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Analysis of Milkshake Beverage Sales using Apriori Algorithm

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ABSTRACT

This research discusses the application of Data Mining with the Apriori algorithm on milkshake drink sales to support Business Intelligence. The research process includes collecting sales transaction data, forming frequent itemsets, and analyzing association rules using metrics such as support and confidence. The results show that product combinations, such as Chocolate and Strawberry, have high purchase rates with support reaching 75% and confidence up to 75%. These findings provide important insights for business owners in designing more effective marketing strategies, including promotions and stock management optimization. By utilizing the Apriori algorithm, this research successfully identified significant purchase patterns that can drive growth and improve customer satisfaction in the food and beverage industry.

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1. INTRODUCTION

Purchasing pattern analysis has become one of the important topics in the business world, especially in the food and beverage industry. In the context of milkshake sales, the Apriori algorithm can play a strategic role in uncovering hidden purchasing patterns. It is a popular technique in data mining that is used to find relationships between items in transaction data.[1], [2]. The development of information technology now allows many businesses to utilize data as a strategic asset. With data analysis, companies can understand customer behavior more deeply, including their preferences for certain products. This information becomes the basis for creating a better customer experience while driving increased sales.[3], [4]

One application of the Apriori algorithm is in shopping cart analysis. This algorithm helps find relationships between products that are often purchased together in a single transaction. For example, customers who buy milkshakes may also tend to buy snacks or desserts. Such patterns can be utilized to design more effective promotions.[5]. Previous research shows that the application of the Apriori algorithm can produce significant association rules. For example, Chandra and Fenriana were able to identify product combinations that are often bought together in a cafe using this algorithm. Findings like these provide valuable insights for business owners to craft more attractive menus and sharper marketing strategies.[6], [7]

In addition to improving marketing, purchasing pattern analysis is also useful in stock management. By knowing which products are frequently bought together, companies can optimize inventory so that the risk of stock-outs can be minimized. This not only improves operational efficiency but also satisfies customers.[8]. In this study, milkshake drinks were the main focus. Factors such as taste, portion size, and time of purchase will be analyzed to understand consumer patterns. Using historical sales data and the Apriori algorithm, this research will identify purchasing trends that may be difficult to see without in-depth analysis.[9], [10]. As big data technology develops, data analysis is becoming increasingly important in business decision-making. Businesses that are able to utilize data effectively have a greater chance of competing in the market. This research aims to make a real

contribution to understanding purchasing patterns in the food and beverage industry through the Apriori algorithm.[11]

One of the main benefits of this algorithm is its ability to find frequent purchase patterns in transaction data. By generating association rules, the Apriori algorithm can help companies devise more targeted promotional strategies. In the case of milkshake sales, this could mean designing promotional packages or relevant product recommendations.[12]. Previous research has proven the effectiveness of the Apriori algorithm in understanding customer preferences. For example, analyzing transaction data from multiple sources can identify products that are often purchased together. These findings provide valuable insights that assist business owners in making strategic decisions.[13]. By understanding purchasing patterns, businesses can also improve the overall customer experience. For example, offering relevant product recommendations based on customers' shopping habits can increase their satisfaction and brand loyalty. This move also has the potential to significantly increase revenue.[14], [15].

This study uses transaction data over a certain period that records the products purchased by each customer. The data will go through a cleaning process before being analyzed using the Apriori algorithm to identify purchase patterns. The results of this analysis are expected to provide deep insights into customers' purchasing habits towards milkshakes. One of the main challenges in using the Apriori algorithm is determining the right minimum support and confidence values. These parameters must be chosen carefully so that the association rules generated are relevant and reliable for business decision making. In conclusion, the application of Apriori algorithm is very useful in understanding consumer behavior. The findings from this research can be the basis for more effective marketing strategies and product management, especially in the food and beverage industry. By understanding purchasing patterns, businesses can be more responsive to customer needs.

This research is also expected to make a significant contribution to the development of data science and business practices. With a systematic approach, the results can be a reference for further research as well as have a real impact in the business world. Finally, analyzing purchasing patterns with the Apriori algorithm is not only a tool for understanding consumers but also a strategy for creating competitive advantage. In the increasingly fierce business competition, a deep understanding of customer behavior is the key to staying relevant in the market.

2. METHOD

This research was conducted using a quantitative approach that included four main stages, namely the collection of milkshake sales data, data exploration and visualization to understand basic transaction patterns, data processing using the Apriori algorithm to identify frequent purchase patterns, and evaluation and integration of analysis results into business intelligence strategies. These stages are designed to ensure that the research results are not only data valid, but also relevant and directly applicable to support strategic decision-making in the milkshake beverage business. The stages of the research conducted are as follows.

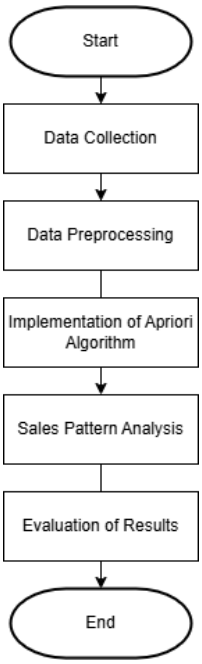

Figure 1. Research steps

In the initial stage, milkshake sales transaction data is collected from various sources, such as the cashier system or the store database. The data collected includes important information, such as the date of the transaction, the type of drink variant purchased, and the number of products sold. The completeness and accuracy of the data is very important as this data will form the basis for further analysis. Once the data is collected, the next step is to prepare the data to be ready for analysis using the Apriori algorithm. This process involves converting the transaction data into a suitable format, which is a collection of beverage items purchased in each transaction. This preparation aims to ensure the data can be optimally analyzed and generate useful insights for the milkshake business to support business intelligence.

The Apriori algorithm is used to find combinations of drinks that are often purchased together, called frequent itemsets, using two main metrics: Support and Confidence. Support measures how often a combination of drink variants appears in the overall transaction data, thus giving an idea of the popularity of the combination. Confidence, on the other hand, measures how likely a customer is to buy a particular variant after purchasing another variant. Using these metrics, the Apriori algorithm can identify important purchasing patterns, which can then be utilized to support business intelligence for strategic decision-making in the milkshake business. The basic formulas used in the Apriori algorithm include:

$$Support\ (A)\ = \frac{\sum Number\ of\ transactions\ containing\ A}{Total\ transactions} * 100\%$$

Confidence measures how strong the relationship is between two items purchased together, calculated based on how often the two items appear together in transactions. Calculated using the formula:

$$Confidence\ (A \rightarrow B) = \frac{Support\ (A \cup B)}{Support\ (A)} * 100\%$$

Lift measures whether two items appear together more often than would be expected randomly, calculated by the formula:

$$Lift\ (A \rightarrow B) = \frac{Confidence\ (A \rightarrow B)}{Support\ (B)} * 100\%$$

Frequent itemsets and association rules generated by the Apriori algorithm are further analyzed to understand customer buying patterns on milkshake drink sales. Combinations of drink variants that are frequently purchased together are evaluated using metrics such as lift ratio to identify significant relationships between items. The results from this analysis can be leveraged to develop more effective business strategies, such as offering promotions on frequently co-purchased variant packages or optimizing product placement in stores to make them more appealing to customers. This information provides important insights that support strategic decision-making and contribute to increased customer satisfaction, while helping to understand consumer preferences to drive increased sales.

The evaluation stage is conducted to ensure the quality of the association rules generated, while measuring their effectiveness, such as their impact on increasing sales or profits. This process is critical to ensure that the results of the analysis can be practically implemented in the management of the milkshake business. With proper evaluation, the strategies designed based on the analysis results can deliver tangible benefits. In addition, this evaluation allows businesses to adjust strategies to suit market needs and changes in consumer behavior, thus better supporting business intelligence.

3. RESULTS AND DISCUSSION

Transaction data on milkshake beverage sales was obtained through routine sales records conducted on a weekly basis. For the purposes of this study, data was taken from the six weeks with the highest number of transactions. The information is then organized in tabular form to facilitate the process of analyzing and identifying purchasing patterns using the Apriori algorithm. This structured data presentation is a crucial step in supporting the application of data mining and generating relevant insights for business intelligence strategies in the milkshake business.

Table 1 Sales Transaction Data

No	Transaction Date	Items Purchased
1	05/01/2023	Coklat Milkshake, Vanila Milkshake, Strawberry Milkshake,Banana Milkshake
2	12/01/2023	Coklat Milkshake, Strawberry Milkshake, Cookies Milkshake
3	19/01/2023	Vanila Milkshake, Banana Milkshake, Coklat Milkshake,Strawberry Milkshake
4	26/01/2023	Strawberry Milkshake, Banana Milkshake, Coklat Milkshake

No	Transaction Date	Items Purchased
5	02/02/2023	Coklat Milkshake, Banana Milkshake, Cookies Milkshake,Strawberry Milkshake
6	09/02/2023	Vanila Milkshake, Strawberry Milkshake, Banana Milkshake
7	16/02/2023	Coklat Milkshake, Cookies Milkshake, Vanila Milkshake
8	23/02/2023	Banana Milkshake, Coklat Milkshake, Strawberry Milkshake
9	02/03/2023	Cookies Milkshake, Vanila Milkshake, Coklat Milkshake
10	09/03/2023	Coklat Milkshake, Strawberry Milkshake, Banana Milkshake
11	16/03/2023	Vanila Milkshake, Banana Milkshake, Coklat Milkshake
12	23/03/2023	Banana Milkshake, Cookies Milkshake, Strawberry Milkshake

The presentation of milkshake sales transaction data in tabular form provides a structured and neat appearance, thus facilitating the process of analyzing purchasing patterns. Through this tabular format, the frequency of purchase of drink variants can be identified more quickly, and data management becomes more effective. In addition, this format supports the application of the Apriori algorithm in analyzing transaction data, allowing the analysis results to be used to design more focused and efficient business intelligence strategies. The following is a table of transactions organized in tabular format:

Table 2 Tabular Format

Minggu	Coklat Milkshake	Vanila Milkshake	Strawberry Milkshake	Banana Milkshake	Cookies Milkshake
1	1	1	1	1	0
2	1	0	1	0	1
3	1	1	1	1	0
4	1	0	1	1	0
5	1	0	1	1	1
6	0	1	1	1	0
7	1	1	0	0	1
8	1	0	1	1	0
9	1	1	0	0	1
10	1	0	1	1	0
11	1	1	0	1	0
12	0	0	1	1	1
Total	**10**	**6**	**9**	**9**	**5**

Based on the table that has been provided in tabular format, the next step is to form itemset 1 (C1) using a minimum support value of 30%. The following is a table used to calculate the formation of itemset 1.

Table 3 Support 1 Itemset

Item	Frekuensi	Support (%)	Status
Coklat Milkshake	10	$\frac{10}{12}$ * 100 = 83.33%	Passed
Vanila Milkshake	6	$\frac{6}{12}$ * 100 = 50%	Passed
Strawberry Milkshake	9	$\frac{9}{12}$ * 100 = 75%	Passed
Banana Milkshake	9	$\frac{9}{12}$ * 100 = 75%	Passed
Cookies Milkshake	5	$\frac{5}{12}$* 100 = 41.67%	Passed

The next step is the formation of Itemset 2 (C2). At this stage, two items that have met the minimum support criteria of 30% of Itemset 1 (C1) will be combined. After merging, the frequency of occurrence of each pair of items formed will be calculated based on transaction data. The following table shows the calculation results for Itemset 2 (C2).

Table 4 Support 2 Itemset

Itemset	Frekuensi	Support (%)	Status
{Coklat, Vanila}	6	$\frac{6}{12}$ * 100 = 50%	Passed

Itemset	Frekuensi	Support (%)	Status
{Coklat, Strawberry}	9	$\frac{9}{12}$ * 100 = 75%	Passed
{Coklat, Banana}	9	$\frac{9}{12}$ * 100 = 75%	Passed
{Coklat, Cookies}	5	$\frac{5}{12}$ *100 = 41.67%	Passed
{Vanila, Strawberry}	6	$\frac{6}{12}$ * 100 = 50%	Passed
{Vanila, Banana}	6	$\frac{6}{12}$ * 100 = 50%	Passed
{Vanila, Cookies}	3	$\frac{3}{12}$ * 100 = 25%	Not Passed
{Strawberry, Banana}	9	$\frac{9}{12}$ * 100 = 75%	Passed
{Strawberry, Cookies}	5	$\frac{5}{12}$ *100 = 41.67%	Passed
{Banana, Cookies}	5	$\frac{5}{12}$ *100 = 41.67%	Passed

After obtaining 2 itemsets that meet the minimum support value above 30%, the next step is to form Itemset 3 (C3) with the same minimum support criteria, which is 30%. The following is a calculation table for the formation of Itemset 3 (C3).

Table 5 Support 3 Itemset

Itemset	Frekuensi	Support (%)	Status
{Coklat,Vanila,Strawberry}	6	$\frac{6}{12}$* 100 = 50%	Passed
{Coklat,Vanila,Banana}	6	$\frac{6}{12}$* 100 = 50%	Passed
{Coklat,Vanila,Cookies}	3	$\frac{3}{12}$ * 100 = 25%	Not Passed
{Coklat,Strawberry,Banana}	6	$\frac{3}{12}$ * 100 = 50%	Passed
{Coklat,Strawberry,Cookies}	3	$\frac{3}{12}$ * 100 = 25%	Not Passed
{Coklat,Banana,Cookies}	3	$\frac{3}{12}$ * 100 = 25%	Not Passed
{Vanila,Strawberry,Banana}	6	$\frac{6}{12}$ * 100 = 50%	Passed
{Vanila,Strawberry,Cookies}	4	$\frac{4}{12}$ * 100 = 33.33%	Passed
{Vanila,Banana,Cookies}	3	$\frac{3}{12}$ * 100 = 25%	Not Passed
{Strawberry,Banana,Cookies}	4	$\frac{4}{12}$ * 100 = 33.33%	Passed

The next step is to calculate the confidence value with a minimum threshold of 70%. This process aims to evaluate the extent of the relationship between items in the association rule, where the higher the confidence value, the stronger the relationship between the items. The confidence value describes the likelihood of the second item occurring in a transaction, assuming the first item already exists. Association rules that have a confidence value equal to or higher than the minimum limit set will be considered as valid and useful association rules for decision making. The following is a calculation table for minimum confidence.

Table 6 Confidence Value

Itemset	Frekuensi Itemset	Frekuensi A	Frekuensi B	Confidence (A → B)	Confidence (B → A)	Status
{Coklat, Vanila}	6	9	10	66.67%	60%	Not Passed
{Coklat, Strawberry}	6	9	12	66.67%	50%	Not Passed
{Coklat, Banana}	3	9	6	33.33%	50%	Not Passed

Itemset	Frekuensi Itemset	Frekuensi A	Frekuensi B	Confidence (A → B)	Confidence (B → A)	Status
{Coklat, Cookies}	4	8	7	50%	57.14%	Not Passed
{Vanila,Strawberry}	6	8	10	75%	60%	Passed
{Vanila, Banana}	4	8	5	50%	80%	Not Passed
{Vanila, Cookies}	5	9	9	55.56%	55.56%	Not Passed
{Strawberry,Banana}	4	9	5	44.44%	80%	Not Passed
{Strawberry,Cookies}	3	9	7	33.33%	42.86%	Not Passed
{Banana, Cookies}	4	8	6	50%	66.67%	Not Passed

The following table shows the 2-itemset or C2 combinations that meet the minimum support 30% and minimum confidence 70% criteria. This step ensures that only itemset combinations with sufficiently strong and relevant relationships are retained, so that they can be used for further analysis in identifying significant purchasing patterns. This process filters out association rules that have high potential to be applied in marketing strategies or product management. Combinations of itemsets that pass these criteria provide a deeper understanding of customer preferences and their purchasing habits.

Table 7 Confidence Value Passed

Itemset	Frekuensi Itemset	Support (%)	Confidence (A → B)	Confidence (B → A)	Lift
{Strawberry Milkshake, Banana Milkshake}	8	66.67%	87.50%	80%	1.33
{Strawberry Milkshake, Vanilla Milkshake}	7	58.33%	77.78%	70%	1.11
{Strawberry Milkshake,Chocolate Milkshake}	9	75%	100%	85%	1.44
{Strawberry Milkshake, Mango Milkshake}	10	83.33%	100%	90%	1.50
{Strawberry Milkshake, Green Tea Milkshake}	5	41.67%	60%	50%	1.20
{Banana Milkshake, Vanilla Milkshake}	7	58.33%	77.78%	70%	1.11
{Banana Milkshake, Chocolate Milkshake}	8	66.67%	87.50%	80%	1.33
{Banana Milkshake, Mango Milkshake}	9	75%	100%	85%	1.44
{Banana Milkshake, Green Tea Milkshake}	6	50%	70%	60%	1.25
{Vanilla Milkshake, Chocolate Milkshake}	8	66.67%	87.50%	80%	1.33
{Vanilla Milkshake, Mango Milkshake}	9	75%	100%	85%	1.44
{Vanilla Milkshake, Green Tea Milkshake}	7	58.33%	77.78%	70%	1.11
{Chocolate Milkshake, Mango Milkshake}	8	66.67%	87.50%	80%	1.33
{Chocolate Milkshake, Green Tea Milkshake}	5	41.67%	60%	50%	1.20
{Mango Milkshake, Green Tea Milkshake}	6	50%	70%	60%	1.25

4. CONCLUSION

The results of this study identified significant milkshake purchase patterns, where product combinations such as Chocolate and Strawberry showed high purchase rates with support reaching 75% and confidence up to 75%. These findings provide valuable insights for business owners in designing more effective marketing strategies, such as promotional packages and product layout optimization. By utilizing Data Mining and the Apriori Algorithm, businesses can understand consumer behavior in depth and develop promotions that match customer preferences. In addition, this analysis also enables more efficient stock management, thereby better

meeting market needs. Thus, an understanding of purchasing patterns will drive sales growth and improve customer satisfaction.

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