Implementation of The Apriori Algorithm on X Cafe Sales Transactions for Product Bundling Package Recommendations

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Abstract

Bundling packages are a marketing strategy in which several products are combined at a more attractive price than if purchased separately. This strategy effectively increases sales, attracts new customers, and levels up the average transaction value. Cafe X, located in Bogor, is a coffee shop that has not yet had a product bundling strategy package to increase product sales. This study aims to implement the Apriori algorithm on sales transactions at Cafe X to bundle product recommendations. The research stages consist of data collection, preprocessing, implementation of an apriori algorithm, and extracting association rules. In this study, a website-based apriori algorithm was implemented. Users can enter the minimum support value, minimum confidence value, and the recommended menu for product bundling. Based on the research results, it is produced for data input on the application with menu recommendations in the form of Tsuin Iced Coffee and Chicken Strips menus with a minimum support of 50% and a minimum Confidence of 90% can produce recommendations for 3 product bundling packages, including Package 1 recommendations are Tsuin Iced Coffee, Chicken Strips, Hot Barbeque Chicken. Package 2 recommendations are Tsuin Iced Coffee, Chicken Strips, and Nachos. Package 3 recommendations are Tsuin Iced Coffee, Chicken Strips, Hot BBQ chicken and Nachos.

Keywords: algorithm, apriori, bundling product, coffee, sales transaction

1. Introduction

X Café is a coffee shop in Bogor that sells various foods such as Asian Food, Pasta, Western Food, Snacks, and beverages menus. The beverages include Coffee Mocktail, Signature Coffee, Non-Coffee Mocktail, and milk and tea-based drinks. This cafe aims to increase sales and customer satisfaction. However, this cafe does not yet have a product bundling package. Therefore, this research is needed on product bundling.

Product bundling is a marketing strategy in which several products or services are combined into a single package or offering sold together at a lower price than the total price if the products were purchased separately. (Fang et al., 2022; Mutasar & Niesa, 2021; Sukron & Windyarti, 2021). Bundling package is a marketing strategy in which several products or services are combined into one package at a more attractive price than if purchased separately. This strategy effectively increases sales, attracts new customers, and increases the average transaction value. (Ilmi & Zulkarnain, 2023). Bundling packages can be an effective strategy because it can increase the transaction value. By purchasing a package, customers buy more products at once, thus increasing the overall transaction value. In addition, product bundling can be a solution for introducing new products. Less popular products can become more attractive when bundled with more popular products. (Lestari & Hafiz, n.d.; Mandiri et al., 2024).

Meanwhile, product bundling packages can be obtained from sales transaction data analysis as a decision-maker in making business solutions (Anggraini et al., 2023; Shely Amalia & Darwis, 2021). In sales transactions, it is necessary to explain consumer purchasing patterns so that they will become product recommendations that must be promoted or associated (Purnomo et al., n.d.; Salman Al Faridzi & Rahman Prehanto, 2022). However, designing an attractive and profitable bundling package can be challenging without the correct data. Therefore, implementing the Apriori algorithm is needed to identify the most frequently purchased product combinations and design a more effective bundling package that suits customer preferences.

The apriori algorithm is a type of algorithm in data mining where this algorithm applies to association rules to find rules for a combination of items in a product sales transaction database (Haidar & Hidayat, n.d.; Oktafia Lingga Wijaya & Yuliansyah, 2022; Purnomo et al., n.d.; Santoso, 2021). The apriori algorithm is applied to applications to obtain association rules and find patterns of relationships between one or more items in data (Nindyya et al., 2023; Ratna et al., 2021; Widodo & Lemantara, 2023). This algorithm will find product associations in joint purchasing patterns to form the basis for forming packages. The Apriori algorithm works with the concept of support and confidence. Support measures how often an itemset appears in the data, while Confidence measures how often an item appears if other items in the itemset also appear. This algorithm is used to find frequent item sets that meet the minimum support and then get a rule that meets the minimum confidence level of the previous frequent item sets. This algorithm has advantages, including curiosity about the type of transaction data, ranging from retail sales data to web log data. In addition, there is a parameter adjustment by setting the minimum support and confidence values to control the level of accuracy and the number of association rules generated (Nindya Saraswati & Yeyen Pratika, 2024; Oktory & Hadiwandra, 2024; Widodo & Lemantara, 2023) .

This study aims to implement the Apriori algorithm in sales transactions at Café X for product bundling. Related research includes research by Saraswati and Pratika (2024) on the role of product bundling in coffee shops (Nindya Saraswati & Yeyen Pratika, 2024). Another related study is the research by Prastika et al. (2024), namely Analysis of Consumer Purchasing Patterns Using the Apriori Algorithm. (Laila Safitry et al., 2025).

2. Materials and Methods

The research stages consist of several stages: the collection of sales transaction data, data preprocessing, implementation of the Apriori Algorithm, formation of association rules, and product bundling recommendations. The research stages can be seen in Figure 1.
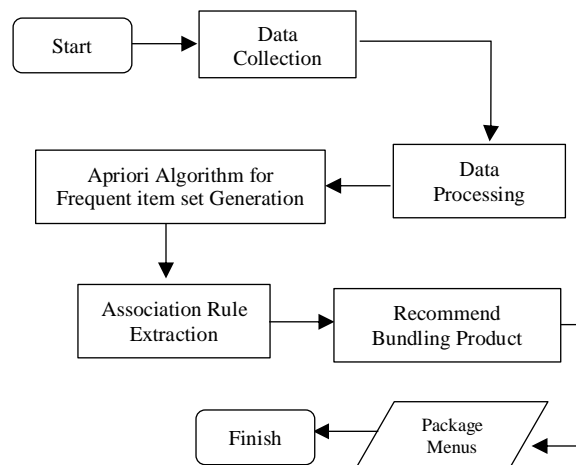

Figure 1. Research Stages

2.1. Data Collection

Data collection was carried out using data observation techniques. The data collected was sales transaction data at Café X. In addition, observations were made on the menu data at the café. This is due to the need for product bundling from implementing the apriori algorithm.

2.2. Data Preprocessing

At this stage, several processes will be carried out. The first stage is Data Selection. At this stage, the transaction data selection process is carried out where the data processed is transaction data with a minimum purchase of 2 product items. The next stage is Data Cleaning. Data Cleaning is carried out by cleaning missing value data and only 1 item of purchase data. The last stage is data transformation. Data transformation is carried out at this stage by changing transaction data into tabular form through binary numbers 0 and 1.

2.3. Apriori Algorithm for Frequent Item Set Generation

At this stage, the implementation of the Apriori algorithm is carried out. The algorithm in pseudocode form (Figure 2) is then converted into the PHP-Mysqli programming language. A frequency pattern analysis is carried out in the implementation process of the apriori algorithm. This analysis is carried out to find a combination of items that meet the minimum Support value requirements in the database (Alma et al., 2020; Fathurrahman et al., 2024; Fathurrozi et

al., 2023). The second item Support value is obtained using Formula 1 (Alma et al., 2020; Arief Wibowo et al., 2023; Giovanni et al., n.d.) (Guntur Alam & Abdullah, 2024).

```
k=1
Fₖ ={i|i ∈ I ∧ σ({i})≥ ×minsup}
repeat
k=k+1
Cₖ =apriori-gen (Fₖ ₋₁)
foreach transaction t ∈ T do
Cₜ =subset (Cₖ ,t)
foreach candidate itemset t ∈ Cₜ do
σ(c)= σ(c)+1
end for
end for
Fₖ ={c|c ∈ Cₖ ∧σ (c)≥N ×minsup}
until Fₖ = ∅
The result= ∪Fₖ
```

Figure 2. Apriori Pseudecode Algorithm

$$Support\ (A, B) = \frac{\sum Transaction\ include\ A\ and\ B}{\sum Transactional} \tag{1}$$

Each item represents one item whose frequency of occurrence is greater than a specified minimum value (ϕ). For example, $\phi = 2$, it is said that everything is greater than or equal to two times. The set of k item sets is displayed repeatedly Fk (Figure 2). After finding all the high values, find the association rule that meets the minimum reliability by calculating the reliability of the relationship rule A -> B. The reliability value of rule A -> B is obtained using Formula 2 (Alma et al., 2020; Fathurrahman et al., 2024; Fathurrozi et al., 2023).

$$Confidence\ (B|A) = \frac{\sum Transaction\ include\ A}{\sum Transaction\ include\ A\ and\ B} \tag{2}$$

2.4. Association Rule Extraction

Association rule extraction is performed after all iterations are completed. Association rules can be formed if the combination that has been formed meets the minimum confidence that has been determined in the form of "if...then....".

3. Results and Discussion

The data obtained is still qualitative, as is the sales transaction data from December 2024. In addition, there is a data menu in the Cafe and product prices. The amount of data is 500 sales transaction data.

The next stage is data preprocessing, which begins with data selection. At this stage, data selection and data cleaning are carried out (Table 1). Transaction data that is less than two items is cleaned. From 500 data to 440 data (Figure 3), the data will be processed for the next preprocessing stage. Figure 4 shows the data preprocessing stage.

The next stage is the application of the apriori algorithm by entering the input of minimal support, minimal confidence, and the recommended menu that will be used as a bundling product. Figure 5 is a display of the interface with input of recommended menus in the form of Tsuin Iced Coffee and chicken Strips with a minimum support of 50% and a minimum Confidence of 90%. Then, the calculation is carried out by applying the Apriori algorithm using Formula (1) and Formula (2). The results of the calculation of formula one and formula 2 in the application can be seen in Figure 6.

Table 1. Data Selection Result

Receipt Number	Product Purchasing
1O5W7H	Tsuin Iced Coffee, Hot Bbq Chicken Taco, Smoke Beef & Cheese, Lychee Tea, Chicken Strips, Nachos, Mineral Water, Chicken Strips, French Fries, Tsuin Berry Latte
1O5W7J	Tsuin Iced Coffee, Hot Bbq Chicken Taco, Lychee Yakult, Lychee Tea, Nachos, Mineral Water, Lychee Tea, Chicken Strips, French Fries, Tsuin Berry Latte, Cheesecake Danish, Cappuccino, Smoke Beef & Cheese
…	…
1O5W2N	Fish n Chips, Almond Croissant w/ Caramel Sauce, Hot BBQ Chicken Taco, Earl Grey Milk Tea, Lychee Yakult, Venus, Caramel Tsuin Coffee, Strawberry Latte, Caramel Chocolate Tart, Tsuin Berry Latte
…	…
1O5VY8	Croissant Bread Pudding w/ Ice Cream, Spicy Wings, Almond Brownies w/ Ice Cream, Tsuin Iced Coffee, AMERICANO, Mineral Water, Nachos
1O5W5D	Earl Grey Milk Tea, Spicy Wings, Crispy Chicken with Sambal Bawang, Smoke Beef & Cheese, Tsuin Iced Coffee, Cheesecake Danish, Mineral Water, Siu Mai, Summer Friday

Figure 3. X Café Dataset

Figure 4. Preprocessing Data on Web Based Application

Figure 5. Input Interface display of recommended menus that will be used as examples of bundling products.

Figure 6. Recommendation Results based on Minimum Support 50%, Minimum Confidence 90% for Tsuin Iced Coffee, Chicken Strips Recommendations

Figure 7 shows the Generate Rule generated from input of Minimum Support 50% and Minimum Confidence 90% for the Recommendation of Tsuin Iced Coffee and Chicken Strips.

Figure 7. Generate Rule for Minimum Support 50%, Minimum Confidence 90% for Recommendation of Tsuin Iced Coffee, Chicken Strips.

In Figure 7, the rule is obtained as follows:

If Buying Chicken Strips and Tsuin Iced Coffee, **Then** Will Buy Hot BBQ Chicken Taco

If Buying Chicken Strips and Tsuin Iced Coffee, **Then** Will Buy Nachos

If Buying Chicken Strips and Tsuin Iced Coffee, **Then** Will Buy Hot BBQ Chicken Taco, Nachos.

The analysis resulted in three product bundling recommendations for the Tsuin Iced Coffee and Chicken Strips menus, shown in Table 2.

Table 2. Bundling Product Recommendation for the menu of Tsuin Iced Coffee, Chicken Strips

	Bundling Product Recommendation	Certain Value
Menu Package 1	Tsuin Iced Coffee, Chicken Strips, Hot Bbq Chicken	92.95
Menu Package 2	Tsuin Iced Coffee, Chicken Strips, Nachos	90.60
Menu Package 3	Tsuin Iced Coffee, Chicken Strips,Hot Bbq Chicken Nachos	90.26

4. Conclusion

X Cafe, located in the Bogor area does not have a product bundling strategy package to increase product sales. This study aims to implement the Apriori algorithm on sales transactions at Cafe X for product bundling. Product bundling packages can be obtained from sales transaction data analysis. In this study, the Apriori algorithm was implemented on a website-based application. Users can enter the minimum support value, minimum Confidence value and the menu that will be recommended for product bundling. Based on the research results produced for data input on the application with menu recommendations in the form of Tsuin Iced Coffee, Chicken Strips with a minimum support of 50% and a minimum Confidence of 90%, recommendations for 3 product bundling packages can be produced, namely Package 1 recommendations in the form of Tsuin Iced Coffee, Chicken Strips, Hot Bbq Chicken. Package 2 recommendations consist of Tsuin Iced Coffee, Chicken Strips, Nachos. Package 3 recommendations consist of Tsuin Iced Coffee, Chicken Strips, Hot Bbq Chicken Nachos.

Acknowledgments

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