E. (2020). Aturan Asosiasi Data Alat Tulis Kantor Menggunakan. *Proceeding SENDIU*, 978–979.

Urva, G., Albanna, I., Sungkar, M. S., Gunawan, I. M. A. O., Adhicandra, I., Ramadhan, S., Rahardian, R. L., Handayanto, R. T., Ariana, A. A. G. B., & Atika, P. D. (2023). *PENERAPAN DATA MINING DI BERBAGAI BIDANG: Konsep, Metode, dan Studi Kasus*. PT. Sonpedia Publishing Indonesia.

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