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Analysis of Consumer Purchasing Patterns Using the Apriori Algorithm on Sales Transaction Data from Anak Panah Kopi Salatiga

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Abstract: Anak Panah Coffee is a café located in Salatiga, offering a menu of 12 items. To enhance consumer satisfaction, the management of Anak Panah Coffee has decided to implement a marketing strategy for promoting its products. Given the challenges faced by Anak Panah Coffee, this study aims to analyze consumer preferences to provide benefits both to the business and its customers. This research utilizes the Apriori algorithm, based on field data that can be calculated objectively. The results of applying the Apriori algorithm reveal two association rules with a minimum support of 30% and a minimum confidence of 60%. The first rule indicates that customers who purchase Sunny Go Coffee are likely to also purchase Mushroom Crispy, with a support value of 50% and confidence of 56%. The second rule suggests that customers who buy Crispy Mushrooms are likely to also purchase Sunny Go Coffee, with a support value of 50% and a confidence of 71%.

Keywords: Anak Panah Coffee; Marketing Strategy; Apriori Algorithm.

1. Introduction

Cafes have become one of the popular places in modern society's social life. As a smaller place to eat and drink, cafes were originally known as coffee houses, which provided a limited menu with a focus on coffee. Historically, the term "cafe" in English comes from the French borrowed from the Turkish "kahve," which means coffee. For two centuries after the mid-17th century, coffee houses in Europe flourished, especially in London, which became not only a place to drink coffee, but also a space for political discussions and meetings. Coffee shop owners competed to provide newspapers from various political parties, so that the place became a center for information, business transactions, and cultural activities. In the 19th century, coffee houses lost most of their functions related to news gathering due to the emergence of more efficient newspapers and post offices. Over time, cafes have evolved and become more varied places, providing a variety of foods and drinks to meet various consumer tastes. In Salatiga, there is a cafe known as Anak Panah Kopi. This cafe offers 12 interesting menu choices, with a combination of various foods and drinks that can pamper the consumer's tongue. The many menu choices provided provide a diverse experience for customers, but on the other hand also add to the challenges in terms of marketing. Thus, the management of Anak Panah Kopi decided to develop an effective marketing strategy to attract more consumers and increase sales of their products. In this effort, it is important to understand consumer interest patterns that can be the basis for designing appropriate policies and increasing customer satisfaction. As a first step, this study focuses on analyzing consumer purchasing patterns using sales transaction data at Anak Panah Kopi. This transaction data can be used as an itemset to be used in finding consumer interest patterns. For this purpose, this study applies the Apriori Algorithm, a data mining method used to find frequent itemset or a set of items that often appear together in sales transactions. The Apriori Algorithm works with an iterative approach, or often referred to as level-wise search, which allows the identification of itemsets by searching for (K + 1) itemsets based on (K) itemsets that have been previously found. By using the Apriori Algorithm, the Anak Panah Kopi cafe can obtain more in-depth information about the combination of products that are often purchased together by consumers. The results of this study are expected to provide a clearer picture of consumer preferences, which in turn can be the basis for making business decisions, such as developing new menus or more targeted marketing strategies.

Previous studies have applied the Apriori Algorithm in examining consumer interest patterns in various sectors. The algorithm can be used to analyze the correlation of itemsets based on skincare product sales data and achieve a support value of around 8% and a confidence of 60% [1], and can analyze consumer interest patterns in buying menus at coffee shops to find combinations of food and beverage menus that are often purchased together and understand consumer preferences based on certain menus [2]. Previous research related to consumer purchasing patterns is a necessity because by increasing the menu with market demand, it helps them make good decisions. With these results, the application of the Apriori Algorithm used at Anak Panah Kopi is expected to be very helpful in developing marketing strategies for the cafe. It is hoped that the results of the study can provide a more complete picture of the nature of consumer purchasing behavior that appears at Anak Panah Kopi, while at the same time offering recommendations that can help in forming effective marketing strategies and can find certain relevant purchasing patterns that can then be used in making policies and business decisions that are more profitable for cafes and consumers.

2. Related Work

Previous studies have shown that the Apriori algorithm has been widely applied to analyze consumer purchasing patterns in various sectors. In retail, the Apriori algorithm is used to identify relationships between products that are frequently purchased together, supporting stock management strategies and product promotions. Patil (2023) stated that Apriori algorithm analysis can improve promotion efficiency by identifying significant purchasing patterns [3]. Mujianto *et al.* (2019) showed that this algorithm helps analyze transaction data to find relationships between items, resulting in more effective sales strategies [4]. Hermawan (2024) added that this algorithm can reveal hidden associations between products, which is useful for optimizing product layout [5]. In the food and beverage sector, the Apriori algorithm is applied to identify menu combinations that are frequently purchased together. Raihan (2024) stated that this algorithm can be used to design promotional strategies based on consumer purchasing patterns in cafes [6]. Research by Sari (2024) utilized the Apriori algorithm in a web-based system to determine sales patterns and provide relevant business recommendations [7]. Dianti (2024) used this algorithm in a convenience store to optimize product sales strategies by analyzing consumer purchasing patterns [8][8]. In the beauty sector, the Apriori algorithm has also been applied to identify product purchasing patterns and support data-driven marketing strategies. Kurniawan (2023) showed that this algorithm can generate relevant product recommendations based on consumer purchasing patterns, supporting stock management and promotional strategies [9]. Research by

Hasugian *et al*. (2022) applied the Apriori algorithm to building tools and materials, generating important data for more effective promotions [10].

Other studies reveal how the Apriori algorithm is used in the cafe industry to improve sales strategies. Sumantri (2020) used this algorithm to identify frequently purchased menu combinations, which can be applied in bundling promotions [11]. Zhou (2024) emphasized that the Apriori algorithm is capable of developing a data-driven recommendation system to understand consumer behavior patterns, improving customer experience [12]. Jannah (2023) showed that this algorithm can help design food and beverage product bundling, which significantly increases sales [13]. In addition, other relevant studies have shown additional benefits of the Apriori algorithm. Amanda *et al*. (2023) used this algorithm to analyze purchasing patterns in a coffee shop, assisting in the development of product combination-based promotions [1]. Gumilang (2021) applied the Apriori algorithm to analyze transaction data in a web-based store, generating purchasing patterns that support inventory management [2]. Iswandi *et al*. (2020) utilized this algorithm for the layout of goods in a large retail store, supporting transaction pattern-based decisions [14]. Research by Nawangsih and Purnamasari (2023) emphasizes the importance of the Apriori algorithm in determining combinations of beauty products that are often purchased together [16]. Different from previous studies that often highlight the retail sector in general or web-based recommendation systems, this study emphasizes specific analysis in the case of cafes to generate data-based association rules that support marketing strategies [15][17]. The results provide practical guidance in menu management and promotions to improve sales efficiency.

3. Research Method

This research was conducted using a structured approach and systematic methodology to ensure that the results obtained were valid and reliable. The research process begins with a clear formulation of the problem to determine the research objectives and scope of the study to be conducted. This formulation of the problem is very important as a guide in the next steps so that the focus of the research is maintained. After the objectives and scope of the research are determined, the next stage is to conduct a literature study. This literature study aims to gain a deeper understanding of the topic being studied, as well as to find out previous studies that are relevant to this research. The literature used includes academic journals and books related to the Apriori algorithm, consumer purchasing patterns, and data mining applications in business. This is important to provide a strong theoretical basis, which can strengthen the analysis carried out. At the data collection stage, the author conducted interviews with the management of Anak Panah Kopi to explore further information regarding the problems being faced, especially related to consumer purchasing patterns and the need to improve marketing strategies. This interview provided insight into the obstacles faced in the business, and helped in determining the types of data that were relevant for further analysis. Sales transaction data for the past year was then collected as the main source of information in this study. The transaction data collected includes details about the products sold, the number of units purchased, and the time and frequency of purchases. This data was chosen because it is considered the most relevant to analyzing consumer interest and preference patterns that can provide a clearer picture of the relationship between product items purchased together. The use of this historical data allows researchers to explore purchasing trends over a certain period of time, which is useful for formulating more effective strategic recommendations. Furthermore, the collected data is analyzed using an association rule approach. Association in this context refers to a method in data mining that is used to find relationships between items that are frequently purchased together in a transaction. The purpose of this association approach is to identify product combinations that tend to be purchased together by consumers. By understanding this association pattern, Anak Panah Kopi can design more targeted marketing strategies, such as promotions or sales packages that combine products that are frequently purchased together. In the association algorithm, two important parameters used to determine the relationship between items are support and confidence. Support measures how often a combination of items appears in the overall transaction data, which is calculated as the percentage of item combinations that meet certain criteria in the association rule. Conversely, confidence measures the probability that item B is purchased if item A is purchased in a transaction. Mathematically, support and confidence are calculated using the following formula:

$$Support\ (A) = P(A) = (The\ number\ of\ transactions\ containing\ item\ A) \,/\, (Total\ number\ of\ transactions)$$

$$\begin{aligned} Confidence\ (A \rightarrow B) &= P(B|A) \\ &= (The\ number\ of\ transactions\ containing\ A\ and\ B) \\ &\,/\, (Number\ of\ transactions\ containing\ A) \end{aligned}$$

These two values are used to find association rules that meet the minimum criteria that have been set, such as minimum support and minimum confidence. Thus, this analysis will produce rules that describe consumer purchasing patterns that can be used to improve stock management, menu arrangement, and more attractive promotional offers for consumers. As a final stage, the results of this association rule analysis are expected to provide a clearer picture of consumer purchasing patterns at Anak Panah Kopi, as well as providing recommendations for the development of more appropriate marketing strategies. The following are the research methods.

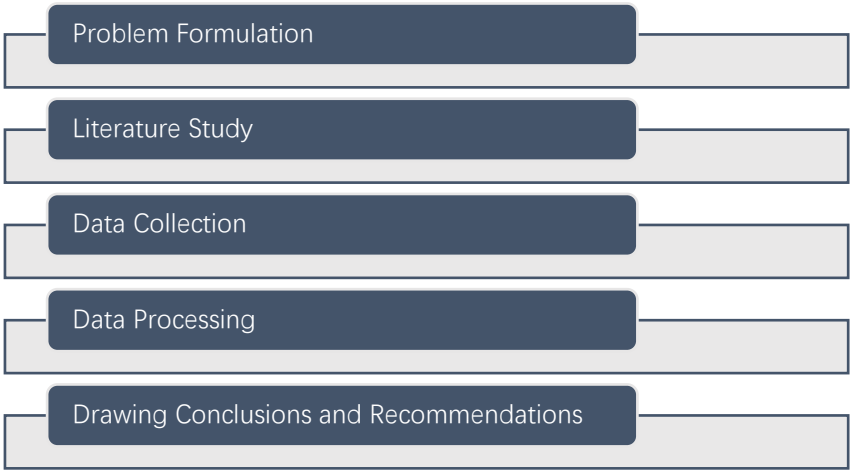

Figure 1. Research Method

Based on Figure 1, the beginning of the research was carried out by formulating the problem to determine the purpose of the research and the scope of the research to be carried out. To obtain motivation or knowledge about the problem being studied, a literature study was conducted either from journals or books. At the data collection stage, the author conducted interviews with Anak Panah Kopi to discuss the problems being experienced and collect data. The author took one year's sales transaction data at Anak Panah Kopi. The data was analyzed using an approach based on Association rules. Association is a process of finding all Association rules that meet the minimum support and minimum confidence requirements in the data. Support is the percentage of item combinations in the Association rules formed by the Association method formed by the Association method in data mining.

4. Result and Discussion

4.1 Results

At this stage, the data obtained from Anak Panah Kopi sales transactions are processed by selecting the items that are most in demand by consumers. This selection process aims to find the most frequent purchasing patterns from the recorded transaction data. The data used in this study comes from sales transactions that took place from January to December 2024. After data processing, association rules are applied to identify combinations of items that are often purchased together. The results of the association rule analysis are presented in the following table to provide a clearer picture of consumer purchasing patterns. In the following stage, the data is processed by selecting data to find out the items that are most in demand. Based on the data obtained from transactions from January to December 2024, the data is processed so that it can be found by following the Association rules in table 1 below:

Table 1. Sales Data

No	Item	Type	Quantity
1	Sunny Go Coffee	Beverage	49
2	Americano	Beverage	32
3	Mocha Latte	Beverage	35
4	Cappuccino	Beverage	38
5	Green Tea Jasmine	Beverage	51
6	Crispy Mushroom	Food	45
7	Rum Coffee	Beverage	26

8	Spanish Latte	Beverage	28
9	Hazelnut Latte	Beverage	30
10	Kopi Susu Sanger	Beverage	48
11	APK Mix Platter	Beverage	21
12	Mendoan	Food	19

Table 1 shows sales data per item from Anak Panah Kopi for one year, which includes various types of drinks and food offered at the cafe. Based on this table, the number of sales per item is recorded during those months. For example, Sunny Go Coffee was sold 49 times, while Mendoan was sold 19 times. This data is the basis for further analysis in determining the combination of items that are most often purchased together by consumers. The processed data is changed into Tabular format, by forming data using the concept of binary numbers, namely 0 and 1. 1 means there is a transaction. The data is obtained from the recapitulation data. The data that has been in tabular format will be as in table 2 below.

Table 2. Tabular Sales Transactions

Month	Purchased Items				
	Spanish Latte	Sunny Go Coffee	Green Tea Jasmine	Jamur Crispy	APK Mix Platter
1	0	1	1	1	0
2	1	1	0	1	0
3	0	0	1	1	1
4	1	1	1	0	0
5	0	1	1	1	0
6	0	1	0	1	1
7	1	1	0	1	0
8	1	1	0	0	1
9	1	0	1	0	1
10	0	1	1	0	1
11	0	1	1	1	0
12	1	0	1	0	1
Total Itemsets	6	9	8	7	6

The collected data is converted into a tabular format using the concept of binary numbers, where 1 indicates that the transaction includes a particular item, and 0 indicates that the item is not included in the transaction. This format makes it easier to analyze purchasing patterns involving multiple items in a single transaction. Table 2 shows how the transaction data for each month is converted into binary format. Table 3 below is the result of the calculation of the formation of one itemset. The number of transaction tips is obtained from the tabular format in table 2 above. The support value of each itemset is obtained from each itemset is obtained from the number of transactions containing A divided by the total transactions.

Table 3. Formation of 1-Itemset

No	Item	Transactions	Support (%)
1	Spanish Latte	6	50
2	Sunny Go Coffee	9	75
3	Green Tea Jasmine	8	66,66666667
4	Jamur Crispy	7	58,33333333
5	APK Mix Platter	6	50

From the data that has been converted into tabular format, calculations are performed to find the support value of each itemset. Support is a value that indicates how often items appear together in transactions. Table 3 shows the formation of one itemset based on the number of transactions and the support value for each item. Support is calculated by dividing the number of transactions containing the item by the total transactions. Because the support value is 30%, the five items, namely Spanish Latte, Sunny Go Coffee, Green Tea Jasmine, Crispy Mushrooms, APK Mix Platter have met the support and are continued for the calculation of two itemsets. The formation of two itemsets by combining items that have met the minimum support.

Table 4. Calculation of 2-Itemset

No	Item	∑ Transactions	*Support* (%)
1	*Sunny Go Coffee - Green Tea Jasmine - APK Mix Platter*	4	33%

After the formation of one itemset, the next step is to find two itemsets that often appear together, using a combination of items that have met the minimum support value. Table 4 shows the calculation for two itemsets that meet the minimum support, which will then be used to form association rules. In table 4, combinations that do not meet the support value of 30% will be removed, namely Sunny Go Coffee - Green Tea Jasmine - APK Mix Platter. Then the data will be obtained as in table 5 below.

Table 5. Formation of 2-Itemset

No	Item	Transactions	Support (%)
1	Spanish Latte - Sunny Go Coffee	4	33%
2	Sunny Go Coffee - Green Tea Jasmine	4	42%
3	Sunny Go Coffee - Jamur Crispy	5	50%
4	Green Tea Jasmine - Jamur Crispy	4	33%
5	Green Tea Jasmine - APK Mix Platter	4	33%

Based on table 5 above, there is no combination that meets the requirements, so the formation of the item set is stopped and continued with the next step, namely the formation of the Association rule. From the formation of a combination of two itemsets that have been found, the value of support from the candidate confidence rule is obtained as in table 6 below.

Table 6. Formation of 3-Itemset

No	Rule	Confidence		
1	If buying Spanish Latte, then buying Sunny Go Coffee	4	6	67%
2	If buying Sunny Go Coffee, then buying Spanish Latte	4	9	44%
3	If buying Sunny Go Coffee, then buying Green Tea Jasmine	4	9	44%
4	If buying Green Tea Jasmine, then buying Sunny Go Coffee	4	8	50%
5	If buying Sunny Go Coffee, then buying Crispy Mushroom	5	9	56%
6	If buying Crispy Mushroom, then buying Sunny Go Coffee	5	7	71%
7	If buying Green Tea Jasmine, then buying Crispy Mushroom	4	8	50%
8	If buying Crispy Mushroom, then buying Green Tea Jasmine	4	7	57%
9	If buying Green Tea Jasmine, then buying APK Mix Platter	4	8	50%
10	If buying APK Mix Platter, then buying Green Tea Jasmine	4	6	67%

After getting a combination of two itemsets, a confidence calculation is performed for each association rule formed. Confidence measures how likely it is that an item will be purchased if another item has been purchased. Table 6 shows the association rules formed along with the confidence value for each rule. Table 6 shows that there are four items that have met the confidence of 60%, so items that do not meet the minimum confidence will be deleted and will be like table 7 below.

Table 7. Formation of Association Rules

No	Rule	Confidence		
1	If buying Spanish Latte, then buying Sunny Go Coffee	4	6	67%
2	If buying Sunny Go Coffee, then buying Crispy Mushroom	5	9	56%
3	If buying Crispy Mushroom, then buying Sunny Go Coffee	5	7	71%
4	If buying APK Mix Platter, then buying Green Tea Jasmine	4	6	67%

From the results, the rules that meet the minimum confidence value of 60% are selected and arranged in the final table, which provides a purchasing pattern that can be used for further marketing strategies and product management. Table 7 presents the final association rules that meet the minimum support and confidence requirements. The final association rules are sorted based on the minimum support and minimum confidence that have been determined, as can be seen in table 8 below.

Table 8. Formation of Association Rules

No	Rule	Support (%)	Confidence (%)
1	If buying Sunny Go Coffee, then buying Crispy Mushroom	50%	56%
2	If buying Crispy Mushroom, then buying Sunny Go Coffee	50%	71%

Based on the results above, the interest pattern found is that if consumers buy Sunny Go Coffee, they are likely to also buy Crispy Mushrooms, and vice versa, if they buy Crispy Mushrooms, they tend to buy Sunny Go Coffee. This pattern provides an overview for Anak Panah Kopi to develop a more targeted marketing

strategy. Based on table 8 above, the interest pattern obtained is if you buy Sunny Go Coffee, then you buy Crispy Mushrooms with a support value of 50% and a confidence value of 56%, and if you buy Crispy Mushrooms, then you buy Sunny Go Coffee with a support value of 50% and a confidence value of 71%. By knowing the number of beverage and food products sold, Anak Panah Kopi can use it to market its products.

Table 9. Final Formation of Association Rules

No	Rule	Support (%)	Confidence (%)
1	If buying Sunny Go Coffee, then buying Crispy Mushroom	50%	56%
2	If buying Crispy Mushroom, then buying Sunny Go Coffee	50%	71%

Based on table 9 above, the interest pattern obtained is if you buy Sunny Go Coffee, you will buy Crispy Mushrooms with a support value of 50%, and if you buy Crispy Mushrooms, you will buy Sunny Go Coffee and a Confidence value of 56%. And Sunny Go Coffee with a confidence value of 71%. By knowing the number of beverage products sold, Anak Panah Kopi Salatiga can use it to market its beverage products.

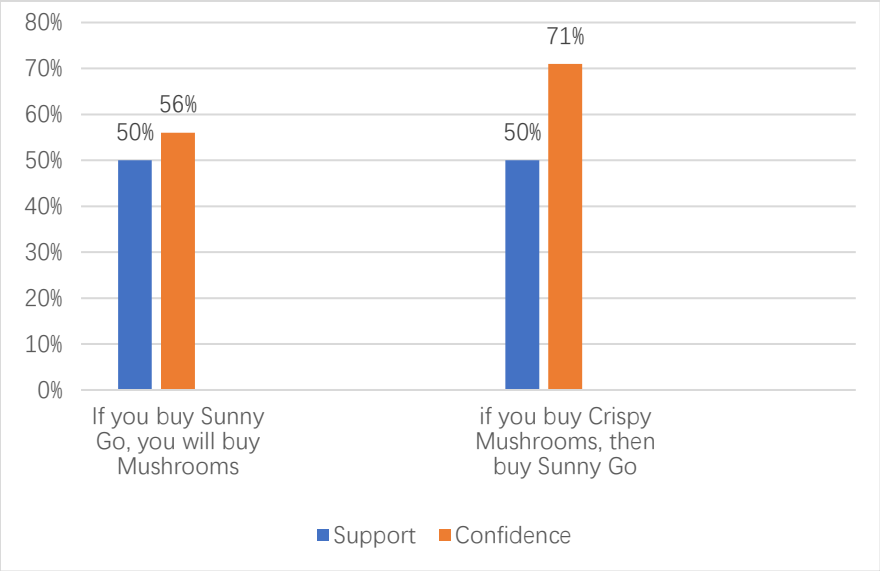

Figure 2. Final Association Graph of Coffee Sales Transactions

As seen in Figure 2, it shows the relationship between Sunny Go Coffee and Crispy Mushroom products through the density of support and confidence values based on the results of the analysis algorithm using apriori. The output of this analysis provides a strong pattern in purchases between the two products. The first rule shows that if consumers buy Sunny Go Coffee, there is a 56% chance that they will also buy Crispy Mushroom. This figure is supported by a support level of 50% which indicates that the coexistence of the two products appears in 50% of transactions in the data set. On the other hand, in the second rule, we can see that if a customer consumes Crispy Mushroom, then we can say that the customer has a 71% chance of consuming Sunny Go Coffee, with the same support value, which is 50%. The higher confidence value in this second rule indicates that the purchase of Crispy Mushroom has a stronger correlation with Sunny Go Coffee -> Crispy Mushroom than vice versa. Noting which products tend to be purchased together not only has interesting insights into the social drinking habits of white-collar workers, but also strategic value depending on whether this information is used in creating package-based promotions that combine the two products, or in formulating stock management and product arrangements in the cafe to drive sales. This approach opens up ways to cut marketing costs and maximize profits while maintaining consumer satisfaction.

4.2 Discussion

The use of the Apriori Algorithm has proven effective in analyzing consumer purchasing patterns in various sectors, including food, beverages, beauty, and retail. In a study related to Anak Panah Kopi, this algorithm was used to identify the relationship between purchases of Sunny Go Coffee and Crispy Mushrooms. The results of the analysis showed that there was a 56% probability that consumers would buy Crispy Mushrooms if they bought Sunny Go Coffee, while the probability increased to 71% if consumers bought Crispy Mushrooms first. This data is a basis that can be used to improve marketing strategies, such as package promotions. The application of the Apriori algorithm to other sectors also provides significant results. Iswandi, Permana, and Salisah (2020) used the Apriori algorithm to optimize the layout of goods at Hypermart Xyz Lampung. This analysis helps to place goods efficiently based on detected consumer purchasing patterns [14]. Naldy and

Andri (2021) applied it in a building store to understand the relationship between products and develop relevant package-based promotions [15]. Nawangsih and Purnamasari (2023) used the Apriori algorithm to analyze beauty product purchase transactions. The study successfully identified customer preferences for certain product combinations, providing a basis for developing appropriate promotions [16]. Novianti and Elisa (2020) utilized the same algorithm to determine association rules on minimarket transaction data, which yielded valuable information for promotion management [17]. In the food and beverage sector, the Apriori algorithm also demonstrated efficiency. Nurrahmi and Sukma (2020) designed food and beverage package recommendations based on an analysis of purchasing patterns in a cafe, providing guidance for menu management and promotional offers [18]. Rahmi and Mikola (2021) used a similar approach in a grocery store, helping to determine product combinations that are frequently purchased together [19]. Research by Rosmayati *et al*. (2023) on coffee sales showed that the Apriori algorithm can be used to determine products that are frequently purchased together, improving stock management and sales strategies [20][19]. Other studies also support the effectiveness of the Apriori algorithm. Saragih (2021) used it to analyze fishing gear sales patterns, which yielded guidance for stock management and promotional strategies [21]. Sigalingging and Harman (2020), and Styawati *et al*. (2021), applied the Apriori algorithm to understand customer transaction patterns, helping businesses determine popular product combinations [22][23]. In the cafe sector, Tulodo *et al*. (2021) showed how the Apriori algorithm can be applied to increase sales at Oriental Cafe. Their findings helped determine product combinations that are often purchased together, supporting increased promotions [24]. Ulfha and Amin (2020) also applied the Apriori algorithm to identify drug purchasing patterns, providing real benefits for business management efficiency [25]. The results of the analysis at Anak Panah Kopi provide a strong foundation for developing data-based marketing strategies, such as the promotion of Sunny Go Coffee and Jamur Crispy product packages. By basing decisions on identified purchasing patterns, businesses can improve marketing efficiency, optimize stock management, and drive consumer loyalty. Evidence from various previous studies confirms that the Apriori algorithm is a reliable tool for data-based strategic decision making.

5. Conclusion and Recommendations

From the results of the Apriori Algorithm calculation, consumer interest when buying Sunny Go Coffee will buy Crispy Mushrooms with a Support value of 50% and a Confidence value of 56%, and when buying Crispy Mushrooms, they will buy Sunny Go Coffee with a Support value of 50% and a confidence of 71%. These results can be concluded that most likely if consumers buy Crispy Mushrooms, consumers also buy Sunny Go Coffee in one transaction. The use of Association rule parameters, namely a minimum support value of 30% in a confidence value of 60% can provide guidelines in identifying consumer interest patterns. This information can help Anak Panah Coffee in developing marketing strategies. With this research, it is hoped that there will be improvements or developments in the application of the Apriori Algorithm for Anak Panah Coffee transaction data and suggestions from the research conducted are to develop a web-based program and an android-based application to make it easier to use.

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