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Implementation of RFM Analysis to Enhance Sales Patterns of Food and Beverages at Bonjour Café and Resto Using the Apriori Algorithm

Julvan Marzuki Putra Sibarani *
Information Systems Study Program, Faculty of Computer Science, Sekolah Tinggi Ilmu Komputer Cipta Karya Informatika, East Jakarta City, Special Capital Region of Jakarta, Indonesia.
Corresponding Email: julvansibarani@gmail.com.

Yuma Akbar
Information Systems Study Program, Faculty of Computer Science, Sekolah Tinggi Ilmu Komputer Cipta Karya Informatika, East Jakarta City, Special Capital Region of Jakarta, Indonesia.
Email: yumekhan@gmail.com.

Sutisna
Information Systems Study Program, Faculty of Computer Science, Sekolah Tinggi Ilmu Komputer Cipta Karya Informatika, East Jakarta City, Special Capital Region of Jakarta, Indonesia.
Email: ananasutisnapribadi@gmail.com.

Kiki Setiawan
Information Systems Study Program, Faculty of Computer Science, Sekolah Tinggi Ilmu Komputer Cipta Karya Informatika, East Jakarta City, Special Capital Region of Jakarta, Indonesia.
Email: ki2djoaz@stikomcki.ac.id.

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Abstract: The rapid growth of the culinary business has made business competition in this field increasingly tight, so a strategy is needed to increase food and beverage sales patterns. Bonjur Cafe Resto serves many food and beverage menus, but business actors need to try to produce product innovations in order to provide satisfactory service to customers. In this condition, a data processing technique is needed to determine customer segmentation and menu recommendations at Bonjur Cafe Resto. The analysis method used is RFM Analysis by analyzing customer behavior, analyzing purchase transaction data consisting of Recency Frequency Monetary (RFM) attributes and data mining techniques with the Apriori algorithm, where this algorithm is used to determine the most frequently appearing data set (frequent itemset). The results of this study are grouped into five categories of customers based on their purchasing behavior and association rules are formed with predetermined parameters, support 28% and confidence

70%. This can later be a recommendation for a menu combination from the data that has been collected and applied using the apriori algorithm so that it is expected to be used for service evaluation and be able to increase customer satisfaction so that Bonjur Cafe Resto can develop better.

Keywords: RFM Analysis; Apriori Algorithm; Segmentation; Customer; Frequent Itemset.

1. Introduction

The rapid growth of the food and beverage business today makes the competition in the culinary business world very tight. Bonjur Cafe Resto is a business engaged in the culinary field. The menus served are snacks such as French fries, fried rice, sausages and so on as well as various processed coffee and juice drinks at economical prices, especially for students and school children [1]. Bonjur Cafe Resto provides supporting facilities needed by consumers such as Free Wi-Fi, an attractive place that makes people feel comfortable so that it can be used as a temporary resting place. The large number of daily consumer orders makes transaction data increase over time. In this case, it is necessary to analyze transaction data to obtain sales patterns. With information about sales patterns, Bonjur Cafe Resto can find out what is most often purchased by consumers [2]. In this study, the Apriori Algorithm was used, namely by providing relationships between items in sales data. The application of the Apriori Algorithm helps in forming candidate combinations of possible items, then testing is carried out whether the combination meets the minimum support and confidence parameters which are the threshold values given by the user [2]. In terms of providing the best service to customers, this food and beverage business must use the best business strategy, but sometimes there are several factors that become obstacles or constraints in determining the strategy. One of the contributing factors is the difficulty in producing analysis related to existing customer sales data [3]. A significant increase in transaction data will not be valuable if the data is not processed into something that has more value. Data mining techniques can be one way to process historical sales transaction data sourced from a large dataset [4]. Sales transactions are a sales effort that is carried out every minute, every day, every week, even years. So that the data will continue to accumulate, it can come from manual processes or computational processes. So that the existing data has not been utilized properly by decision makers 0. This study applies the RFM model to analyze customer characteristics or behavior using sales data at Bonjur Cafe Resto [6]. Bonjur Cafe Resto itself sells food and drink menus separately, whereas if we examine it more closely, perhaps if we introduce new innovations such as purchasing menus in economy packages, for example, which include heavy meals and drinks or snacks and drinks, sales could increase and the menus sold would be maximized.

Therefore, this research will provide a solution related to a way to analyze sales data in order to maximize marketing strategies and business strategies. From the results of our research, it is expected to help Bonjur Cafe Resto in maximizing the running of the business process, then being able to provide a picture of new innovations that can be used for menu combination recommendations, and also from the results of our research, it can help Bonjur Cafe Resto to see what menus can be developed and minimize raw material purchases for menus that are less popular so that they are not too long in the raw material warehouse and will expire. For this reason, one method that can be used is to apply the use of the Apriori Algorithm which can be used to determine the menus that are most often purchased by consumers by looking at consumer tendencies in making transactions [2]. In data mining, there are methods and techniques for fulfilling broad information needs and this information can be used as material for decision making. The application of data mining can be done with the apriori algorithm, where this algorithm is one of the most frequently used algorithms because it is easy to use, very simple, and can be used to determine the most frequently appearing data sets (frequent itemset) [3]. In this case, customer segmentation is needed by companies to better understand the characteristics of their different customers, so that companies can plan the right approach to each different customer segment [7]. Several studies have been developed to determine the best models and methods for conducting customer segmentation. Several previous studies that have been developed state that the model that is widely used and has a high level of accuracy is Recency, Frequency, Monetary (RFM). This model is an assessment process based on customer behavior that will be seen from the time of the customer's last transaction (Recency), the number of transactions (Frequency), and the money spent (Monetary). By studying the records of customer interactions and transactions in the past, companies can assess the 3 (three) aspects of these dimensions. The RFM model is widely applied to marketing databases and is a common tool used to build marketing strategies. RFM based on customer segmentation produces segmentation capabilities between 75% and 85%.

The underlying problem of this research is the absence of analysis related to the most popular menus of customers at Bonjur Café Resto, which results in difficulties in determining the purchase of raw materials based on favorite menus. In addition, there has been no promotion of favorite menus on Bonjur Café Resto's social media. Therefore, this study aims to answer two main questions: how to determine favorite menus to improve food and beverage sales patterns, and how the results of RFM and Apriori Algorithm analysis in this study. The objectives of the study include the application of data mining concepts using the Apriori Algorithm to identify the relationship between product items, so that they can be recommended to customers to increase sales, and to determine customer segmentation to increase the effectiveness of menu promotions. The contribution of this study lies in the utilization of existing datasets, with a focus on consumption trends and time analysis, to improve food and beverage sales patterns at Bonjur Café Resto.

Systematic Literature Review (SLR) is a method used to identify, evaluate, and interpr*et al*l research relevant to a particular research question, topic, or phenomenon. A comprehensive understanding of the research is an important requirement for researchers in conducting a study. SLR is an approach related to literature review, which focuses on the research questions to be answered. This process is carried out systematically through identification, selection, and assessment of relevant research literature [7]. The general stages in conducting an SLR include three main phases. First, the planning phase in where the Research Question (RQ) is determined as the basis and guide for the SLR process. RQ serves to direct the search and extraction of literature. The analysis and synthesis of data resulting from the SLR are the answers to the RQ that has been determined. A good RQ must be useful, measurable, and lead to understanding state-of-the-art research of the research topic [7]. Second, the implementation phase (conducting) which contains the implementation of SLR according to the established protocol. This stage begins with determining the literature search keywords (search string) based on PICOC (Population , Intervention, Comparison, Outcomes, Context). Understanding synonyms and alternative keywords will affect the accuracy of literature searches. Furthermore, literature search sources (e.g., digital libraries) are also determined [7]. Third, the reporting phase, which is the writing of SLR results in the form of publications, such as scientific journal papers. , or as Chapter 2 (Literature Review) in a thesis, dissertation, or dissertation. The structure of writing an SLR generally consists of three main parts: Introduction, Main Body, and Conclusion [7]. Survey methodology in this study is compiled based on the PICOC (Population, Intervention, Comparison, Outcomes, Context) framework to identify information needs from previous studies. The population in this study is the implementation of RFM Analysis to improve sales patterns. The intervention carried out is an effort to determine the favorite menu and analyzing the results of RFM and Apriori Algorithm. Comparison is made between Apriori Algorithm and RFM Analysis. The expected results are determining favorite menus and customer segmentation for promotion.

The survey protocol in collecting scientific journals and books relevant to the title of this research is summarized in the period 2019 to 2024. The types of publications used are journals and book chapters. The search string used is a combination of "Data Mining", "Implementation of RFM Analysis and Apriori Algorithm", and "Apriori Algorithm". The final results of the selection are 20 journals and 5 books. Literature review is a compilation of theories from various sources used as references in research or scientific papers. The main literature review used in this study. Several related studies that are used as references are the application of the Apriori Algorithm to sales transactions for food and beverage menu recommendations [3], analysis of food and beverage product sales patterns using the Apriori Algorithm [20], implementation of data mining using the Apriori Algorithm in determining inventory [21], implementation of the Apriori Algorithm in determining the combination of MSME menus [22], application of data mining in determining drug purchase transaction patterns using the Apriori Algorithm [23], implementation of the Apriori Algorithm in eyeglass sales [24], application of the market basket analysis data mining method to product sales data using the Apriori Algorithm [25], implementation of the Apriori Algorithm for web-based sales analysis [4], application of data mining using the Apriori Algorithm to transaction data as supporting information for sales strategies [26], analysis of drug sales transactions using the Apriori Algorithm [27], application of the Apriori Algorithm to sales data in stores [11], implementation of data mining to sales data with the Apriori Algorithm [28], analysis of consumer purchasing patterns in sales transactions using the Apriori Algorithm [29], implementation of association rules in analyzing sales data using the Apriori Algorithm [30], application of the Apriori Algorithm in e-commerce sales data analysis [10], implementation of the Apriori Algorithm in determining the ordering of goods for mobile phone sales transactions [31], application of the Apriori Algorithm in the sale of two-wheeled vehicle spare parts [32], segmentation of retail customers for pharmaceutical products using the data mining clustering method with modified Recency Frequency Monetary (RFM) analysis [33], customer loyalty segmentation based on RFM using K-Means [8], and implementation of data mining using the Apriori Algorithm to improve drug sales patterns 0.

The Recency Frequency Monetary (RFM) model is a behavior-based model used to analyze customer behavior and make predictions based on database data [8]. The RFM model is a popular method for measuring customer relationships. This model analyzes three attributes, namely Recency (R), Frequency (F), and Monetary (M) [6]. Recency indicates the time of the customer's last interaction with the product, Frequency refers to the number of times the customer interacts or makes a transaction, and Monetary Value indicates the total money spent by the customer in a certain time period [9][10]. The Apriori algorithm is a method for finding patterns of relationships between one or more items in a dataset. This algorithm is commonly used in business data processing to find frequent itemsets with the highest patterns. Frequent itemsets are patterns of items in a dataset that have support and confidence values that meet the minimum threshold [22]. The Apriori algorithm is also used to find association rules that meet the minimum support and confidence requirements [24]. The stages of the Apriori algorithm include high-frequency pattern analysis, association rule formation, and evaluation [25]. Association rules are descriptive data mining tasks for finding associative rules between data items [13]. Dataset is a collection of data used as research experiment material [14]. Dataset can be in the form of numeric, categorical, text, or image data. Dataset can be classified into private and public based on its accessibility. Based on the background and problems that have been described, this study aims to provide analytical solutions for Bonjur Cafe Resto in optimizing its marketing and business strategies. Through the application of the Apriori Algorithm and RFM analysis, this study is expected to identify consumer purchasing patterns, determine favorite menus, and conduct customer segmentation. The results of this analysis will provide recommendations for potential menu combinations, assist in planning raw material inventory, and minimize waste due to less popular menus. Thus, this study not only contributes to increasing operational efficiency and sales of Bonjur Cafe Resto, but also provides new insights into the use of transaction data for more strategic decision making. In addition, this study is also expected to contribute to the development of science in the field of data mining, especially in the application of the Apriori algorithm and RFM analysis in the culinary industry. Through the Systematic Literature Review (SLR) approach, this study has also reviewed various relevant previous studies, so that it can provide a strong and comprehensive theoretical basis for the analysis to be carried out.

2. Research Method

The study was designed to investigate how the implementation of RFM analysis and Apriori Algorithm can improve food and beverage sales patterns at Bonjur Cafe Resto. A quantitative approach was adopted in this study, with sales transaction data as the main source. This methodology includes data collection, data processing, data analysis, and interpretation of results, all of which are carried out systematically to answer the research questions.

2.1 Research Data

The data used in this study consists of primary data and secondary data. Primary data is daily sales transaction data of Bonjur Cafe Resto during December 2023, totaling 465 transactions. This data was obtained directly by the researcher as the administrator of the REKALABA cashier application system. Secondary data in the form of relevant scientific journals and textbooks, are used as a theoretical basis and reference. Primary data was collected through direct observation of the REKALABA cashier application system, recording every sales transaction that occurred. The data recorded includes the transaction date, menu name (food and drink), number of products sold (quantity), and total transaction price. This data is then verified to ensure its accuracy and completeness. The primary data attributes used in this study are as follows:

Table 1. Description of Primary Data Attributes

Attribute	Information
Customer_ID	Customer Identity
Date	Time of purchase
Menu Name	Name of food and drink menu
Total Qty Sales	Total number of orders
Total Amount	Total order cost

Secondary data were collected through a systematic literature search of scientific journal databases, digital libraries, and academic search engines. The literature selected was relevant to the research topic, had good publication quality, and contributed to the understanding of theory and methodology.

2.2 Data Analysis Methods

The study used two main analysis methods: RFM analysis and Apriori Algorithm. RFM analysis is used to understand customer behavior based on three dimensions: recency (last transaction time), frequency (transaction frequency), and monetary (total transaction value). The RFM analysis process includes calculating the RFM value for each customer, scoring based on categories (high, medium, low), segmenting customers based on a combination of RFM scores, and interpreting each segment to design appropriate marketing strategies. The Apriori Algorithm is used to find patterns of relationships between items (menus) that are often purchased together. The Apriori Algorithm process involves determining minimum support and minimum confidence, searching for frequent itemsets, forming association rules, and interpreting association rules for menu recommendations.

2.3 Test Design

Testing was conducted using RapidMiner Studio software. The testing process includes several stages: (1) add data, which is the process of retrieving sales transaction data that has been saved in Excel format; (2) select data, which is the process of viewing and checking the data to be used; (3) Apriori Algorithm process, which is the process of combining data with operations related to the Apriori Algorithm; and (4) Apriori Algorithm running results, which is the process of viewing the results of applying the Apriori Algorithm to the RapidMiner application. This study also adopted the CRISP-DM (Cross-Industry Standard Process for Data Mining) framework as a guide..

1) Business Understanding
   This stage aims to focus on the objectives and needs of the research, namely to implement RFM analysis and the Apriori Algorithm to improve food and beverage sales patterns at Bonjur Cafe Resto..
2) Data Understanding
   This stage provides an analytical foundation by summarizing the data and identifying potential problems in the data. Data obtained from Bonjur Cafe Resto sales will be pre-processed for data cleansing and data transformation..
3) Data Preparation
   This stage includes all activities required to build the final data from the initial raw data. At this stage, data cleaning and data transformation are carried out. The stages in data preparation include:
   a) Data collection
      Collecting data obtained from Bonjur Cafe Resto sales.
   b) Cleansing Data
      The process of removing data that is not included in the data set and transforming data from one format to another using the replace operator in the RapidMiner application.

3. Result and Discussion

3.1 Results

The results of the research that has been carried out starting from the identification of the tools used, implementation and testing with the CRISP-DM methodology, to data analysis using the Apriori Algorithm. The main objective of this chapter is to systematically describe the research findings and provide an in-depth interpretation of the results that have been obtained.

3.1.1 Research Tools

In any research, the availability of adequate tools is a crucial factor that determines the smoothness and accuracy of the analysis process. Research tools in this context are divided into two main categories, namely software and hardware. Software plays a role in processing and analyzing data, while hardware provides the physical infrastructure to run the software. The software used in this study has a specific role in supporting the data analysis process. The two main software used are Microsoft Excel and RapidMiner. Microsoft Excel version 2019 was chosen because of its ease of use and its ability to process data in tabular format. In this study, Excel was used mainly for the initial stages of data processing, such as filtering and

organizing sales transaction data before further analysis. Excel was also used to perform manual calculations in the Apriori Algorithm process. On the other hand, RapidMiner version 2024.0.1 was used as the main tool for data mining analysis, especially in the application of the Apriori Algorithm. RapidMiner was chosen because it provides various operators and algorithms needed for the data mining process, including the ability to find association patterns between items. The specifications of the software used can be seen in Table 2.

Table 2. Software Specifications

No.	Software	Version	Function
1	Ms. Excel	2019	Filtering, processing, and preparing initial data before analysis.
2	RapidMiner	2024.0.1	Perform data analysis using the Apriori Algorithm and visualize the results.

The hardware used in this study is a laptop with sufficient specifications to run data analysis software. This laptop is equipped with an Intel Core i5-7200U processor, which provides sufficient computing power to run data analysis applications. 8 GB of RAM ensures that applications can run smoothly without experiencing performance constraints. For data storage, this laptop has two types of storage media, namely a 238 GB SSD (Solid State Drive) to speed up data access and a 932 GB HDD (Hard Disk Drive) to store larger amounts of data. In addition, this laptop is also equipped with an Intel HD Graphics 620 graphics card which is sufficient to display data visualization. The hardware specifications used can be seen in Table 3.

Table 3. Hardware Specifications

Hardware	Specification
Processor	Intel Core i5-7200U
Memory	8 GB
Storage	SSD 238 GB, HDD 932 GB
Display	Intel HD Graphics 620

3.1.2 Implementation and Testing

The implementation and testing in this study focus on the application of the Apriori Algorithm to analyze Bonjur Café Resto sales transaction data during December 2024. The data used includes 465 sales transactions recorded through the REKALABA system. The testing process was carried out by adopting the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology, which is a framework commonly used in data mining projects. CRISP-DM consists of six interrelated stages, namely Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment. This methodology was chosen because it provides a clear and systematic structure in conducting data mining analysis, starting from understanding business objectives to implementing the analysis results. The implementation of CRISP-DM in this study was carried out systematically to ensure that each stage was carried out carefully and produced valid output.

1) Business Understanding
   The first stage in CRISP-DM is business understanding, where the research objectives and relevant business questions are clearly defined. The main objective of this research is to increase sales of Bonjur Café Resto by understanding customer preferences and optimizing product offerings. Some of the business questions asked are: What are the best-selling products? During peak hours, what are the highest sales? Who are Bonjur Café Resto's main customers? How can external factors such as weather affect sales? This business understanding forms the foundation for the entire research process, ensuring that the data analysis conducted is relevant to the business needs and objectives.
2) Data Understanding
   The second stage is data understanding, where sales transaction data collected from the REKALABA system is analyzed in depth. The data used includes 465 sales transactions during December 2024. This data contains information about the items purchased, the number of items, and the time of the transaction. It is important to note that customer data in this study is personal and is not disclosed in detail to maintain privacy. The raw data obtained from the REKALABA system is then further processed to ensure its quality and completeness. The initial analysis at this stage helps researchers to understand the characteristics of the data and identify potential problems that may arise during the analysis process.

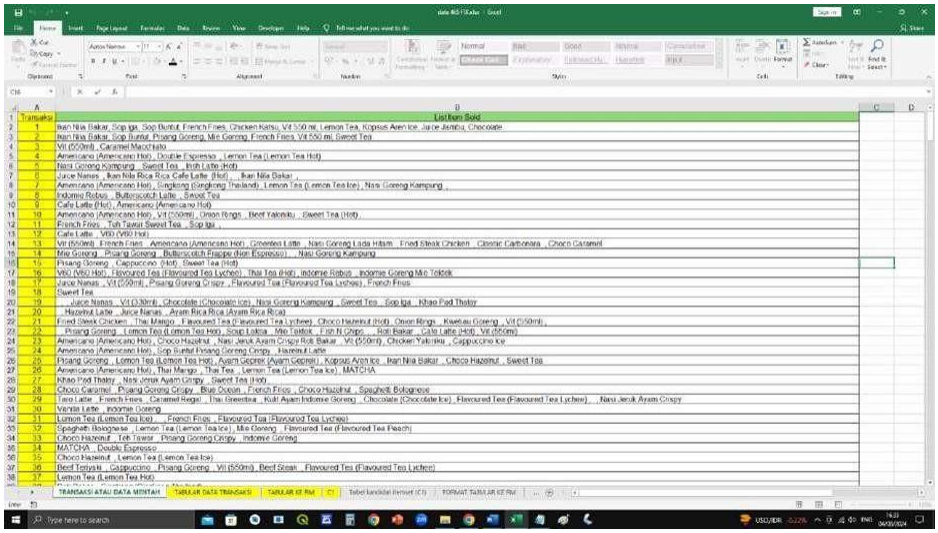


Figure 1. Raw Data

3) Data Preparation

The third stage is data preparation, where the raw data obtained from the REKALABA system is processed and transformed into a format suitable for analysis. This process involves several steps, including data cleansing to remove irrelevant or invalid data, and data transformation into a tabular format that is easier to process. Data cleansing is done to ensure that the data analyzed is accurate and does not contain errors that can affect the results of the analysis. Transforming data into a tabular format facilitates the analysis process using RapidMiner and Microsoft Excel. The cleaned and transformed data is then ready to be used in the modeling process.

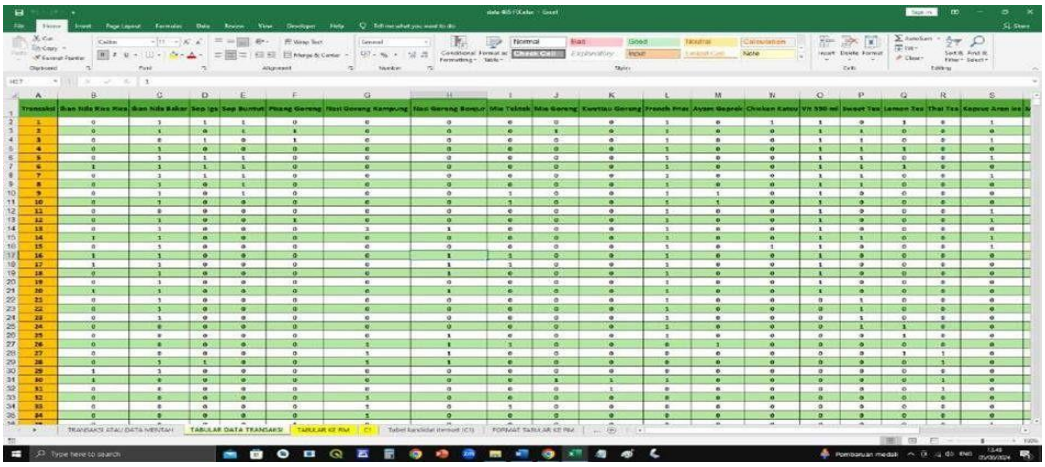


Figure 2. Tabular Data Transformation

4) Modeling

The fourth stage is modeling, where the Apriori Algorithm is applied to find association patterns between items. Modeling is done with the help of RapidMiner software and manual calculations using Microsoft Excel. The Apriori Algorithm works by finding combinations of items that are often purchased together, which are measured by support and confidence values. The support value shows how often an item or combination of items appears in the dataset, while the confidence value shows how strong the relationship is between two items. In this stage, the researcher determines the minimum support and confidence values that will be used as thresholds in forming association rules. The support value for one item is calculated using the formula:

$$\text{Support(A)} = \frac{\text{Number of Transactions Containing A}}{\text{Total Transactions}}$$

Meanwhile, the support value for two items is calculated using the formula:

$$\text{Support}(\text{Item A}, \text{Item B}) = \frac{\text{Number of Transactions Containing Item A and Item B}}{\text{Total Transactions}}$$

The confidence value for the association rule A → B is calculated using the formula:

$$\text{Confidence} = \text{P}(\text{B}|\text{A}) = \frac{\text{Support}(\text{A}, \text{B})}{\text{Support}(\text{A})}$$

This stage aims to find a combination of items that meet the minimum requirements for support values in the database.

5) Evaluation
The fifth stage is evaluation, where the model that has been created is tested to ensure its accuracy. Evaluation is carried out by applying the create association rules method, which forms sales association rules based on the relationship between product items. The purpose of the evaluation is to ensure that the model created is appropriate and in accordance with the research objectives, and can provide useful insights for Bonjur Café Resto. The evaluation results will determine whether the model can be continued to the deployment stage or needs to be improved. Evaluation also involves analyzing the support and confidence values of the association rules formed, to ensure that the rules have statistical significance and business relevance.
6) Deployment
The sixth and final stage is deployment, where the results of the data mining analysis are presented in the form of a final report.

3.1.3 Final Test Results

After going through a series of implementation and testing stages, this study produced several important findings that can provide valuable insights for Bonjur Café Resto. The final results of this test include data analysis using the Apriori Algorithm, both manually and with the help of RapidMiner software, as well as interpretation of the association rules formed. Data analysis in this study uses association techniques, which aim to find association rules that can describe the combination of food and beverage items that are most often purchased by consumers. These association rules can be used as a basis for making business decisions, such as creating menu packages, product placement in stores, or promotional strategies. The data analysis process is carried out by following these steps:

1) Determination of Processed Data
The first step is to determine the sales transaction data to be analyzed. In this study, the data used is Bonjur Café Resto's sales transaction data during December 2024. This data includes information about the items purchased in each transaction.
2) Determination of Minimum Support and Confidence Values
The second step is to determine the minimum support and minimum confidence values that will be used as thresholds in forming association rules. The minimum support value indicates how often an item or combination of items appears in the dataset, while the minimum confidence value indicates how strong the relationship is between two items. In this study, the minimum support value was set at 28% and the minimum confidence value was set at 70%.
3) Drafting of Association Rules
The third step is to create association rules based on the calculated support and confidence values. Association rules will show the combination of items that are frequently purchased together and how strong the relationship is between those items.

As an illustration, the association rule search process is performed using simplified sales transaction data. This process involves iterations to find combinations of items that meet the minimum support requirements.

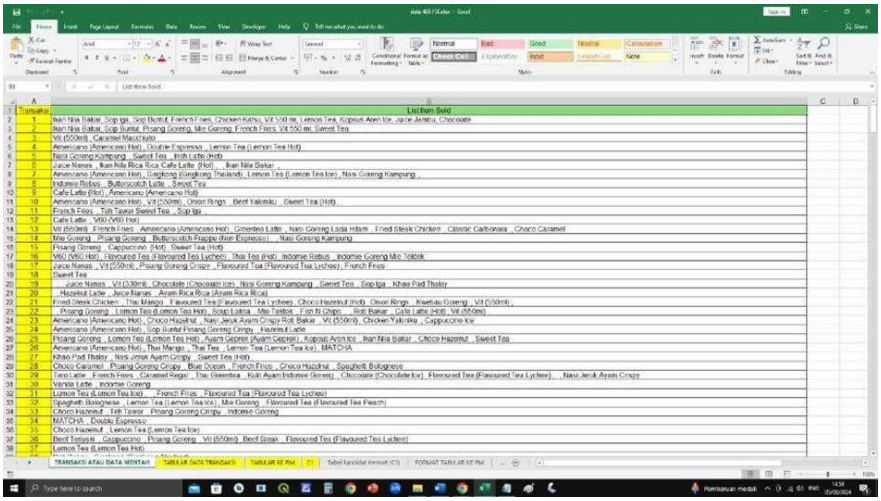


Figure 3. Test Data

Iteration 1: In the first iteration, a 1-itemset (C1) candidate is formed from the transaction data and its support value is calculated. The support value is calculated by dividing the number of occurrences of an item by the total number of transactions. Items that have a support value below the minimum support value (28%) will be eliminated.

$$Support\ (A) = \frac{\text{Number of Transactions containing A}}{\text{Total Transactions}}$$

After the calculation is carried out, large itemset 1 is obtained which contains items that meet the minimum support requirements..

Kandidat 1 itemset C1

Nama Itemset	Support
Ikan Nila Rica Rica	19%
Ikan Nila Bakar	57%
Sop Iga	19%
Sop Buntut	17%
Pisang Goreng	9%
Nasi Goreng Kampung	15%
Nasi Goreng Bonjur	34%
Mie Tektek	13%
Mie Goreng	4%
Kwetiau Goreng	4%
French Fries	66%
Ayam Geprek	6%
Chicken Katsu	4%
Vit 550 ml	49%
Sweet Tea	36%
Lemon Tea	15%
Thai Tea	9%
Kopsus Aren Ice	19%
Matcha	13%
Juice Mangga	4%
Juice Jambu	9%
Juice Buah Naga	4%
Caramel Macchiato	6%
Chocolate	4%
Americano	13%

Gambar 4. Large Itemset 1

Iteration 2: In the second iteration, a candidate 2-itemset (C2) is formed from large itemset 1 and its support value is calculated. The support value is calculated by dividing the number of occurrences of the item combination by the total number of transactions. Items that have a support value below the minimum support value (28%) will be eliminated.

1 itemset C1

Nama Itemset	Support
Ikan Nila Bakar	55%
Nasi Goreng Bonjur	34%
French Fries	43%
Vit 550 ml	49%
Sweet Tea	36%

Figure 5. Candidate List 2 Itemset C2

After the calculation is carried out, a large itemset 2 is obtained which contains a combination of items that meet the minimum support requirements.

Kandidat 2 itemset C2

Nama Itemset	Support
Ikan Nila Bakar, Nasi Goreng Bonjur	17%
Ikan Nila Bakar, French Fries	23%
Ikan Nila Bakar, Vit 550 ml	38%
Ikan Nila Bakar, Sweet Tea	23%
Nasi Goreng Bonjur, French Fries	9%
Nasi Goreng Bonjur, Vit 550 ml	15%
Nasi Goreng Bonjur, Sweet Tea	4%
French Fries, Vit 550 ml	30%
French Fries, Sweet Tea	26%
Vit 550 ml, Sweet Tea	21%

Figure 6. Large Itemset 2

Since there are no more item combinations that meet the minimum support requirements, the iteration stops. From the results of this iteration, the item combination "Grilled Tilapia, Vit 550 ml, French Fries" is obtained with a support value of 28%. Next, the association rule calculation is carried out with a minimum confidence requirement of 70%. From this calculation, an association rule is formed: "If Grilled Tilapia and Vit 550 ml are purchased, then French Fries are purchased."

$$Support\ (A\ \cup\ B) = \frac{\text{Number of Transactions containing A and B}}{\text{Total Transactions}}$$

The list of candidate 2 itemsets C2 that are formed will then be eliminated with a minimum support requirement of 28%.

Kandidat 2 itemset C2	
Nama Itemset	**Support**
Ikan Nila Bakar, Nasi Goreng Bonjur	17%
Ikan Nila Bakar, French Fries	23%
Ikan Nila Bakar, Vit 550 ml	38%
Ikan Nila Bakar, Sweet Tea	23%
Nasi Goreng Bonjur, French Fries	9%
Nasi Goreng Bonjur, Vit 550 ml	15%
Nasi Goreng Bonjur, Sweet Tea	4%
French Fries, Vit 550 ml	30%
French Fries, Sweet Tea	26%
Vit 550 ml, Sweet Tea	21%

Figure 7. Candidate 2-Itemset C2

List of 2 itemsets C2 formed meets the support requirement of 28%.

2 itemset C2	
Nama Itemset	**Support**
Ikan Nila Bakar, Vit 550 ml	38%
French Fries, Vit 550 ml	30%

Figure 8. Frequent 2-Itemset L2

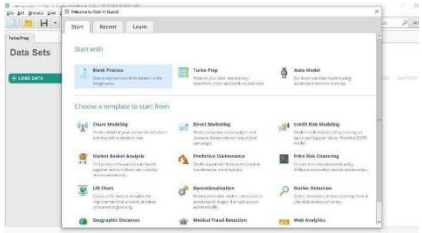
Because the minimum support requirement is already below 28%, the iteration stops here with the item Grilled Tilapia Fish, Vit 550 ml, French Fries support 28%.

Nama Itemset	Support
Ikan Nila Bakar, Vit 550 ml, French Fries	40%

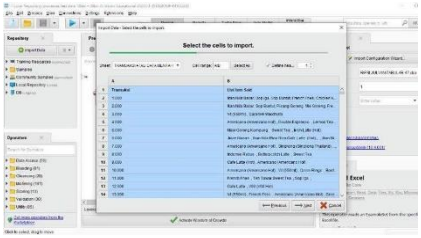
Figure 9. Frequent 3-Itemset L3

Below are the results of the Association Rule calculation with a minimum Confidence requirement of 70%. Then the rule is formed, If Grilled Tilapia Fish is purchased, Vit 550 ml then French Fries are purchased. In addition to manual analysis, this study also uses RapidMiner software to perform data mining analysis. RapidMiner was chosen because of its ability to process large amounts of data and provide various operators needed for data mining analysis.

Gambar 10. RapidMiner 2024.0.1



Gambar 11. Tampilan Awal



Gambar 12. Import Data

The data imported into RapidMiner is sales transaction data that has been converted into binary format, where the number 1 (true) indicates that the item was purchased in the transaction, while the number 0 (false) indicates that the item was not purchased.

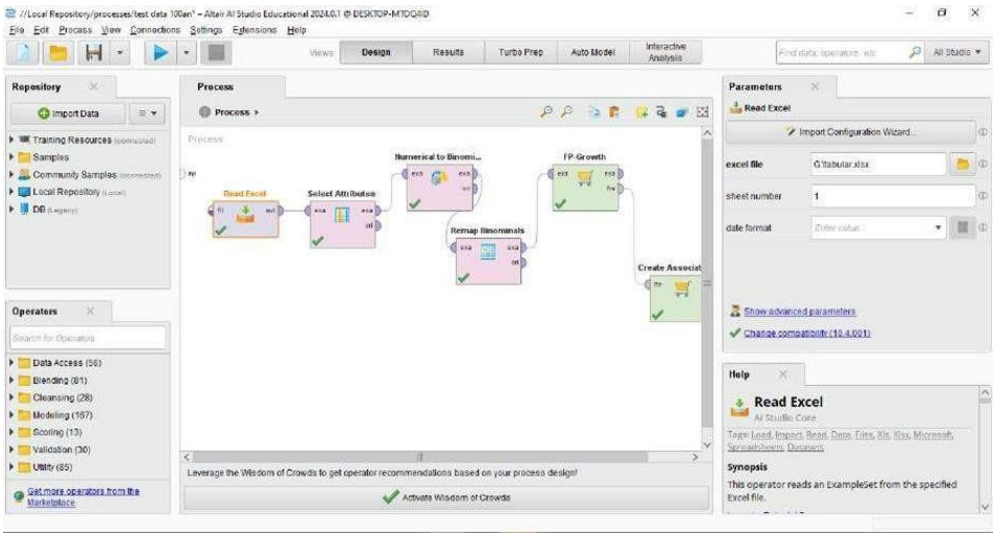


Figure 13. Test Design

The testing process in RapidMiner involves several operators, namely:

1) Select Attributes
   This operator is used to select the attributes to be analyzed.
2) Numerical to Binominal
   This operator is used to convert numeric data in transaction data into binary data (true/false).
3) Remap Binominals
   This operator is used to modify the internal mapping of binary attributes according to the specified positive and negative values.
4) FP-Growth
   This operator is used to determine the frequent itemset of transaction data.
5) Create Association Rules
   This operator is used to generate association rules from the frequent itemset that has been found.

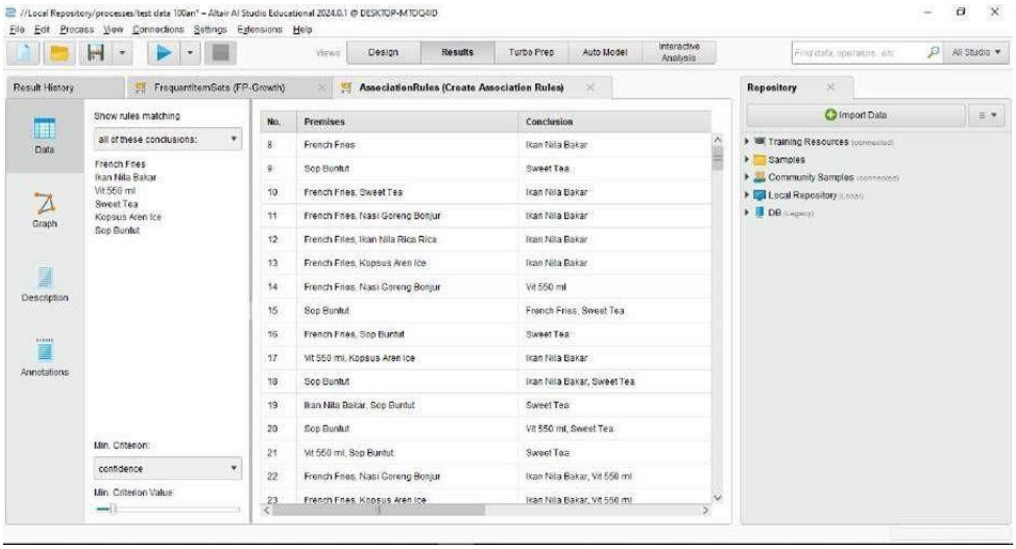


Figure 14. Association Results Display

The results of the analysis in RapidMiner show the association rules formed along with their support and confidence values. The support value shows the percentage of item combinations in the database, while the confidence value shows the strength of the relationship between items in the association rules.

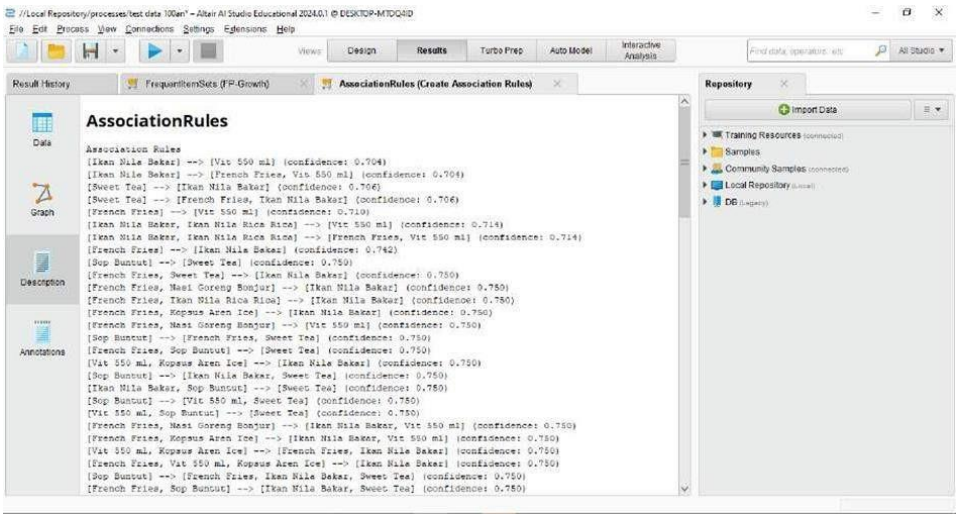


Figure 15. Description display on Ass

The results of this data mining analysis provide valuable insights for Bonjur Café Resto in understanding customer purchasing patterns and can be used as a basis for making better business decisions.

3.1.4 Implementation of RFM Analysis for Customer Segmentation

Based on the calculations from implementing RFM (Recency, Frequency, Monetary) Analysis, customer segmentation was determined using the following criteria:

1) Recency
   How recently a customer made a purchase.
2) Frequency
   How often a customer makes purchases.
3) Monetary
   How much money a customer spends.

This analysis resulted in the classification of customers into five distinct categories:

Table 4. Segmentasi Pelanggan 1

Category	Description
Loyal customers	Routine/Consistent
Business Customers	Meeting
VIP/Loyal Customers	High frequency, high transactions, potential to bring in new people
New Customer	New
Losing Customers	Disappointed, not coming again

Customer data is private company data, so the author took the initiative to anonymize customer data by changing the customer name label to the customer_ID label.

No.	ID_Pelanggan	SEGMENTASI	Date	Total Item	Total Price
1	BJ001045	KEHILANGAN PELANGGAN	2023-12-01	2	Rp 113.300
2	BJ001050	PELANGGAN VIP/Loyal	2023-12-01	18	Rp 488.400
3	BJ001001	PELANGGAN SETIA	2023-12-01	3	Rp 74.800
4	BJ001002	PELANGGAN SETIA	2023-12-01	3	Rp 63.800
5	BJ001003	PELANGGAN SETIA	2023-12-01	3	Rp 90.200
6	BJ001030	PELANGGAN BARU	2023-12-01	9	Rp 191.400
7	BJ001031	PELANGGAN BARU	2023-12-01	12	Rp 243.100
8	BJ001044	KEHILANGAN PELANGGAN	2023-12-01	3	Rp 73.700
9	BJ001043	KEHILANGAN PELANGGAN	2023-12-01	2	Rp 51.700
10	BJ001004	PELANGGAN SETIA	2023-12-01	8	Rp 185.900
11	BJ001005	PELANGGAN SETIA	2023-12-01	7	Rp 144.100
12	BJ001040	KEHILANGAN PELANGGAN	2023-12-01	3	Rp 90.200
13	BJ001051	PELANGGAN VIP/Loyal	2023-12-01	14	Rp 443.300
14	BJ001033	PELANGGAN BARU	2023-12-01	9	Rp 272.800
15	BJ001039	KEHILANGAN PELANGGAN	2023-12-01	3	Rp 74.800
16	BJ001034	PELANGGAN BARU	2023-12-02	9	Rp 243.100
17	BJ001001	PELANGGAN SETIA	2023-12-02	8	Rp 168.300
18	BJ001064	KEHILANGAN PELANGGAN	2023-12-02	1	Rp 16.500
19	BJ001052	PELANGGAN VIP/Loyal	2023-12-02	25	Rp 644.600
20	BJ001003	PELANGGAN SETIA	2023-12-02	4	Rp 111.100
21	BJ001002	PELANGGAN SETIA	2023-12-02	8	Rp 234.300
22	BJ001070	PELANGGAN BARU	2023-12-02	13	Rp 335.500
23	BJ001004	PELANGGAN SETIA	2023-12-02	8	Rp 246.400
24	BJ001005	PELANGGAN SETIA	2023-12-02	7	Rp 189.200
25	BJ001006	PELANGGAN SETIA	2023-12-02	8	Rp 234.300
26	BJ001007	PELANGGAN SETIA	2023-12-02	8	Rp 238.700
27	BJ001008	PELANGGAN SETIA	2023-12-02	4	Rp 118.800
28	BJ001009	PELANGGAN SETIA	2023-12-02	6	Rp 190.300
29	BJ001053	PELANGGAN VIP/Loyal	2023-12-02	26	Rp 720.500
30	BJ001010	PELANGGAN SETIA	2023-12-02	2	Rp 57.200
31	BJ001011	PELANGGAN SETIA	2023-12-02	4	Rp 108.900
32	BJ001012	PELANGGAN SETIA	2023-12-02	4	Rp 128.700
33	BJ001013	PELANGGAN SETIA	2023-12-02	4	Rp 100.100
34	BJ001014	PELANGGAN SETIA	2023-12-02	2	Rp 52.800
35	BJ001015	PELANGGAN SETIA	2023-12-02	3	Rp 72.600
36	BJ001030	PELANGGAN BARU	2023-12-02	10	Rp 317.900
37	BJ001062	KEHILANGAN PELANGGAN	2023-12-02	1	Rp 19.800
38	BJ001001	PELANGGAN SETIA	2023-12-03	2	Rp 66.000
39	BJ001002	PELANGGAN SETIA	2023-12-03	2	Rp 59.400
40	BJ001003	PELANGGAN SETIA	2023-12-03	3	Rp 85.800
41	BJ001004	PELANGGAN SETIA	2023-12-03	3	Rp 85.800
42	BJ001005	PELANGGAN SETIA	2023-12-03	3	Rp 81.400
43	BJ001006	PELANGGAN SETIA	2023-12-03	2	Rp 52.800
465	...	...	...	...	...

Figure 16. Sales Transaction Data 1

3.2 Discussion

The study was designed to analyze Bonjur Café Resto's sales transaction data during December 2024, with the main objective of increasing sales through a deeper understanding of customer preferences. Two main methods were used in this study: the Apriori Algorithm to find association patterns between items purchased together, and RFM (Recency, Frequency, Monetary) analysis to segment customers based on their purchasing behavior. This study adopted the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology as a framework to ensure that the data analysis process is carried out systematically and structured, starting from understanding business objectives to implementing the results. The research tools used include Microsoft Excel 2019 software for initial data processing and manual calculations of the Apriori Algorithm, and RapidMiner 2024.0.1 as the main tool for data mining analysis and visualization of results. The hardware used is a laptop with adequate specifications to run data analysis software. Implementation and testing are carried out by following the CRISP-DM stages sequentially. The first stage, business understanding, defines the research objectives and relevant business questions, such as best-selling products, peak sales times, identification of key customers, and the influence of external factors on sales. The second stage, data understanding, involves an in-depth analysis of sales transaction data collected from the REKALABA system, covering 465 transactions during December 2024. This data includes information on items purchased, number of items, and transaction times. The third stage, data preparation, involves cleaning and transforming the raw data into a tabular format suitable for analysis using RapidMiner and Microsoft Excel. The fourth stage, modeling, applies the Apriori Algorithm to find association patterns between items, with support and confidence values as the main metrics. The minimum support value is set at 28% and the minimum confidence is set at 70%. The fifth stage, evaluation, tests the resulting model by applying the create association rules method to form sales association rules. Finally, the deployment stage, presents the results of the data mining analysis in the form of a final report.

The final test results showed several important findings. Manual analysis of the Apriori Algorithm identified that the item combination "Grilled Tilapia, Vit 550 ml, French Fries" was frequently purchased together, with a support value of 28%. The association rule formed was "If Grilled Tilapia and Vit 550 ml are purchased, then French Fries are purchased," which meets the minimum confidence requirement. Analysis using RapidMiner confirmed this finding, with visualization of the association rules providing a clearer understanding of the relationships between items. In addition, the implementation of the RFM analysis resulted in customer segmentation into five categories: Loyal Customers, Business Customers, VIP/Loyal Customers, New Customers, and Lost Customers. This segmentation is based on recency (when the customer last made a purchase), frequency (how often the customer makes a purchase), and monetary value (how much money the customer spends). Customer data was anonymized by replacing the customer name label with Customer_ID to maintain privacy. Overall, this study successfully provided valuable insights into customer purchasing patterns and customer segmentation, which can be used by Bonjur Café Resto to improve operational efficiency, design more effective marketing strategies, and increase customer satisfaction.

4. Related Work

Research related to the application of the Apriori algorithm in various contexts has been widely conducted. This algorithm is often used to analyze sales transaction patterns. Sinaga, Sirait, and Windarto (2021) used the Apriori algorithm to analyze consumer ordering patterns in a coffee shop, which aims to understand customer preferences and assist in decision making regarding stock and promotions [1]. Haidar (2021) also implemented the Apriori algorithm to find sales transaction patterns in a kitchen, which provides insight into which products are often purchased together [2]. Merliani *et al*. (2022) applied the Apriori algorithm to sales transactions to provide recommendations for food and beverage menus, which can increase sales and customer satisfaction [3]. Nursikuwagus and Hartono (2016) implemented the Apriori algorithm in web-based sales analysis, which allows business owners to monitor sales trends in real-time [4]. In addition, the Apriori algorithm is also used in other contexts such as poverty data analysis. Aprianti, Hafizd, and Rizani (2017) implemented association rules with the Apriori algorithm on a poverty dataset, which can help identify factors that contribute to poverty [13]. The application of the Apriori algorithm is also seen in the analysis of e-commerce sales data by Badaruddin and Rayendra (2022), which aims to improve understanding of online consumer behavior [10]. Aditya, Marisa, and Purnomo (2016) also applied the Apriori algorithm to sales data in a store, which showed that this algorithm was effective in identifying purchasing patterns [11]. Several studies have used the RFM (Recency, Frequency, Monetary) method and clustering algorithms such as K-Means. Susilowati *et al*. (2022) used the RFM and K-Means methods for segmenting new student admissions promotion locations, which helped in targeting promotions effectively 0. Widiyanto and Witanti (2021) used RFM analysis and the K-Means algorithm for customer segmentation as the basis for marketing strategies, which can increase the effectiveness of marketing campaigns [6]. Pailan, Chrisnanto, and Hadianna (2020) also conducted RFM-based customer loyalty segmentation using K-Means in a fisheries company [8]. Taqwim, Setiawan, and Bachtiar (2019) used the RFM model with the fuzzy C-means clustering method for customer segmentation, which provides a more flexible approach to customer grouping [9].

Several studies also focus on the implementation of the Apriori algorithm in selling certain products. Siregar (2022) analyzed the sales patterns of food and beverage products using the Apriori algorithm, which can help in product arrangement and promotion [20]. Dongga, Koru, and Lante (2023) implemented the Apriori algorithm to determine inventory in a supermarket [21]. Muhammad, Vulandari, and Harsadi (2022) applied the Apriori algorithm to determine menu combinations in MSMEs, which can increase sales and efficiency [22]. Rahayu, Bernadus, and Datya (2024) applied data mining with the Apriori algorithm to determine the transaction patterns of drug purchases at pharmacies [23]. Purnia and Warnilah (2017) implemented the Apriori algorithm in the sale of glasses, which showed that this algorithm can be used in various types of products [24]. Tana *et al*. (2018) applied market basket analysis with the Apriori algorithm to product sales data in a store [25]. Takdirillah (2020) also applied the Apriori algorithm to retail business sales transaction data [26]. Nurajizah (2019) analyzed drug sales transactions using the Apriori algorithm [27]. Kristania and Listanto (2022) implemented the Apriori algorithm on sales data in a company [28]. Djamaludin and Nursikuwagus (2017) analyzed consumer purchasing patterns using the Apriori algorithm [29]. Miranda, Fahrullah, and Kurniawan (2022) applied association rules with the Apriori algorithm to analyze sales data in an online store [30]. Khanza, Toyib, and Onsardi (2021) applied the Apriori algorithm to increase cellphone sales [31]. Abidin, Amartya, and Nurdin (2022) applied the Apriori algorithm to the sale of two-wheeled vehicle

spare parts [32]. Saputra and Sibarani (2020) also implemented the Apriori algorithm to improve drug sales patterns 0. Other studies also explore other data mining methods. Fauzi and Mulyana (2021) used the least square method to predict LED lamp sales [12]. Novianti (2019) implemented the Naïve Bayes algorithm on the hepatitis dataset [15]. Sari *et al*. (2020) applied the K-Means algorithm for clustering poverty data [16]. Wibowo and Handoko (2020) segmented pharmaceutical retail customers using the modified RFM method [33]. Previous studies have proven the effectiveness of these two methods in generating valuable insights for strategic decision making. However, there is a gap in the literature indicating that many studies tend to focus on general datasets or established sectors, with minimal studies specifically examining the simultaneous application of these two methods in the context of restaurants or cafes, especially with a focus on analyzing specific monthly transaction data such as December. This study attempts to fill this gap by analyzing Bonjur Café Resto sales transaction data during December 2024, using a combination of the Apriori algorithm and RFM analysis within the CRISP-DM framework. This approach not only applies both methods separately but also integrates them systematically to ensure the validity and reliability of the analysis results. The unique contribution of this study lies in its focus on December transaction data, which is a crucial period for many businesses, thus providing more specific insights into consumer behavior during that period. In addition, this study also integrates the Apriori algorithm to identify association patterns between items with RFM analysis for customer segmentation, resulting in a more holistic understanding of customer preferences and purchasing behavior. The application of the CRISP-DM methodology ensures that the data analysis process is carried out in a structured manner, starting from understanding business objectives to implementing the results. The use of Microsoft Excel 2019 software for manual calculation of the Apriori Algorithm and RapidMiner 2024.0.1 for data mining analysis and visualization of results also provides validation and comparison of the analysis results. Thus, this study not only complements the existing literature but also makes a significant contribution in the utilization of the Apriori algorithm and RFM analysis in the context of restaurants or cafes, especially in the analysis of monthly transaction data. The results of this study are expected to provide actionable insights for Bonjur Café Resto to improve operational efficiency, design more effective marketing strategies, and increase customer satisfaction.

5. Conclusion and Recomendations

This study successfully implemented RFM analysis and Apriori algorithm on Bonjur Café Resto sales transaction data, which proved effective in identifying customer segmentation and product association patterns. The results of the analysis showed that both methods provided valuable insights to improve sales strategies. Specifically, RFM analysis successfully grouped customers into five categories based on their purchasing behavior, namely: Loyal Customers, Business Customers, VIP/Loyal Customers, New Customers, and Lost Customers. This segmentation provides a strong basis for Bonjur Café Resto to design more targeted and personalized marketing strategies, for example by providing special incentives for loyal customers. In addition, the application of the Apriori algorithm successfully identified product purchasing patterns that often occur simultaneously. These findings provide important information for Bonjur Café Resto to optimize menu offerings, provide more relevant product recommendations to customers, and improve operational efficiency. Thus, this study shows that the combination of RFM analysis and Apriori algorithm can be an effective tool to improve understanding of customer behavior and optimize sales strategies at Bonjur Café Resto.

Based on the findings of this study, several suggestions can be considered for further research. First, further research can utilize the survival analysis model to predict when customers will stop subscribing or make their next purchase. This model can provide more accurate information about customer retention and allow Bonjur Café Resto to take proactive actions in retaining customers. Second, future research can integrate the Apriori algorithm with sentiment analysis to understand the relationship between products, brands, and customer opinions. This approach can provide deeper insights into customer preferences and help Bonjur Café Resto in improving the quality of products and services. Thus, this study opens up opportunities for further exploration in the use of data mining methods to improve business performance in the restaurant and cafe sector.

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