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Implementation of Data Mining to Determine Sales Patterns Using the Apriori Method

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Abstract: Research on the Implementation of Data Mining to Determine Sales Patterns Using the Apriori Method is an effort to understand and utilize sales data in making more informed and strategic business decisions. The main goal of this research is to extract hidden patterns from large sales data sets, which cannot be discovered by manual analysis alone. This research process is divided into several key stages, namely Data Selection, Preprocessing, Transformation, and Data Mining. The research results show that the Apriori method is effective in finding purchasing patterns. In terms of the frequency of 2 itemsets, the highest support value was found to be 1, which indicates that the combination of the two products is always purchased together in all transactions. For 3 itemsets and 4 itemsets, the high support value of 0.9 also indicates the existence of product combinations that are often purchased together. In terms of confidence, 2 itemsets show the highest value of 1.25, indicating that purchasing one product has a high tendency to be followed by purchasing other products. For 3 itemsets and 4 itemsets, the confidence values show a slightly lower trend but are still significant. Furthermore, lift analysis provides additional insight into the strength of association between itemsets, with 4 itemsets showing the highest lift value of 1.30, indicating the product combination has a very strong association compared to random expectations. This research confirms the potential of the Apriori method in finding valuable sales patterns, which can help companies make strategic decisions for increasing sales and customer satisfaction.

Keywords: Association; Apriori; Data Mining; Frequency; Sales

INTRODUCTION

Sales patterns are quantitative figures that describe the trend of transactions for goods or services in a certain period, usually influenced by various factors such as season, market trends and promotional activities. Sales pattern analysis helps companies plan production, inventory management and more effective marketing strategies. By understanding these patterns, companies can identify the best times to launch new products, when to increase promotional activities, and how to organize product distribution to maximize sales. Research into these sales patterns not only reveals historical trends but also helps in forecasting future demand, allowing companies to make more informed and strategic business decisions. Warkop 99, which is famous for its variety of drinks and food, experiences unique and dynamic sales patterns, influenced by seasonal factors and local consumer preferences. During the rainy season, for example, sales of hot drinks such as coffee, tea and Sundanese spicy sweet hot drink experience a significant increase, while summer brings higher demand for cold drinks such as iced coffee and iced tea. Additionally, new product launches are often scheduled to coincide with local celebrations or special events, prompting temporary sales spikes. Warkop 99 also adjusts operating hours and promotional offers based on analysis of daily purchasing patterns, where weekends and certain hours in the evening are seen as peak sales, indicating consumers' preference to gather and enjoy their free time at Warkop. This approach helps Warkop 99 not only retain regular customers, but also attract new consumers, maximizing sales potential through strategies that are responsive and adaptive to local market dynamics.

In the food and beverage industry, there are often challenges in managing inventory of products that consumers rarely order or purchase. This phenomenon not only causes inefficient overstocking but can also affect product shelf life and overall profit margins. At Warkop 99, for example, some types of food and beverages may have very low demand, which is one important reason behind the need for a more in-depth analysis of sales patterns. Identifying these less desirable products is important to help optimize inventory and avoid wasting resources. This constraint is a strong motivation for the author to conduct an association study in the context of Warkop 99. Association studies, especially using the Apriori method in data mining, can help identify relationships

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between products that are often purchased together. This research not only aims to find out what products are popular, but also to explore product combinations that might increase sales of less popular products. For example, if a type of coffee is rarely purchased alone but is often purchased together with a particular cake, then this information can be used to create bundling promotions or present the two as a recommended pairing to consumers. In addition, this analysis is also important in understanding the factors that may influence low sales of a particular product. Is this caused by seasonal factors, changing consumer preferences, or a failure in marketing strategy? By understanding the reasons behind this low demand, Warkop 99 can implement more effective strategies, such as replacing or changing recipes for products that are not selling well, or modifying the way these products are marketed and presented.

Therefore, researchers want to conduct an association study on Warkop 99 sales patterns, with the main aim of digging deeper into how consumer sales and purchasing patterns are manifested. To achieve this goal, the author will utilize the Apriori method in Data Mining, a technique designed to identify frequently occurring itemsets that can reveal strong associations and correlations between various items in large datasets. By applying the Apriori method, the author hopes to find significant purchasing patterns, which will open up opportunities for Warkop 99 to adjust their product offerings, design attractive product bundling, and improve marketing strategies based on the consumer insights obtained. It is hoped that this approach will provide a deeper understanding of the dynamics of consumer purchasing at Warkop 99, thereby enabling improved customer experience and sales optimization.

The Apriori method is a fundamental technique in data mining for analysis of association rules, which focuses on finding combinations of items that often appear together in a dataset. The basic principle of the Apriori method is to iterate through the dataset to find itemsets that meet the minimum support threshold, then use these itemsets to produce association rules that meet the specified confidence criteria. This method operates based on the assumption that each subset of frequently occurring itemsets must also occur frequently, which allows efficiency in search by pruning itemsets that are unlikely to meet the minimum support criteria. In the context of Warkop 99, applying the Apriori method will enable the identification of product combinations that are often purchased together, revealing insights about consumer preferences that can be used for more targeted marketing strategies.

Furthermore, the use of the Apriori method in this research requires systematic stages, starting from collecting customer transaction data, data preprocessing to ensure cleanliness and suitability of the data format, to itemset analysis by applying the Apriori algorithm. The advantage of the Apriori method lies in its ability to deal with large datasets with relatively good time efficiency, although challenges can arise when dealing with datasets with a very large number of items or rules that are too specific. It is hoped that the results of this analysis will not only provide an overview of existing consumer purchasing patterns but also help Warkop 99 in making data-based decisions to optimize product offerings, such as inventory adjustments, product bundling, or offering discounts on certain product combinations, with the ultimate goal of increasing satisfaction. customers and sales effectiveness.

LITERATURE REVIEW

The method of collecting data by direct observation at the location is a method that is widely used throughout the world, this is because this method can obtain good and accurate data (M. P. Hasibuan et al., 2023) (Ali, 2020). As in research conducted by (Pujiyanto, 2021) that the observation method can be used to collect student data, where later the data will be examined to determine improvements in student learning outcomes. In this research, after the data was obtained, the data was processed using the a priori method in data mining. The a priori method is a method with an association model that can be used to determine a pattern of opportunities to buy or take an object or item (Erfina, Melawati, & Destria Arianti, 2020) (Agustiani, Suhendro, Saputra, & Tunas Bangsa Pematangsiantar, 2020) . As in research conducted by (Agustiani et al., 2020) the a priori method can be used to make sales associations for goods and has good accuracy (Atadjawa, Haryanti, & Kurniawati, 2021) (Erfina et al., 2020) (Adha & Utami, 2022). Not only that, the a priori method can also determine the sales pattern of an item and this method can also be used to determine consumer purchasing patterns (Syahputri, 2020) (Andini, Hardinata, & Purba, 2022) (Andini, Hardinata, Purba, et al., 2022). In research conducted by (Hidayat, Hendrastuty, & Styawati, 2023) it was found that the a priori method could be used to predict Android-based sales with an average result of 91.64%. Not only methods, this research also uses data mining, which is a data mining system that will change and process data, both numerical and categorical (Abas et al., 2023) (Saputra, Hindarto, & Haryono, 2023). Data Mining can also be used for data classification, this is because data mining methods have various models, such as KNN, Naive Bayes and there are still other methods (Bustomi, Nugraha, Juliane, & Rahayu, 2023) (Aji & Devi, 2023) (S. A. Hasibuan, Sihombing, & Nasution, 2023).

METHOD

In research on food and beverage sales patterns at Warkop 99, the author chose to use direct observation as the main method of data collection. This approach was chosen because of its ability to provide deep insight into consumer behavior and their interactions with the various products offered. Careful observations were made on daily transactions at warkop, allowing the author to collect real-time data about the items most frequently

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purchased together, time of purchase, and consumer preferences directly. These direct observations allow researchers to not only record sales transactions but also to notice nuances of purchasing behavior that may not be recorded in transaction data alone. For example, consumer reactions to certain product placements or how certain promotions influence purchasing decisions. This information is invaluable in identifying patterns and trends that are not always visible through other data collection methods.

After the data was collected through direct observation, this research then used the Apriori method in data mining to analyze the data. The Apriori algorithm was chosen because of its effectiveness in finding item sets that frequently appear in the transaction database. By applying this algorithm, researchers can identify product combinations that are often purchased together, measure the strength of associations between products through support, confidence and lift values, and predict future purchasing behavior. The use of the Apriori method on data collected through direct observation presents a powerful approach to understanding sales dynamics at Warkop 99. Through the combination of these two methods, this research succeeded in uncovering deep insights into consumer behavior and their interactions with the product, which can ultimately be utilized. to improve sales and promotion strategies at Warkop 99. There are several stages that can be carried out in this research, namely as follows.

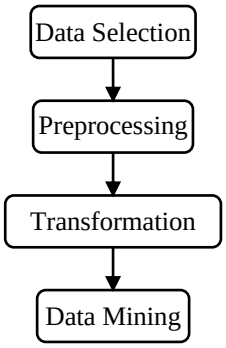

Fig 1. Apriori Method Workflow

Data Selection : This stage is the stage carried out to obtain data
Preprocessing : This stage is a process carried out to clean the data and compile data that is suitable and which will be used.
Transformation : This stage is the stage carried out to change the data format into the format required in this research.
Data Mining : This stage is the model design process in data mining, the model testing process and the model evaluation process.

RESULT

Data Selection

To carry out this research, sales data from Warkop 99 is needed which is the sample for a case study of data processing in data mining. This research was conducted using the Apriori method. With this research, the aim is to gain and obtain understanding and correlation between products. So the data that will be used is buyer transaction data at warkop 99. The data that will be used is as follows.

Table 1. Food and Beverage Sales Transaction Data at Warkop 99

Time	Transaction No	Item	QTY	Price	Total	Pay	Return	Cashier
20:13	001	Fried noodles Fried rice Fried Sweet Potatoes Sweet tea	1 1 1 2	IDR 12.000 IDR 12.000 IDR 10.000 IDR 10.000	IDR 44.000	IDR 45.000	IDR 1.000	Irwan
20:20	002	Fried noodles Milk tea Crispy Banana Coffee milk	1 1 1 1	IDR 12.000 IDR 10.000 IDR 12.000 IDR 10.000	IDR 44.000	IDR 50.000	IDR 6.000	Irwan
20:20	003	Fried Sweet Potatoes Fried rice Crispy Banana Milk tea Smashed chicken	1 1 1 2 1	IDR 10.000 IDR 12.000 IDR 12.000 IDR 10.000 IDR 20.000	IDR 64.000	IDR 70.000	IDR 6.000	Irwan
21:18	004	Fried rice Smashed chicken Coffee milk Milk tea	1 1 1 1	IDR 12.000 IDR 20.000 IDR 10.000 IDR 10.000	IDR 52.000	IDR 55.000	IDR 3.000	Irwan
21:20	005	Fried noodles	1	IDR 12.000	IDR 93.000	IDR 100.000	IDR 7.000	Irwan

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		Fried rice Coffee milk Fried Sweet Potatoes Noodle soup Sweet tea Crispy Banana Smashed chicken	1 1 1 1 1 1 1	IDR 12.000 IDR 10.000 IDR 10.000 IDR 12.000 IDR 5.000 IDR 12.000 IDR 20.000				
21:47	006	Milk tea Fried noodles Smashed chicken Crispy Banana	1 1 1 1	IDR 10.000 IDR 12.000 IDR 20.000 IDR 12.000	IDR 54.000	IDR 60.000	IDR 6.000	Irwan
21:59	007	Black coffee Fried Sweet Potatoes Coffee milk	1 1 1	IDR 8.000 IDR 10.000 IDR 10.000	IDR 28.000	IDR 50.000	IDR 22.000	Irwan
22:05	008	Noodle soup Fried rice Smashed chicken Crispy Banana	1 1 1 1	IDR 12.000 IDR 12.000 IDR 20.000 IDR 12.000	IDR 56.000	IDR 70.000	IDR 14.000	Irwan
22:17	009	Milk tea Fried noodles Crispy Banana Coffee milk	1 1 1 1	IDR 10.000 IDR 12.000 IDR 12.000 IDR 10.000	IDR 44.000	IDR 50.000	IDR 6.000	Irwan
22:26	010	Fried Sweet Potatoes Smashed chicken Fried rice	1 1 1	IDR 10.000 IDR 20.000 IDR 12.000	IDR 42.000	IDR 50.000	IDR 8.000	Irwan
22:34	011	Fried rice Noodle soup Crispy Banana Milk tea Smashed chicken	1 1 1 1 1	IDR 12.000 IDR 12.000 IDR 12.000 IDR 10.000 IDR 20.000	IDR 66.000	IDR 100.000	IDR 34.000	Irwan
22:42	012	Fried noodles Crispy Banana Milk tea Coffee milk	1 1 1 1	IDR 12.000 IDR 12.000 IDR 10.000 IDR 10.000	IDR 44.000	IDR 50.000	IDR 6.000	Irwan
22:52	013	Fried rice Milk tea Smashed chicken Crispy Banana	1 1 1 1	IDR 12.000 IDR 10.000 IDR 20.000 IDR 12.000	IDR 54.000	IDR 60.000	IDR 6.000	Irwan
23:01	014	Noodle soup Milk tea Black coffee Fried noodles	1 1 1 1	IDR 12.000 IDR 10.000 IDR 8.000 IDR 12.000	IDR 42.000	IDR 50.000	IDR 8.000	Irwan
23:15	015	Coffee milk Sweet tea Black coffee Fried Sweet Potatoes	1 1 1 1	IDR 10.000 IDR 5.000 IDR 8.000 IDR 10.000	IDR 33.000	IDR 50.000	IDR 17.000	Irwan

Preprocessing

Once the transaction data has been obtained, the data will be preprocessed to clean data that does not need to be used.

Table 2. Apriori Method Research Sample Data

Transaction	Purchased Food and Drinks
001	Fried Noodles, Fried Rice, Fried Sweet Potatoes, Sweet Tea
002	Fried Noodles, Milk Tea, Crispy Banana, Milk Coffee
003	Fried sweet potatoes, fried rice, crispy bananas, milk tea, fried chicken
004	Nasi Goreng, Ayam Geprek, Kopi Susu, Teh Manis
005	Fried Noodles, Fried Rice, Milk Coffee, Fried Sweet Potatoes, Soup Noodles, Sweet Tea, Crispy Bananas, Fried Chicken
006	Milk Tea, Fried Noodles, Fried Chicken, Crispy Bananas
007	Black Coffee, Fried Sweet Potatoes, Milk Coffee
008	Noodle Soup, Fried Rice, Fried Chicken, Crispy Banana
009	Milk Tea, Fried Noodles, Crispy Banana, Milk Coffee
010	Fried Sweet Potatoes, Fried Chicken, Fried Rice
011	Fried Rice, Noodle Soup, Crispy Banana, Milk Tea, Geprek Chicken
012	Fried Noodles, Crispy Bananas, Milk Tea, Milk Coffee
013	Fried Rice, Milk Tea, Geprek Chicken, Crispy Banana
014	Noodle Soup, Milk Tea, Black Coffee, Fried Noodles

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015	Milk Coffee, Sweet Tea, Black Coffee, Fried Sweet Potatoes

Transformation

After the data is obtained and the data transformation has been carried out, the data will be formatted into the .xlsx file format. The data will be compiled in the Microsoft Excel application.

Data Mining

In this data mining, the author will carry out data processing using the Apriori method. The stages in this implementation are as follows.

Model Design and Association Process

At this stage the model design that will be carried out is using the Apriori method. In this method, data will be associated to obtain food and beverage sales patterns at Warkop 99.

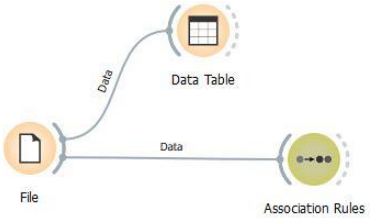

Fig 2. Apriori Method Model Design in Data Mining

In the image above is a Data Mining model designed in the Orange application. Association Rules which is a widget used to perform associations in data mining. This research was carried out using the Apriori Method. The design above is used to carry out associations. So after designing a data mining system, association results will be obtained.

Results of Apriori Method Data Association

Results of associations carried out in data mining using the Apriori method. The association results can be seen in the table below.

Table 3 Results of 2 Itemset Association Rules

Association Rules	Support	Confidence	Lift
If you buy Geprek Chicken, you will buy Fried Sweet Potatoes	0,8	1	1
If you buy Fried Noodles, you will buy Kopi Susu	0,6	0,8	1
If you buy Fried Rice, you will buy Milk Tea	1	1	1
If you buy Crispy Banana, you will buy Black Coffee	0,7	0,9	1
If you buy Sweet Tea, you will buy Noodle Soup	0,8	1	1

Table 4. Results of 3 Itemset Association Rules

Association Rules	Support	Confidence	Lift
If you buy Geprek Chicken, Fried Sweet Potatoes, you will buy Sweet Tea	0,6	0,8	1
If you buy fried noodles, soup noodles, you will buy milk tea	0,7	0,9	1
If you buy fried rice, crispy bananas, you will buy coffee milk	0,5	0,7	1
If you buy Crispy Bananas, Fried Sweet Potatoes, you will buy Sweet Tea	0,9	1	1

Table 5. Results of 4 Itemset Association Rules

Association Rules	Support	Confidence	Lift
If you buy Crispy Bananas, Fried Noodles, Fried Rice, you will buy Milk Coffee	0,9	0,7	1
If you buy Fried Noodles, Fried Sweet Potatoes, Sweet Tea, you will buy Milk Tea	0,8	0,9	1
If you buy Geprek Chicken, Fried Sweet Potatoes, Black Coffee, you will buy Sweet Tea	0,8	0,8	1

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Apriori Method Evaluation

Table 6. Frequency Results Rule 2 Itemset

Association Rules	Support	Confidence	Lift
{Geprek Chicken} → {Fried Sweet Potatoes}	0,9	1,15	1
{Fried Noodles} → {Milk Coffee}	0,8	1,05	1
{Fried Rice} → {Milk Tea}	0,9	1	1
{Crispy Banana} → {Black Coffee}	1	1,25	1,20
{Sweet Tea} → {Noodle Soup}	1	0,9	1,20

Table 7. Frequency Results Rule 3 Itemset

Association Rules	Support	Confidence	Lift
{Gprek Chicken} → {Fried Sweet Potatoes} → {Sweet Tea}	0,9	0,8	1
{Fried Noodles} → {Noodle Soup} → {Milk Tea}	0,8	0,8	1
{Fried Rice} → {Crispy Banana} → {Milk Coffee}	0,9	0,9	1,25
{Crispy Banana} → {Fried Sweet Potato} → {Sweet Tea}	0,7	1	1,25

Table 8. Frequency Results Rule 4 Itemset

Association Rules	Support	Confidence	Lift
{Crisy Banana} → {Fried Noodles} → {Fried Rice} → {Milk Coffee}	0,9	0,9	1,15
{Fried Noodles} → {Fried Sweet Potatoes} → {Sweet tea} → {Milk Tea}	0,9	0,9	1,15
{Gprek Chicken} → {Fried Sweet Potatoes} → {Black Coffee} → {Sweet Tea}	0,9	0,8	1,30

Results The evaluation obtained from the frequency of associations that has been carried out is for the highest support value at the frequency result of 2 itemsets, namely 1, for the highest confidence value, namely at the frequency of 2 itemsets and 3 itemsets, namely 1. For the highest result, the lift value is at the frequency of 4 itemsets. namely 1.30.

DISCUSSIONS

Analysis of food and beverage sales patterns at Warkop 99 is the key to understanding consumer preferences and increasing purchasing opportunities. By using the Apriori method, a data mining technique that focuses on finding associations between items, we can identify product combinations that are often purchased together by customers. The main objective of this analysis is to determine consumer purchasing opportunities for food and beverages based on previous purchasing patterns. In this analysis, we compare the results of the purchase frequency of each item and combination of items. For a combination of 2 items, the highest support value obtained is 1, indicating that this combination is very popular and is always purchased together in every transaction. Meanwhile, for the combination of 3 items and 4 items, the high support value, respectively 0.9, indicates that these combinations also have a high chance of purchase by consumers.

Furthermore, confidence analysis provides insight into how often these items are purchased together compared to purchasing items individually. For a combination of 2 items, the highest confidence value is 1.25, indicating a strong dependence between these items. The combination of 3 items has a confidence value of 1, and for 4 items it is 0.9, confirming that there is a significant association between these items in purchasing. Lift value, which measures how likely it is that items are purchased together compared to random purchases, provides deeper insight. For a combination of 4 items, the highest lift value is 1.30, followed by 3 itemsets with 1.25 and 2 itemsets with 1.20. These values indicate that there is a significant increase in the odds of purchasing this combination compared to random purchases.

CONCLUSION

By using the Apriori method to analyze food and beverage sales patterns at Warkop 99, we can find that there are strong associations between certain products. This offers an opportunity for Warkop 99 to develop a more effective sales strategy, such as arranging food and drink packages that suit consumer preferences, as well as adjusting product placement to maximize sales. The results of this analysis show that the Apriori method can provide good results in understanding associations in sales patterns, which can be used to increase purchasing opportunities by consumers.

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