Visual Merchandising Concepts in Planogram Development at Retail Product Shelves Based on Association Rules and Clustering of Customer Preference Analysis

UNDERGRADUATE THESIS

Submitted to the International Undergraduate Program in Industrial Engineering in Partial Fulfilment of Requirement for the Degree of Sarjana Teknik at the Faculty of Industrial Technology
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Demikian surat keterangan kami keluarkan, agar dapat dipergunakan sebagaimana mestinya.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Yogyakarta, 11 Juli 2024

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DEDICATION PAGE

With deep gratitude and pride, I dedicate this undergraduate thesis to my beloved parents, Abi and Umi, who have always provided endless love, support, and prayers. To my siblings, Elquthb, who have constantly given encouragement and laughter throughout this journey. And to all my friends and close companions who have always been there to accompany me through the joys and sorrows during the preparation of this undergraduate thesis. Additionally, with profound respect, I extend my heartfelt thanks to my supervisor, Mr. Dr. Ir. Agus Mansur, S.T., M.Eng.Sc., IPU, for the guidance, knowledge, and patience provided throughout the writing process of this undergraduate thesis. The support and direction given have been invaluable in completing this work.

MOTTO

"Verily, with that hardship comes ease.
So, when you have finished (your task), strive hard in devotion (to another task)."
(QS. Ash-Sharh: 6-7)

"What has passed me by will never be my destiny,
and what is destined for me will never pass me by."
– Umar bin Khattab RA

PREFACE

Assalamu'alaikum Warahmatullaahi Wabaraakatuh

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11. All parties involved and assisting the author during the study, especially in conducting undergraduate thesis research, cannot be mentioned individually.

The author realizes that this undergraduate thesis report still has many things that could be improved. The author expects suggestions and criticism for perfection and improvement in this research report. This report can benefit the education sector, be applied in the field, and be developed further.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Yogyakarta, July 10th, 2024

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ABSTRACT

The increase in economic activity within society is supported by the distribution and development of retail businesses that are becoming more widespread throughout Indonesia. However, issues still need to be reported regarding the services received by customers, and customers also exhibit different shopping habits. Therefore, retail managers must understand the needs and desires of customers while shopping to ensure they feel comfortable and satisfied. Visual aspects are crucial as they can form the first impression customers experience in a retail store environment. These visual merchandising aspects include the exterior, interior, display, and layout of the retail store, all of which can enhance customer comfort and satisfaction. This study identifies purchasing transaction patterns and visual merchandising preferences related to sales shelves. The processing of one month's sales transactions using the association rules method revealed that 12 rules were formed between product categories, and 17 rules were formed between product sub-categories. In the stage of identifying visual shelf design preferences using the K-Means Clustering method, two clusters were found, each with different characteristics in terms of demographics, satisfaction levels, and design preferences. The discussion of visual preferences identified four aspects for product grouping: brand, colour, size, and price. Differences in interest were found in product grouping based on brand and price. Findings from these two methods were used to design a planogram for the sales shelf by considering the size and specifications. The planogram design is intended to address customer preferences for an attractive visual display and arrangement of sales shelves, providing detailed product information and ease of product search, thereby creating a positive impression for customers. Therefore, this planogram design can benefit retail managers by enabling optimal product stock arrangement and improving service quality.

Keywords: Association Rules, Clustering, Customer Preference, Planogram, Retail Store, Visual Merchandising.

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CHAPTER I
INTRODUCTION

1.1 Background

The changes in time are closely linked to the economic growth occurring in Indonesia. With the changes in time, there will undoubtedly be an impact on adjustments and changes in various sectors, including the economy and society. In the economic sector, this will drive changes in the population's lifestyle, accompanied by changes in the economic structure. Nowadays, people are required and, indeed, should be able to adapt to the current conditions of the times. This is particularly evident in shopping activities to meet daily household primary needs. With the substantial population in Indonesia reaching 287.7 million people in mid-2023, it indirectly boosts economic activities in the country. This is supported by data from Statistics Indonesia (*Badan Pusat Statistik)* Indonesia; household consumption contributes as a priority to Indonesia's Gross Domestic Product (GDP) growth in the second quarter of 2023, amounting to 53.31%. This percentage indicates that daily transactions conducted by the population positively impact the Indonesian economy (Badan Pusat Statistik BPS, 2023).

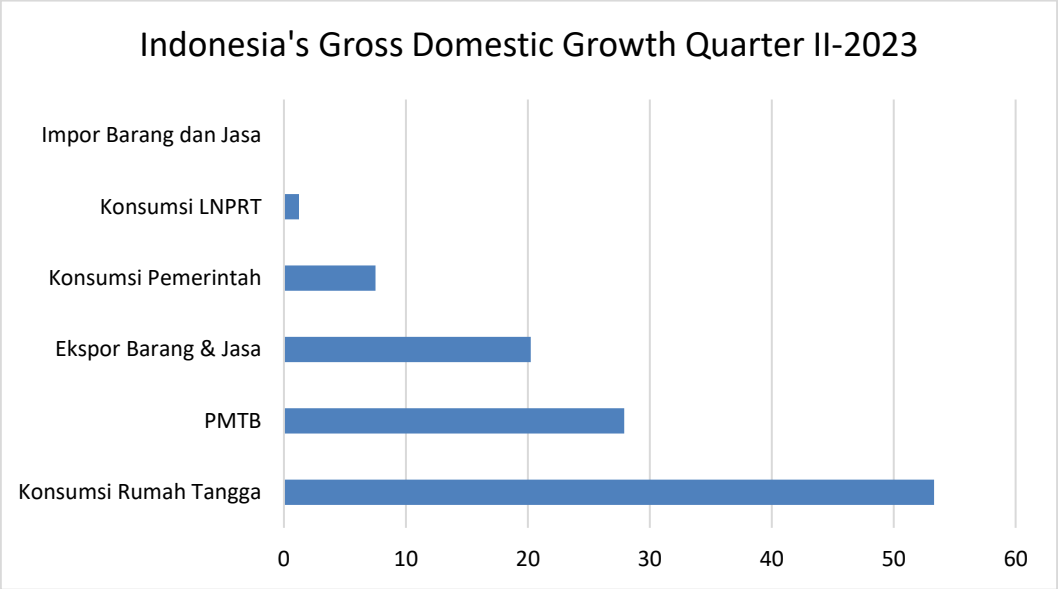


Figure 1. 1 Indonesian Gross Domestic Growth Quarter II (2023)

Source: *Badan Pusat Statistik,* 2023

Shopping activities are crucial for society or consumers to fulfill their needs. According to Presidential Regulation No. 112 of 2007 regarding the classification of shopping centers in Indonesia, two types are mentioned: traditional and modern (Peraturan Presiden Indonesia No.

112, 2007). As time goes by, there are many mentions of shopping centers developing into retail or minimarkets, supermarkets, or even online stores. Retail is a business activity for buying and selling transactions between two parties in small quantities run by people or groups to distribute them to final consumers (Chaniago, 2020). Retail is also known as a retail business intermediary between producers and final consumers in unit quantities. Currently, many retail stores have mushroomed in both rural and urban areas. This shows that society has easy access to fulfill their needs. Based on this, retail business actors in Indonesia face the demands of retail business growth and competition. Especially for traditional retail business actors located in non-urban areas and have unfavorable characteristics in terms of physical, organizational, and capital sources (Felycia & Genoveva, 2021).

A growing retail store in Sleman Regency is Minggir Mart, which offers various products such as household appliances and groceries. Minggir Mart is in Kliran, Sendangagung Village, Minggir District, Sleman Regency, Special Region of Yogyakarta. This retail store is a modern establishment and has implemented technology for all its sales transactions. Consequently, the management of Minggir Mart can easily manage the circulation and selling of the products. However, this has yet to be able to run optimally in selling all the products displayed on the sales shelves. This causes those sales products not to be favored by customers or not to sell well, resulting in excessive stock. In addition, it is also known that there are issues related to the governance of the display of sales products, which still need to be appropriate. The placement of product displays on shelves is found to be mixed between food and non-food items, which is considered unsafe for customer safety or health. A customer will cancel their purchase if they find products placed haphazardly and consider them contaminated with other products from different categories (Castro et al., 2013). The improper placement of product sales impacts customers who find locating the products they desire challenging. Customers often complain about this issue due to the need for clear instructions regarding the product location (Arifianti, 2017).

The problem arises due to the suboptimal management of stock, display arrangement, and product marketing in sales. This is because everything presented and offered to customers will influence their shopping interest. Based on the existing conditions, it is known that the layout of retail stores varies. Therefore, these differences have consequences, as not all shelves are guaranteed to be accessible to customers. A common issue in retail conditions is improper layout management, making the space feel cramped and restricting customer movement. The

size of a retail store significantly impacts the management and positioning of sales shelves. The larger the space, the more room there is to place shelves and provide movement access for customers. These findings relate to how the categorization of various products is arranged on the available shelves, considering an attractive layout that matches the stores' size (Rooderkerk & Lehmann, 2021).

This depends on the attractiveness of customers based on the flow inside the store and the visibility access customers have to products on the shelves (Czerniachowska, 2022). Then, the marketing of a particular product is hindered due to the inability of retail store managers to accommodate all products and promote them to customers. According to Armia (2016), a negative impact in the form of a decrease in sales levels can occur due to customers switching to competing retailers. This happens because customers have a bad perception of the service and layout which makes it difficult for customers to fulfill their needs and cannot find the product they are looking for. This relates to product arrangement, where retail managers need more information regarding products that need attention. However, historical sales data can be utilized to determine and establish sales promotion strategies. This will reveal potentially successful and less successful products, thus requiring special treatment. Simultaneously, it helps identify similarities in customer purchasing patterns and interest in the products sold (Bilgic et al., 2021).

In Data Mining, there is one reliable method for cases related to identifying customer habits. The Association Rules method can determine the association rules and combinations between two or more product items (Nurmayanti et al., 2021). So that it can be applied to identify patterns in purchasing product items at a shopping Centre. Identifying the patterns or combinations of customer product items, retail management can use this information as a reference to implement marketing strategies. Marketing strategies are crucial in this retail business and can drive product sales and enhance customer satisfaction. Therefore, retail store businesses must develop effective marketing strategies by providing attractive offers (Hanaysha, 2018). In addition, it is necessary to know the preferences or voices of customers regarding their shopping experience so that they can know the characteristics and needs of customers in a retailer. This can be done through the application of a clustering or grouping method which can provide retail store customer segmentation information. Clustering is a method that can identify databases that are separated into small groups based on similar characteristics. In this case, it can be used to find out details related to customer segmentation,

shopping behavior characteristics, customer interests and attractiveness, and level of shopping satisfaction (Mulyono et al., 2023). Then it can be developed to prepare store layouts (planograms) and increase customer attractiveness through sales strategies that are tailored to customer preferences (Kaur & Saini, 2022).

The development of marketing strategies can be determined based on the results of data knowledge and can involve stages of redesigning the visual appearance and layout of retail stores. Visuals are known to be one of the crucial factors that can influence customers' decisions when purchasing products. Visuals means everything customers can see and feel when visiting. Several sources and factors include graphics, store layout, display shelves, room lighting, props, building architecture, etc. (Nattakrannuwat & Cui, 2023). Furthermore, these factors become benchmarks in implementing visual merchandising to enhance product attractiveness to customers. A planogram is one tool that can be used to improve the layout of visual shelves or product displays. A *planogram* is a diagram that shows how products are arranged to capture customers' attention. The determination of the planogram is based on product data such as quantity, volume, size, and other product specifications (Arora et al., 2007). A planogram provides benefits by enhancing the visibility of needed products for customers and assisting in managing product stocks to prevent stockouts.

Based on the problem description above, this research focuses on implementing visual merchandising in a retail store named Minggir Mart. It requires improving the retail condition and applying merchandising that can attract potential buyers' attention. The method used in this research is the Association Rule, employed to identify purchasing patterns and association rules among product combinations in customer transactions. This is followed by proposing a product positioning layout using the planogram method and visual merchandising concept. These methods synergize to fulfill customer satisfaction and strive for sales improvement.

1.2 Problem Formulation

Based on this research background description, the problem formulation is as follows:

a. How is the association pattern of product purchases formed from consumer transactions at Minggir Mart through the implementation of Association Rules?
b. How are customer preferences towards the layout of retail stores and customer satisfaction at Minggir Mart based on clustering implementation?

c. What is the recommendation for an effective planogram design for optimizing product arrangement on the sales display shelves at Minggir Mart?

1.3 Research Objectives

The following are the research objectives that will be achieved based on the results of the problem formulation that has been determined:

a. Identifying the pattern of product purchases by consumers from sales transactions using Association Rules.
b. Identifying the customer clustering results regarding retail store layout preference and customer satisfaction in Minggir Mart.
c. Identifying and providing an effective planogram recommendation design to optimize product arrangement on the sales display shelves at Minggir Mart.

1.4 Research Limitations

In carrying out this research, several problem boundaries were determined to serve as a reference and facilitate problem-solving, namely as follows:

a. This research was conducted at a retail store named Minggir Mart located in Kliran, Sendangagung, Minggir, Sleman, Special Region of Yogyakarta.
b. The objects of this research are sales transaction data, the conditions of Minggir Mart, product shelf arrangements, and customer questionnaire data.
c. The sales transaction data used covers the period from October 1st to October 31st, 2023.
d. The method utilized is association rules, clustering, and planograms integrated into the implementation of visual merchandising.

1.5 Research Benefits

Based on the research results found and identified through detailed analysis, it is hoped that it will be useful for the parties involved, especially for retail stores. The following are the benefits that can be obtained from the results of this research:

a. Understanding consumer purchasing patterns by identifying which products are popular and have the potential to increase sales.

b. Providing important information about clustering customer characteristics who shop at retail stores based on demographic aspects, satisfaction ratings, and shelf design preferences.
c. Providing proposals for rearranging the layout and product placement on retail sales display shelves.
d. Serving as a guideline for retailers to design sales strategies and marketing strategies to enhance the shopping appeal of consumers.

1.6 Systematic Research

The systematics of writing this Final Assignment Report is structured into six chapters systematically as follows:

CHAPTER I INTRODUCTION

This chapter contains the background, and issues addressed in this research, focusing on the development of retail in Indonesia, the challenges faced, and efforts to overcome them using relevant methods. It also explains the problem statement, research objectives, research benefits, and the detailed structure of the research implementation.

CHAPTER II LITERATURE REVIEW

This chapter covers the theoretical basis of research development obtained through deductive analysis and explains inductive studies by comparing summaries of previous research.

CHAPTER III RESEARCH METHOD

This chapter elaborates on the implementation methods of this research, including the determination of the object, subject, data sources, and the detailed mechanism flow.

CHAPTER IV DATA COLLECTION AND PROCESSING

This chapter contains the results of the data obtained and processed using the predetermined approach. The processed data results are supported by presenting visualizations such as graphs and tables.

CHAPTER V DISCUSSION

This chapter provides a detailed discussion of the analysis of the results obtained in the previous stages, referencing, and aligning them with the supporting theoretical basis of the research.

CHAPTER VI CONCLUSION AND RECOMMENDATION

This chapter contains the conclusion of the entire research to address the research problem formulation and objectives. Recommendations are then provided for further research development.

CHAPTER II
LITERATURE REVIEW

2.1 Theoretical Basis

2.1.1 Retail Store

Retail is a business that provides and sells goods or services to customers in unit quantities. Retailing is a business that trades goods or services to end consumers for personal needs. Personal needs mean that the goods obtained by the consumer are not used for business purposes (Utomo, 2009). The retail business is very varied in its development and encourages competition between existing retailers. Based on the Presidential Regulation regarding the arrangement and construction of shopping centers in Indonesia, market category restrictions aim to protect each other and maintain the existence between these business ventures. The following are market categories based on the use of technology listed in the document Presidential Regulation No. 112 of 2007:

a) Traditional Market

   Traditional markets are generally built and managed by the government, local governments, state-owned enterprises, or local areas. In the traditional market, there is cooperation between the manager (government) and small, medium, and independent traders who sell in business places in the form of shops, stalls, and tents. This type of market allows bargaining activities between buyers and traders. Traditional market conditions have a bad tendency, such as a lack of infrastructure, layout density, and a slum environment (Andriani & Ali, 2013).

b) Modern Market

   The modern market is a development of the traditional market that has a self-service system for selling various types of goods at retail. According to Sarwoko (2008), this market category is better and superior because it has a modern management system that provides trading with good quality and service. According to government regulations, several types of modern markets have developed in Indonesia, which are as follows:

Table 2. 1 Modern Market Classification

Type	Area (m2)	Sales System	Sales Item
Minimarket	< 400	Retail	Food and household appliances

Type	Area (m2)	Sales System	Sales Item
Supermarket	400 – 5,000	Retail	Food and household appliances
Hypermarket	> 5,000	Retail	Food and household appliances
Department Store	> 400	Retail	Clothing and Fittings
Wholesale market	> 5,000	Wholesaler	Clothing and Food

Based on its characteristic criteria, retail businesses are included in the modern market category, which has implemented retail management and sales methods. This retail industry is the end of the distribution channel for goods to final customers, which is growing rapidly and has intense competition. To maintain the existence of a retail store against the competition, fast response actions are needed to meet customer needs and understand customer behavior. This action has a purpose to make it easier for retail businesses to survive and increase their sales (Surjandari & Seruni, 2010).

2.1.2 Visual Merchandising

Implementing a strategy to attract customers to a retail business is easier than providing satisfaction and comfort to customers during their shopping experience. People tend to remember their "experience" at a place more than other factors. A positive experience in terms of satisfaction will stimulate customers to return to the retail store (Sachdeva & Goel, 2015). Therefore, retailers must pay attention to visually appealing aspects for customers. This will positively impact customers, who will easily find desired products and spend more time shopping at the retail store (Law et al., 2012).

A concept called visual merchandising can be implemented to increase customer satisfaction. This concept is one of non-verbal visual communication that significantly impacts a store's success in marketing strategies. Visual merchandising is a combination of art and science applied to create an attractive impression on merchandise. It is necessary to communicate several attributes, such as store conditions, product value, and quality, to influence customers to purchase the displayed products (Ebster & Garaus, 2011). The focus of implementing visual merchandising is to provide clear information about product locations, direct customers to visit products, organize customer circulation within the retail space, and provide fast and convenient transaction services. Then, several dimensions need to be considered, such as exterior, displays, atmosphere, and product advertising (Cordova et al.,

2020). In general, visual merchandising is an approach to a sales store that pays great attention to the detailed visual appearance of both the exterior and interior. Besides that, visual merchandising can include how to package marketing strategies appropriately using visual aspects that can stimulate customers. Retail managers can succeed in attracting consumers' attention, and on the other hand, consumers feel that shopping is easy and comfy, and they are satisfied with the overall store service.

2.1.3 Planogram

Planogram or space management is a concept of layout and display that aims to optimize the use of space conditions and displays in a retail environment (Pratama et al., 2020). This planogram can be created by analyzing recent and past sales patterns at a retail store to serve as an evaluation and design basis for the planogram. A critical aspect of planogram design is how the products or displays are positioned and presented to attract customers. It is also necessary to pay attention to the ideal quantity of items, the height or depth of the product range, and to combine them with other products around them (Arora et al., 2007).

Especially in retail business, planograms can be implemented to improve the display of sales shelves containing products based on their categories. There are several considerations in determining the design of a planogram so that products are not placed arbitrarily. Considerations for these products include size, weight, color, and type (Czerniachowska, 2022). The placement of products with larger dimensions should be adjusted according to the size of the retail shelves. Heavy products should be positioned on the bottom pallet rack. Product placement should also consider the type and color of the products to attract customers' attention. According to Leolita (2012), planograms can provide benefits such as increasing retail profits, reducing inventory costs, minimizing out-of-stock situations, improving product turnover, and enhancing customers' attractiveness to retail stores.

2.1.4 Retail Layout

Layout is one of the components in the sustainability of a business and plays a crucial role in ensuring work effectiveness. The layout in retail stores serves the purpose of implementing sales or merchandising strategies and provides convenience for customers. The implementation of store layout can be achieved by organizing product areas in the customer traffic flow and creating an attractive visual impression (Feijó & Botelho, 2012). The presence of appealing

visuals in a retail store encourages customers to explore the entire store, potentially leading to unplanned purchases. Additionally, the layout in retail stores plays a vital role in stock management processes and optimizing storage space for display shelves. This establishes a mutual relationship where a positive and comfortable shopping experience for customers can be beneficial for the retail owner. According to Chaniago (2021), several common types of layouts are typically applied in retail stores, as follows:

a) Grid Layout (Straight)

   This layout is suitable for retail stores with spacious areas. This layout concept organizes sales display shelves arranged in straight lines facing each other.

b) Curving Layout (Loop)

   This layout is in the form of a curved corridor that surrounds the store area. Thus, forming a single path or direction that reaches all parts of the store and, inadvertently, allows customers to see all products on the sales display shelves.

c) Free Flow Layout

   This layout does not consider customer traffic flow in the store area. Its implementation involves arranging sales products freely yet easily accessible to customers due to adjustments to the shape of the retail store building.

d) Mixed Layout

   This layout combines all retail layouts, including grid, curving, and free flow. This allows the manager to create flexible customer movement paths for a more enjoyable shopping experience and potentially increase customer shopping duration.

2.1.5 Data Mining

Data mining is extracting information and potentially hidden knowledge that is unclear in its form and random. It is often referred to as knowledge discovery in databases (KDD), which shares the common goal of finding valuable information (Wu et al., 2021). Knowledge discovery in databases is one of the non-trivial processes used to search for valuable information in specific patterns or rules. This is subsequently called new, valid, useful, and understandable knowledge (Gilchrist et al., 2012). According to Naldy & Andri (2021), Data mining is a technique for collecting and processing data using statistics, mathematics, and machine learning to extract useful knowledge such as patterns or relationships. This data mining technique is

divided into several groups of methods based on its functionality, and the following is an explanation related to the functionality of data mining (Lakshmi & Raghunandhan, 2011):

a) Association

   To discover association rules or combinations of items that frequently occur together. Additionally, it is used to identify the item frequencies in a database.

b) Classification

   To estimate instance data into a specific class and to be able to build a model to classify a new object based on training data and test data.

c) Prediction

   To predict several values from a dataset or, in other words, to forecast the numerical values conditions that are unknown based on trends related to time.

d) Clustering

   To identify a large chunk of data and then group it based on the proximity or similarity of characteristics between objects.

e) Characterization

   To summarize a relevant data characteristic concerning a specific class based on the extraction of a particular database.

f) Outlier Analysis

   To identify outliers in a large database, where an outlier is an exception and does not belong to any group. However, outliers have significant value or influence.

Several important stages need to be done in the process of data mining or knowledge discovery in databases. The stages in KDD are interactive and iterative stages that involve user decisions (Fayyad et al., 1996). The following are the stages of the KDD process.

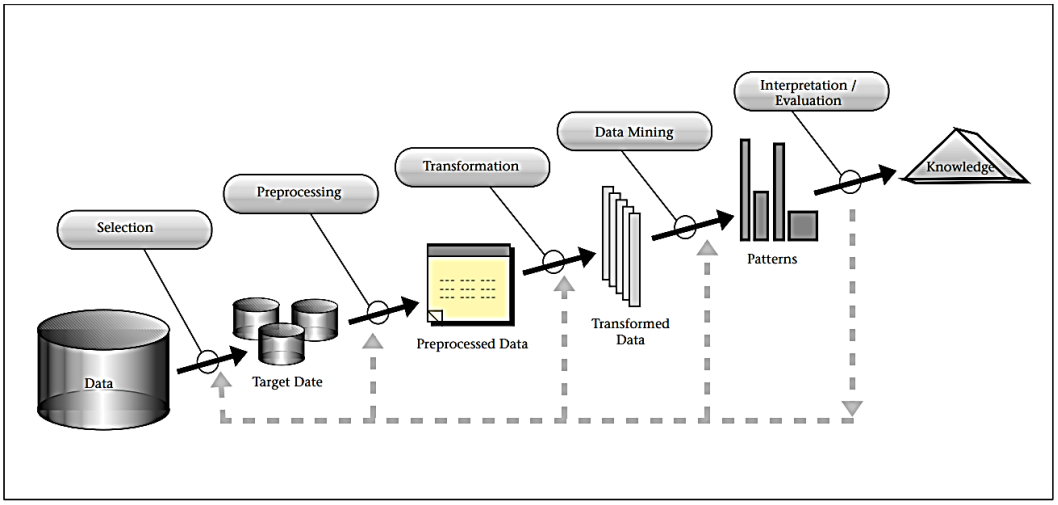


Figure 2. 1 KDD Process Framework

Source: (Fayyad et al., 1996)

a. Data Selection

The initial stage in KDD involves selecting, sorting, and choosing relevant data aligned with the research objectives. Data is acquired from large databases or related data sources for further analysis using data mining methods and is referred to as target data.

b. Preprocessing Data

The selected target data from the large database is called raw data. However, prior to this, data refinement is necessary to address incompleteness. Additionally, cleaning steps are taken to eliminate unnecessary data (with no relationship), remove data noise, and normalize the data.

c. Transformation Data

The chosen data is then transformed into a more suitable form for the selected data mining method.

d. Data Mining

The main stage of KDD involves using data mining techniques to extract valuable information in the form of relationships, rules, patterns, and hidden knowledge.

e. Interpretation or Evaluation

After processing using specific data mining techniques or methods, the resulting information must be interpreted or described to understand the detailed picture. Additionally, an evaluation of the available results is conducted for future reference. The aim is to present the results of the data mining techniques (knowledge) in a comprehensible form and simultaneously validate previous theoretical foundations.

2.1.6 Association Rules

Association Rule is a data mining technique to discover association rules between item combinations, where these combinations reflect occurrences with consequences. Through the "IF-THEN" statements, results from database processing are found and identified as relationships between objects. These association rules can be applied to basket analysis, cross-selling, clustering, catalogues, and more (Kumbhare & Chobe, 2014). In addition, it can also be used for implementing analysis on market purchase transactions, e-commerce transactions, and banking transactions (Sidhu et al., 2014). A simple example of an association rule is like *{bread, milk} => {chocolate jam};* from this rule, it can be inferred that if someone buys bread and milk, there is a possibility that they will also buy chocolate jam at the same time. Information about the relationship between these items is highly valuable for the data owner and can be used for strategy design. In its development, this method has several algorithms that can be used to execute and identify data using association rules. There are several popular algorithms: Apriori, FP-Growth, Eclat, and GUHA procedure ASSOC (Sidhu et al., 2014). The association rule method has two main steps, namely:

a) Discovering all items frequently appearing based on the minimum support threshold.
b) Generating strong association rules from items based on minimum support and confidence values.

Then, in association rules, three important parameters are used to determine the association relationships of the formed items. The following are the three parameters used:

a) Support

   A measure of support value that indicates the extent of dominance of an item or itemset over the total transactions (Nurmayanti et al., 2021).

$$Support\ (A \cap B) = \frac{Total\ transaction\ contains\ A\ and\ B}{Total\ transaction}$$

b) Confidence

   A measure of certainty or confidence value that describes the strength of the relationship between items in an association rule conditionally (Nurmayanti et al., 2021).

$$Confidence\ (A|B) = \frac{Total\ transaction\ contains\ A\ and\ B}{Total\ transaction\ contain\ A}$$

c) Lift Ratio

A measure to determine the strength of the resulting association rules. Furthermore, it is used to ascertain the level of validity of the formed rules, where valid rules have a lift ratio value greater than 1 (Rahmi & Mikola, 2021).

$$Lift\ Ratio\ (A => B) = \frac{Confidence\ (A => B)}{Support\ B}$$

2.1.7 Apriori Algorithm

The Apriori algorithm is commonly used to apply association rule methods. This algorithm can identify and search for rules based on previous data. Two techniques are involved: pruning and joining, which aid in the rule identification. Pruning reduces search space by lowering the support threshold from initial data processing results. The joining technique combines all possible rules that can be formed by setting specific parameters. The combination of these techniques connects items to form rules (Fachrurozi et al., 2020). Generally, Apriori involves several main stages: determining minimum support, generating candidate item sets, recalculating candidate item sets from candidate results, organizing high-frequency patterns, and concluding with an iterative process to identify the absence of any further item sets that can be formed (Kusumo et al., 2021).

2.1.8 K-Means Clustering

Cluster analysis or what can be called clustering is one of the functionalities of data mining. The clustering algorithm is an algorithm with the aim of grouping several data into certain data groups (Silalahi, 2018). This data collection comes from a large database which is then processed through a clustering stage to look for similarities between objects. There are two common clustering methods: hierarchical and non-hierarchical. Additionally, several algorithms have been developed for clustering, including SOM (Self Organizing Map), Fuzzy C-means, and K-means. In this study, the K-Means algorithm is used, which allows for determining the number of clusters to be formed at the beginning of the research (Jamal & Yanto, 2019). However, it is necessary to test the cluster data to identify the ideal number of clusters using the elbow and silhouette visualization methods. In the elbow method, the number of clusters can be determined by observing the percentage comparison results, which will form a sharp angle at a certain point (Madhulatha, 2012). The benefits and application of this cluster analysis technique can be used to make predictions based on the analysis of business problems. The benefits and application of

this cluster analysis technique can be used to make predictions based on the analysis of business problems. Examples of cluster applications include creating market segmentation, marketing strategies, and mapping consumer behavior or preferences.

2.2 Literature Review

A study that applied the association rule market basket analysis method was conducted by Bermúdez et al., (2016), focusing on the development of a retail store to enhance sales. Entitled "Layout Optimization and Promotional Strategies Design in a Retail Store based on a Market Basket Analysis," the research analyzed retail transactions to uncover association rules among product items. A total of 19 thousand tickets or transaction receipts were utilized, identifying 24 product families. Subsequently, the study yielded 60 association rules formed among items in each group. Layout revisions and the design of retail shelf optimization strategies were then conducted based on the generated association rules. Additionally, marketing strategies aimed at increasing sales and customer loyalty were provided. The implementation of these two strategies aims to facilitate customers in finding products and improve the flow of movement to encounter less popular items.

The next research was conducted by Pratama et al., (2020), analyzing the storage system in a drug store, the study titled "Implementation of improved Apriori algorithm for drug planograms in XYZ pharmacies and analysis of medicinal procurement planning using ABC critical index methods" employed the improved Apriori algorithm to uncover associations or combinations of concurrently purchased drug items. Additionally, the ABC critical index method was utilized to determine drug groups based on their procurement levels. A total of 64 transactions containing 101 different types of drugs were identified for this research. Associations among 4 drug groups were discovered. Furthermore, all drugs were categorized into several types based on their usage or procurement percentages. Understanding these relationships and categorizations can serve as a guideline for organizing their storage shelves based on planogram concepts and arranging them considering the type, size, and weight of the medications.

The next research was conducted by Lusiani (2011), entitled *"Optimasi Alokasi Produk pada Ruang Rak Display Gerai Minimarket berdasarkan Harga Produk Menggunakan Multilevel Association Rules,"* The study discusses efforts to optimize product display racks in a minimarket in Indonesia. The study utilized a data mining method called association rules

employing the apriori algorithm and zero-one integer programming. Applying these methods could analyze the frequency of product purchases based on categories, sub-categories, and individual product items (multilevel association rules). It was identified that there were 793 types of products categorized into 27 product categories and 90 sub-categories. The results revealed association rules among product items or their categories. Furthermore, it discussed the determination of items and the design of appropriate pricing using zero-one integer programming with the aim of optimization. Product allocation was based on the average profit generated from each product item, enabling the implementation of strategies such as cross-selling to increase sales profits.

Subsequent research was conducted by Cordova et al., (2020), entitled "Impact of visual merchandising on the purchase decision of consumers from retail stores in central Peru," this study discussing the influence of visual merchandising on customer purchasing decisions was conducted. This research employed a quantitative method, specifically cross-sectional and descriptive. By applying the structural equation model (SEM) method, the study analyzed the influence of various visual merchandising factors. It was found that there is a relationship between external business organizations and cultural and social criteria in influencing purchases. Factors examined included exterior, interior, and atmosphere. The study highlighted the importance of signage, appropriate product placement, and attractive product displays. Therefore, the significant finding of this research is that the implementation of effective visual merchandising significantly influences customer purchasing decisions in retail.

Subsequent research was conducted by Firmansyah and Yulianto (2021), titled "Market Basket Analysis for Books Sales Promotion using FP Growth Algorithm, Case Study: Gramedia Matraman Jakarta," addressing efforts to enhance sales at a retail bookstore. The study employed association rules methodology and the FP-Growth algorithm to analyze which product items were frequently sold in this bookstore. Data processing was based on master data groups of books or products and analyzed using randomly selected historical sales data, totaling 264,970 transactions. Subsequently, 7 association rules were generated based on the minimum support and confidence value criteria. These findings can serve as a reference for designing sales promotion strategies.

Subsequent research was conducted by Leolita (2012), with an article entitled *"Perancangan Layout Toko dan Planogram pada Rak 16 di Unit Swalayan Koperasi Wanita,"* this study focuses on the implementation of a planogram in a supermarket. This research aims

to optimize product placement and enhance the layout of a store to increase customer interest. It explains how to apply planogram techniques effectively on retail shelves, taking into consideration factors such as product categories, room size, shelf capacity, shelf size, and other essential elements. The goal is to organize and manage products to capture more customer attention and convince them to purchase the displayed merchandise.

The following study, titled "Analysis of Transaction Patterns at drug store with Apriori Algorithm," was conducted by Kusumo et al., (2021). The objective of this research was to identify and analyze transaction patterns in the sale of medicines at a pharmacy. A total of 12,000 transaction data were collected and converted into tabular form based on the category or type of medicine product. The method employed was association rule using the Apriori algorithm. Data processing was carried out with the assistance of Rapid Miner software version 9.2. It was discovered that 6 association rules were formed with varying confidence levels. This study provides new insights into medicine purchasing patterns and serves as the best means to determine sales promotions.

The following further research was conducted by Pranata and Utomo, titled *"Penerapan Data Mining Algoritma FP-Growth Untuk Persediaan Sparepart Pada Bengkel Motor (Study Kasus Bengkel Sinar Service)."* The primary objective of this study is to identify the set of data for frequently occurring spare parts and utilize this valuable information to enhance service systems. By employing the FP-Growth algorithm, researchers quickly identified historical spare parts sales data to uncover association rule relationships. The process involved the development of an FP-Tree, which served as a reference for determining these associations. The goal was to evaluate and understand the confidence level of the established rules.

The following research was conducted by Padillah et al., (2022), titled "Application of the FP-Growth Algorithm in Analyzing Patterns and Layout of Foodstuffs," which examined the implementation of the FP-Growth algorithm in a food ingredient store in Indonesia. The study aimed to understand patterns in the purchase of food raw materials and the layout conditions of the store. Data collection was carried out through direct observation and interviews with the store owner. Subsequently, sales transaction data were processed and grouped based on categories. This data processing involved the use of association rules and the FP-Growth algorithm with the support of the FP-Tree structure. The stages included sorting item frequencies, conditional pattern development, and association tree development. With a

minimum support requirement of 30% and a confidence level of 80, the study yielded 10 association rules indicating that the store layout influences the customer shopping process.

The last study was conducted by Nurmayanti et al., (2021), with the title "Market Basket Analysis with Apriori Algorithm and Frequent Pattern Growth (Fp-Growth) on Outdoor Product Sales Data," implementing two algorithms, apriori and FP-Growth, to analyze pattern sales at an outdoor equipment store. This study has the purpose of knowing the different association rules formed between these two algorithms. The aim is to give valuable information to researchers and provide guidance in product sales strategy. The result of the apriori algorithm shows that 10 association rules were formed. Therefore, based on the FP-Growth algorithm, 4 association rules are formed. All these results refer to the association rules parameters, namely, support, confidence, and lift ratio, for validating the rules.

Table 2. 2 Articles Reference

No.	Title	Authors	Methods	Algorithm	Object
1.	Layout Optimization and Promotional Strategies Design in a Retail Store based on a Market Basket Analysis	(Bermúdez et al., 2016)	Association Rules	Apriori	Retail Store
2.	Implementation of improved apriori algorithm for drug planograms in XYZ pharmacies and analysis of medicinal procurement planning using ABC critical index methods	(Pratama et al., 2020)	Association Rules, Planogram, and ABC Critical Index	Apriori	Drug Pharmacies
3.	*Optimasi Alokasi Produk pada Ruang Rak Display Gerai*	(Lusiani, 2011)	Multilevel Association Rules	Apriori and Zero One	Minimarket

No.	Title	Authors	Methods	Algorithm	Object
	Minimarket berdasarkan Harga Produk Menggunakan Multilevel Association Rules			Integer Programming	
4.	Impact of visual merchandising on the purchase decision of consumers from retail stores in central Peru	(Cordova et al., 2020)	Descriptive Quantitative and Structural Equation Model (SEM)	-	Retail Store
5.	Market Basket Analysis for Books Sales Promotion using FP Growth Algorithm, Case Study: Gramedia Matraman Jakarta	(Firmansyah & Yulianto, 2021)	Association Rules – Market Basket Analysis	FP-Growth	Bookstore
6.	*Perancangan Layout Toko dan Planogram pada Rak 16 di Unit Swalayan Koperasi Wanita*	(Leolita, 2012)	Planogram	-	Cooperative Shop (Minimarket)
7.	Analysis of transaction patterns at drug store with Apriori Algorithm	(Kusumo et al., 2021)	Association Rules	Apriori	Drugstore

No.	Title	Authors	Methods	Algorithm	Object
8.	*Penerapan Data Mining Algoritma FP-Growth Untuk Persediaan Sparepart Pada Bengkel Motor (Study Kasus Bengkel Sinar Service)*	(Pranata & Utomo, 2020)	Association Rules	FP-Growth	Motorcycle Spare Parts Workshop
9.	Application of the FP-Growth Algorithm in Analyzing Patterns and Layout of Foodstuffs	(Padillah et al., 2022)	Association Rules	FP-Growth and FP-Tree	Foodstuffs
10.	Market Basket Analysis with Apriori Algorithm and Frequent Pattern Growth (Fp-Growth) on Outdoor Product Sales Data	(Nurmayanti et al., 2021)	Association Rules	Apriori and FP-Growth	Outdoor Equipment Store

CHAPTER III
RESEARCH METHOD

3.1.1 Research Subject

The research subject is a modern retail store named Minggir Mart, one of the comprehensive retail stores providing various household products. This retail store is in Minggir, Sleman Regency, Special Region of Yogyakarta.

3.1.2 Research Object

The object of this research is sales transaction data recorded in retail stores and details of product names which are used as variables in this research. The historical sales transaction data will be processed using the association rules method. Apart from that, data is needed regarding customer characteristics and customer attractiveness preferences regarding Minggir Mart conditions by applying the clustering method. So, it continues with the process of creating a new design related to the planogram which is adjusted to the results of the product item relationship and aligned with customer cluster preferences.

3.1.3 Data Collection Method

The following are the methods of data collection and types of data used in the research:

a) Primary Data

The primary data used in this research is related to layout conditions, shelf conditions, and historical retail sales data. Data on layout and shelves will be used for planogram and merchandising data processing. Meanwhile, historical sales data will be utilized to determine the association rules among product items. Primary data is obtained by directly collecting data from related retail stores. In addition, customer preference data based on similar characteristics is needed which is packaged using the clustering method. This is done at the same time to find out which potential clusters there are. Then proceed with making a proposed planogram design, which directly correlates with customer preferences. This data was obtained through questionnaires based on specific variables. Below are the variables used in this study:

Table 3. 1 Determination of Questionnaire Variables

Aspect	Variable	Indicator
Demography	Gender	This variable is used to determine the customer's gender background. This variable is an important demographic factor that can provide information regarding different interest characteristics of customers when shopping.
	Age	This variable is a benchmark for determining shopping needs and interests that are appropriate for each age group.
	Monthly Income	This variable is used to determine aspects of customer income which can be used as a reference to influence shopping intentions due to adequate financial conditions.
	Shopping Expenses	This variable can determine the amount of money a customer spends every time they shop at a shop.
Visual Merchandising (Berman & Evans, 2013)	Exterior	This variable is used to assess customers' evaluations of the exterior conditions of retail stores, including building conditions, signage, cleanliness of the environment, and the availability of open public spaces.
	Interior	This variable is used to assess customers' evaluations regarding the availability of facilities in retail stores and the interior atmosphere, including decorations, air circulation, and lighting.
	Interior Point of Purchase Display	This variable is used to assess customers' evaluations regarding the presence of sales promotions that can increase impulse buying among customers.
	Shelf and Store Layout	This variable is used to assess customers' evaluations regarding the store layout, the availability of movable space, product placement on sales shelves, and the grouping of items by category or colours.

Aspect	Variable	Indicator
Customer (Listiono & Sugiarto, 2015)	Satisfaction and Loyalty	This variable is used to assess the level of customer satisfaction and loyalty towards the overall aspects of retail stores, including price, service quality, product quality, shopping convenience, and willingness to return.
Planogram Design (Czerniachowska, 2022)	Product Type or Brand	These parameters describe customers' preferences regarding the arrangement of product shelves, whether organized and grouped based on their brands or randomly without considering brand location.
	Color	This parameter can depict how shelves are arranged, grouped by similar-toned colours or mixed. Additionally, according to customers, it is used to identify eye-catching colours that are easily found on shelves.
	Size	This parameter determines the preference for arranging products based on their small or large size on the display shelves.
	Price	This parameter aims to understand how products are arranged on the shelves based on their prices, either from cheap to expensive, expensive to cheap, or randomly without considering the price.

The variables defined in this study will be formulated into a questionnaire containing specific questions. This questionnaire will be distributed to customers who fit the predetermined target criteria. It includes various questions tailored to the research needs and the definition of each customer response as outlined in Table 3.2.

Table 3. 2 Questionnaire of Customer Preferences

Code	Variable	Information
X1	Gender	1: Male 2: Female
X2	Age	In Number

Code	Variable	Information
X3	Monthly Income	1: < Rp 500.000 2: Rp 500.000 - 1.000.000 3: Rp 1.000.000 - 2.000.000 4: Rp 2.000.000 - 3.000.000 5: Rp 3.000.000 - 5.000.000 6: > Rp 5.000.000
X4	Shopping Expenses per Transaction	1: < Rp 25.000 2: Rp 25.000 - 50.000 3: Rp 50.000 - 100.000 4: Rp 100.000 - 150.000 5: Rp 150.000 - 200.000 6: > Rp 200.000
X5	Customer assessment of retail store exteriors in terms of building conditions, signage information, environment cleanliness, and the availability of open public spaces.	1: Very Bad 2: Bad 3: Neutral 4: Good 5: Very Good
X6	Customer assessment of retail store interiors in terms of decorations, air circulation, and lighting.	1: Very Bad 2: Bad 3: Neutral 4: Good 5: Very Good
X7	Customer assessment of Interior point of purchase display in retail stores in terms of promo information, price information, and product placement.	1: Very Bad 2: Bad 3: Neutral 4: Good 5: Very Good
X8	Customer assessment of shelf and layout in retail stores in terms of store size and layout, distance between product shelves, and shelf plan instructions.	1: Very Bad 2: Bad 3: Neutral 4: Good

Code	Variable	Information
X9	Customer satisfaction levels with the overall service at retail store.	5: Very Good 1: Very Dissatisfied 2: Dissatisfied 3: Neutral 4: Satisfied 5: Very Satisfied
X10	The decision of customers to return to shop at a retail store.	1: Yes 2: No
X11	Customer preferences regarding product arrangement on shelves based on brands.	1: Grouped 2: Mixed
X12	Customer preferences regarding product arrangement on shelves based on color of product.	1: Grouped 2: Mixed
X13	Customer preferences regarding product arrangement on shelves based on size of product.	1: Grouped 2: Mixed
X14	Customer preferences regarding product arrangement on shelves based on size of product.	1: Sorted 2: Mixed

b) Secondary Data

The secondary data used include books, articles, journals, or other relevant literary sources. These data are utilized to reinforce the theoretical basis of the research. The obtained data consist of fundamental theories, previous research findings, calculation formulas, and other relevant information.

3.1.4 Research Flow and Mechanism

Figure 3.1 below is a research flow diagram that aims to provide an overview of the mechanism for implementing this research from the beginning to the end of the research:

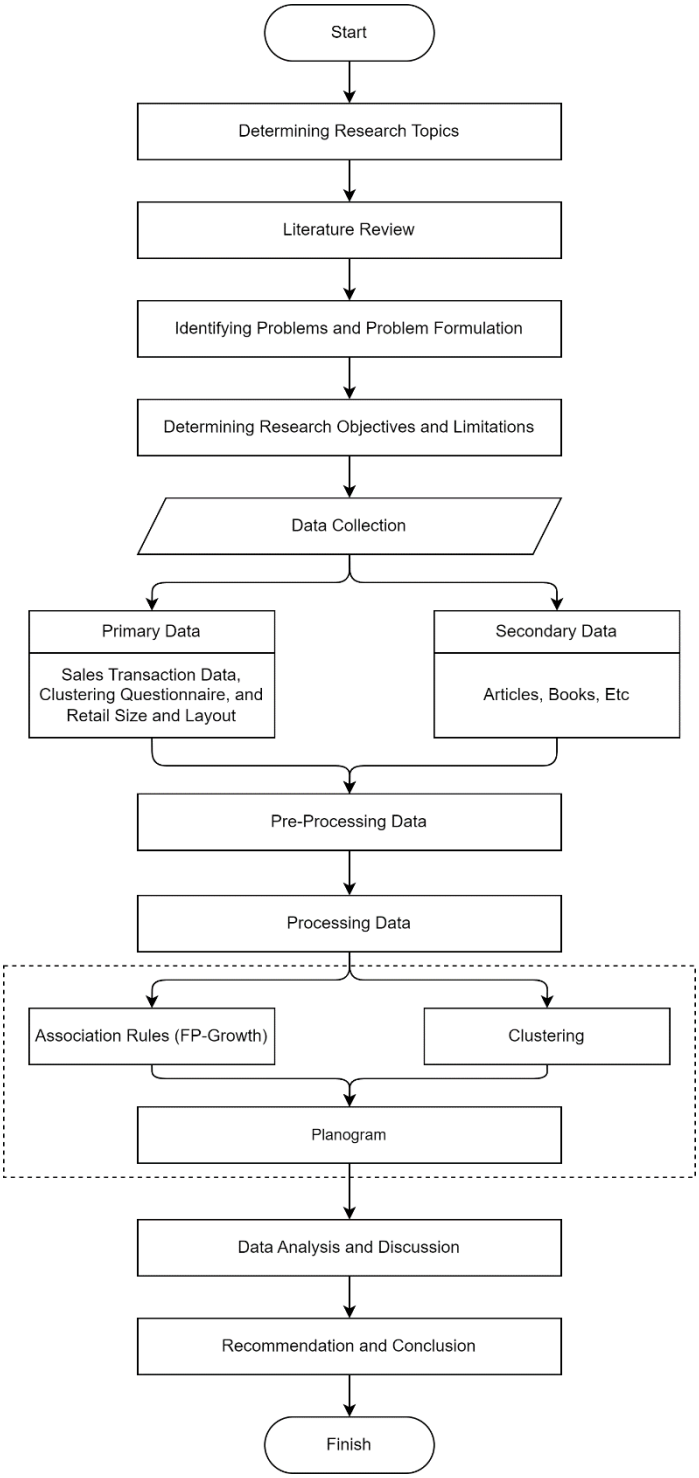


Figure 3. 1 Research Flow Diagram

The following is an explanation of the research flow diagram:

1. Start
2. Determining Research Topics

The first step in this research is to determine the specific discussion topic of the research. Subsequently, the research topic has been identified as applying association rules and layout improvement encompassing the retail store visuals. The association rules method is utilized to discern shopping patterns among customers and is integrated into the rearrangement of the store, particularly the display of sales racks or shelves.

3. Identifying Problem and Problem Formulation

   This stage is conducted to identify and dissect the core issues that must be addressed. It is then followed by formulating the problem to facilitate the research process in the subsequent stages.

4. Determining Research Objective and Limitation

   This stage is conducted to determine the main objectives of the research and identify any limitations that need to be considered for the research to proceed smoothly. This research aims to understand the purchasing transaction patterns of customers, which can be observed through the combinations of products purchased together. Additionally, it aims to redesign the store layout visually and implement planograms for arranging the store shelves.

5. Data Collection

   This stage is carried out to obtain the necessary data before processing. Transaction data is obtained through observation and direct retail store sales system recording. Sales transaction data is collected for 1 month. Then, direct observation is conducted at the retail store to obtain data on size, capacity, and facilities used in planogram and visual merchandising implementation. Additionally, supporting data is collected from books, journal articles, and previous research.

6. Pre-Processing Data

   There are several stages in data pre-processing, namely;

   a. Data Selection

      The selection of appropriate data is carried out to determine the combination of product items from sales transactions. The data used is the sales transactions of Minggir Mart for 1 month, October 1st to October 31st, 2024. Subsequently, the customer questionnaire data was obtained through a Google Form distributed to Minggir Mart customers.

   b. Data Reduction and Cleaning

The data reduction process is carried out to remove data or variables that are not relevant to this research. In addition, overall data cleaning is conducted to remove duplicate data, noise data, and incomplete data.

c. Data Transformation

The data transformation stage involves converting the data into a specific format to facilitate data processing using data mining techniques. In this research, the data, which has been summarized per transaction, is transformed into binary numbers.

7. Data Processing

The data processing process is carried out to determine the results of research that is processed using one of the methods in data mining, namely association rules and clustering. Meanwhile, the algorithm used is FP-Growth. The data processing process utilizes Microsoft Excel and RStudio software. The obtained results consist of association rules that have met three primary parameters: support, confidence, and lift ratio.

Then the process of clustering the results of customer questionnaire data is carried out to identify potential customer clusters and at the same time determine customer preferences regarding aspects of the store, especially regarding the layout of sales shelves. This is done by distributing questionnaires to retail store customers regarding their demographic and shopping experience visually concerning customer satisfaction. The questions are structured based on the objectives of implementing visual merchandising that can be applied to retail stores. The design of this new layout utilizes the planogram concept and focuses more on improving the management of sales display shelves. The creation of this planogram employs a tool such as software called Smart Draw.

8. Data Analysis and Discussion

This stage involves a detailed analysis and discussion of the results regarding the formed association rules and potential clusters about their visual experience during shopping. With the aim of determining the rearrangement of the retail store layout especially for product shelves through the application of planograms in the concept of visual merchandising.

9. Recommendation and Conclusion

This stage is conducted to conclude the final results that have addressed the research problem formulation and provide recommendations that can be applied in the future.

10. Finish

CHAPTER IV
DATA COLLECTION AND PROCESSING

4.1 Data Collection

4.1.1 Retail Store Profile

Minggir Mart is a retail store located in Kliran, Sendangagung Village, Minggir District, Sleman Regency, Special Region of Yogyakarta. Minggir Mart has grown and competes with other retail stores in the area. Currently, the retail store operates two branches to meet the daily household needs of the community. The location of Minggir Mart is quite strategic, situated in the bustling center of the community. In its development, Minggir Mart strives to provide excellent customer service by offering the best services and facilities in various aspects. Additionally, the retail store has implemented a database system that records customer transaction history, which can serve as a valuable reference in the future to enhance service quality. Furthermore, Minggir Mart has numerous display shelves that allow for the organized presentation and arrangement of products for sale.

4.1.2 Historical Data Transaction

In this study, transaction data from Minggir Mart are used for the period of October, from October 1st to October 31st, 2023. A total of 6325 transaction data have been collected. The following is the transaction data of Minggir Mart sales for October 2023.

Table 4. 1 Historical Data Transaction

code	trans_type	staff	date	name	sku	qty	price
7437	cash	Siti	10/1/2023 8:13	Toracafe Iced Cappucino 180ml	8.996E+12	1	3500
7438	cash	Siti	10/1/2023 8:13	Nestle Pure Life 600ml	8.99298E+12	1	2500
7438	cash	Siti	10/1/2023 8:13	Roma Sari Gandum Susu+Coklat 39g	8.996E+12	1	2000
7439	cash	Siti	10/1/2023 8:17	susu indomilk kids coklat 115ml	8.99301E+12	1	3000
7439	cash	Siti	10/1/2023 8:17	Yupi Bolicious Blackberry 5g	8.99274E+12	4	500
7439	cash	Siti	10/1/2023 8:17	Yakult	8.99299E+13	2	2300
7440	cash	Siti	10/1/2023 8:19	Waku waku Mixed Berry	8.99887E+12	1	3000
…	…	…	…	…	…	…	…
13761	cash	Siti	10/31/2023 21:42	Strepsil Cool Single 2.6g	155087	1	1500

4.1.3 Product Category and Sub-category

Grouping products is carried out to simplify the identification and processing of data using an association rule approach. This grouping is based on the similarity of product item types and

adaptation to the actual conditions at Minggir Mart. Category grouping indicates the similarity of product types in general, while sub-category grouping indicates the similarity of product types more specifically and refers to product brands. This research determined 15 product categories and 65 sub-categories, as shown in Table 4.2 below.

Table 4. 2 Products Category and Sub-category

No.	Category	Sub-category
1.	Baby Stuff	Baby Food, Baby Milk, Baby Powder
2.	Beverages	Coffee Drink, Isotonic Drink, Juice, Mineral Water, Soft Drink
3.	Body Care	Cosmetic, Deodorant, Lotion, Perfume, Shaver, Syrup, Skincare
4.	Breakfast	Dairy Milk, Sachet Drink
5.	Cigarette	Cigarette
6.	Cleaner	Detergent, Hygiene Kits, Softener
7.	Confectionery	Candy, Chocolate,
8.	Food	Biscuit, Cake n Bread, Chips, Ice Cream, Instant Food, Instant Noodle, Macaroni, Peanut, Stick and Roll Snack, Wafer
9.	Groceries	Chili Sauce, Condiment, Cooking Oil, Egg, Flour, Margarine, Salt, Soy Sauce, Sugar,
10.	Healthcare	Drug, Plaster, Vitamin
11.	Houseware	Air Freshener, Electronics, Glass, Plate, Spoon, Washing Brush
12.	Miscellaneous	Fashion, Miscellaneous, Toys,
13.	Sanitary	Cotton Bud, Diapers, Mask, Tissue, Women Sanitary
14.	Stationery	Stationery
15.	Toiletries	Body Soap, Oral Care, Shampoo

4.1.4 Retail Store Layout

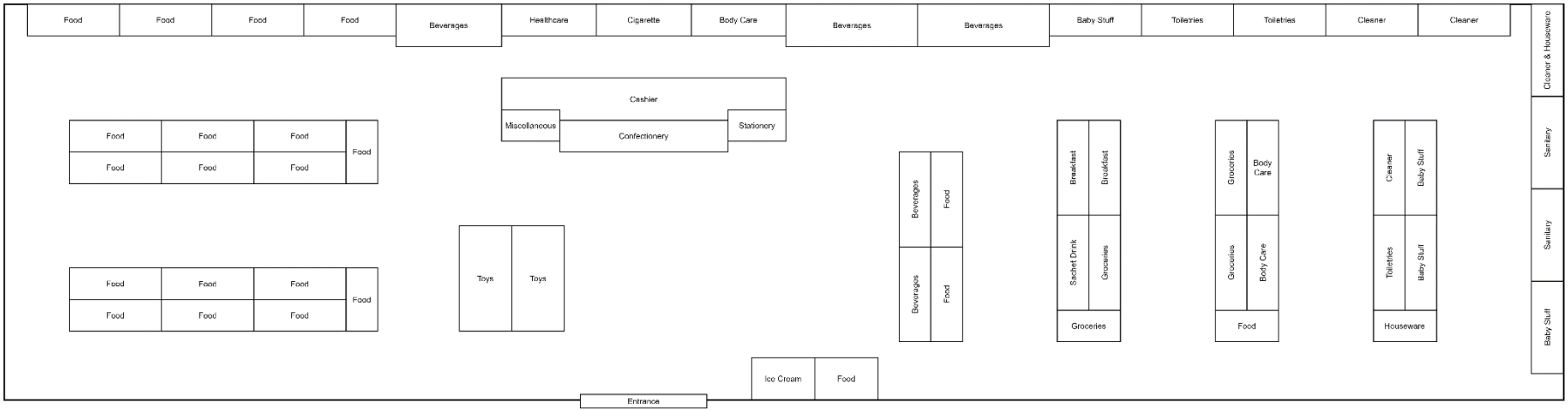


Figure 4. 1 The layout of Minggir Mart

The retail store management has arranged the layout of the sales shelves, as shown in Figure 4.1 above. Products have been placed and grouped based on their similarities. The illustration shows that each shelf contains various sub-categories of products in the same category. In this Minggir Mart retail store, there are a total of 55 shelves, three cooling refrigerators, and one ice cream freezer.

4.1.5 Customer Preferences Data

This research applied customer clustering to understand basic demographics and assess aspects of visual merchandising and preferences for shelf design in retail stores. Data were obtained through a questionnaire using Google Forms, which was distributed to customers to assess the current situation and to be processed using clustering methods. A total of 104 respondent data were collected, encompassing various variables supporting this research, as shown in Table 4.3 below.

Table 4. 3 Customer Data

No	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
1	2	20	1	2	16	12	11	12	4	2	1	1	1	2
2	1	30	4	2	16	12	12	12	3	2	1	1	1	2
3	1	29	3	1	12	9	9	12	5	2	1	1	1	3
4	2	38	4	3	16	10	12	11	4	2	1	2	1	3
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
101	2	20	1	4	15	11	12	9	3	2	2	2	1	2
102	2	21	2	2	15	12	10	12	4	2	1	2	2	1
103	2	22	4	2	13	11	11	10	3	2	1	1	1	1
104	2	27	6	5	14	9	12	10	4	2	1	2	1	1

The data in Table 4.3 above represents the transformed form of the filled questionnaire results. By undergoing the data transformation process, it can facilitate the clustering process and its interpretation. The outcome obtained is the identification of the characteristics of each cluster. Then, profiling preferences of cluster residents regarding indicators for arranging the preferred sales planogram shelves are conducted.

4.2 Data Processing Association Rules

4.2.1 Data Pre-Processing

In this preprocessing stage, the data required for the association rule process is cleaned and adjusted, namely the product items for each transaction. Besides the product names, no other elements are used in this study's identification process of association rules. Product naming for each transaction is altered based on the categorization and sub-categorization of items at Minggir Mart. Previously, various categories and sub-categories had been determined and grouped based on their similarities. The initial data obtained consists of 6325 customer purchase transactions. Subsequently, a data cleansing process is carried out by removing transactions that contain only one product item. Based on the categorization, the number of data that passed the data cleansing is 3242 transaction data. Meanwhile, based on the sub-category grouping, 3655 transaction data are obtained.

4.2.2 Data Transformation

The data transformation stage aims to simplify the names of products in each transaction and change them based on categories and sub-categories. If items from the same category are in a transaction, they are written only once in that transaction. This stage reduces errors in identifying association rules. The results of the transaction data transformation can be seen in Tables 4.4 and 4.5 below.

Table 4. 4 Data Transformation by Category

Code	Items
1	Beverages, Food
2	Breakfast, Confectionery, Beverages
3	Confectionery, Beverages, Food
4	Confectionery, Beverages
…	…
3241	Cigarette, Houseware
3242	Cigarette, Confectionery

Table 4. 5 Data Transformation by Sub-category

Code	Items
1	Cake n Bread, Mineral Water
2	Candy, Dairy Milk, Soft Drink
3	Ice Cream, Wafer
4	Soft Drink, Juice
…	…
3656	Cigarette, Plate
3655	Candy, Cigarette

Each table shows the result of transformation data from the initial raw transaction data into other terms based on product similarities.

4.2.3 Parameter Determination

In the process of generating association rules, it is necessary to determine the values of support and confidence to indicate the significance of this transaction database. The support value

indicates the extent of influence that can arise from the number of items. In contrast, the confidence value can be considered to determine the level and certainty of accuracy of the formed rules. Then, the support and confidence values are determined according to the specific needs and considering the existing case conditions (Scheffer, 2005). This research involves thousands of transaction data for association rule analysis. Therefore, various adjustments need to be made to find the best results. This is done by testing the validity through several experiments of parameter values to obtain optimal results, as shown in Table 4.6 below.

Table 4. 6 Association Rules Parameter for Category

Trial No.	Minimum Support	Minimum Confidence	Rules Formed
1	0.3	0.5	0
2	0.15	0.3	9
3	0.05	0.35	28

Based on the parameter determination experiment conducted on the item category grouping data in Table 4.6, it is known that the selected values for support and confidence are by trial number 3. Where the support value is 0.05, the confidence value is 0.25 and generates 28 rules.

Table 4. 7 Association Rules Parameter for Sub-category

Trial No.	Minimum Support	Minimum Confidence	Rules Formed
1	0.1	0.2	0
2	0.075	0.2	0
3	0.04	0.2	4
4	0.03	0.2	19

Based on the parameter determination experiment conducted on the sub-category item grouping data in Table 4.7, it is known that the selected values for support and confidence are by trial number 4. Where the support value is 0.03, the confidence value is 0.2, and it generates a total of 19 rules. The Apriori algorithm uses these determined values for data processing and association rule identification.

4.2.4 Association Rules Results

The trial was conducted to generate association rules based on several support and confidence value schemes. In this study, several association rules are required to be used as references in

the subsequent stage. Therefore, this research determines to utilize support and confidence values capable of producing numerous rules. The formed association rules can be deemed valid if they meet the condition of having a lift ratio value greater than 1. The results of transaction data processing using the Association Rules approach can be seen in Table 4.8 below.

Table 4. 8 Rules Outputs Based on Categories

No.	rules	support	confidence	coverage	lift	count
1	{Groceries} => {Breakfast}	0.074	0.432	0.171	1.198	239
2	{Breakfast} => {Groceries}	0.074	0.204	0.361	1.198	239
3	{Breakfast, Confectionery} => {Food}	0.056	0.679	0.082	1.143	180
4	{Breakfast, Food} => {Confectionery}	0.056	0.259	0.215	1.135	180
5	{Cigarette} => {Beverages}	0.097	0.573	0.170	1.109	315
6	{Confectionery} => {Food}	0.150	0.658	0.228	1.107	486
7	{Food} => {Confectionery}	0.150	0.252	0.594	1.107	486
8	{Beverages, Confectionery} => {Food}	0.068	0.620	0.110	1.043	220
9	{Confectionery, Food} => {Breakfast}	0.056	0.370	0.150	1.026	180
10	{Beverages, Food} => {Confectionery}	0.068	0.233	0.292	1.020	220
11	{Breakfast} => {Food}	0.215	0.595	0.361	1.001	696
12	{Food} => {Breakfast}	0.215	0.361	0.594	1.001	696
13	{} => {Confectionery}	0.228	0.228	1.000	1.000	739
14	{} => {Breakfast}	0.361	0.361	1.000	1.000	1170
15	{} => {Food}	0.594	0.594	1.000	1.000	1926
16	{} => {Beverages}	0.516	0.516	1.000	1.000	1674
17	{Confectionery} => {Breakfast}	0.082	0.359	0.228	0.994	265
18	{Breakfast} => {Confectionery}	0.082	0.226	0.361	0.994	265
19	{Food} => {Beverages}	0.292	0.491	0.594	0.951	946
20	{Beverages} => {Food}	0.292	0.565	0.516	0.951	946
21	{Confectionery} => {Beverages}	0.110	0.480	0.228	0.930	355
22	{Beverages} => {Confectionery}	0.110	0.212	0.516	0.930	355
23	{Beverages, Breakfast} => {Food}	0.077	0.543	0.142	0.915	250
24	{Confectionery, Food} => {Beverages}	0.068	0.453	0.150	0.877	220
25	{Sanitary} => {Food}	0.054	0.518	0.104	0.872	174
26	{Groceries} => {Food}	0.088	0.514	0.171	0.864	284
27	{Toiletries} => {Food}	0.055	0.493	0.112	0.830	179
28	{Breakfast} => {Beverages}	0.142	0.393	0.361	0.761	460

No.	rules	support	confidence	coverage	lift	count
29	{Beverages} => {Breakfast}	0.142	0.275	0.516	0.761	460
30	{Beverages, Food} => {Breakfast}	0.077	0.264	0.292	0.732	250
31	{Breakfast, Food} => {Beverages}	0.077	0.359	0.215	0.696	250
32	{Cigarette} => {Food}	0.051	0.302	0.170	0.508	166

Table 4.8 shows the results of the association rules formed between categories, which are 32 rules, and those containing the relationship between the two categories, which are 28 association rules. Then, based on the lift ratio value rules as a measure of the validity of the rules, 12 rules were obtained that had a lift ratio value > 1.

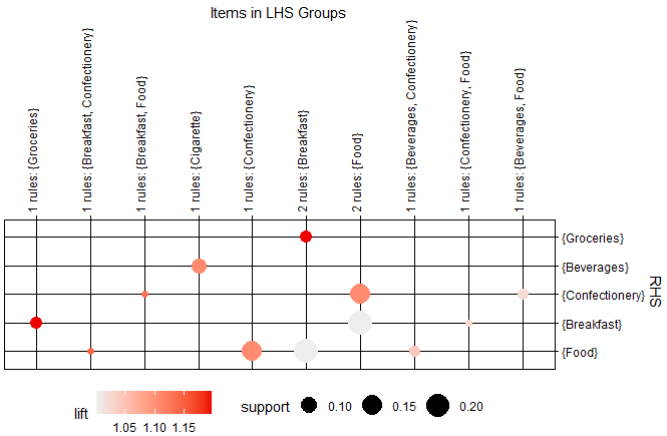


Figure 4. 2 Grouped Matrix of Association Rules by Categories

Figure 4. 3 Mapping of Association Rules by Categories

The image above represents an association rule matrix formed from transaction data based on item categories. It includes the terms LHS, which stands for the main item (antecedent), and RHS, which stands for the secondary item (consequent) in a transaction. It

can be observed that in Figures 4.1 and 4.2, the visualization results show the magnitude of association rules based on their lift ratio and support values. Association rules with the highest lift ratio are highlighted by the most prominent circle symbol, as seen in the association rule "Groceries => Breakfast." Meanwhile, association rules with the highest support value, such as "Breakfast => Food," are indicated by the largest circle size.

Table 4. 9 Rules Outputs Based on Sub-categories

No.	rules	support	confidence	coverage	lift	count
1	{Chips} => {Cake n Bread}	0.033	0.253	0.131	1.862	121
2	{Cake n Bread} => {Chips}	0.033	0.243	0.136	1.862	121
3	{Sachet Drink} => {Instant Noodle}	0.035	0.231	0.152	1.630	128
4	{Instant Noodle} => {Sachet Drink}	0.035	0.247	0.142	1.630	128
5	{Biscuit} => {Candy}	0.042	0.262	0.159	1.599	152
6	{Candy} => {Biscuit}	0.042	0.254	0.164	1.599	152
7	{Cake n Bread} => {Biscuit}	0.032	0.237	0.136	1.496	118
8	{Biscuit} => {Cake n Bread}	0.032	0.203	0.159	1.496	118
9	{Chips} => {Candy}	0.032	0.243	0.131	1.481	116
10	{Candy} => {Dairy Milk}	0.045	0.272	0.164	1.452	163
11	{Dairy Milk} => {Candy}	0.045	0.238	0.187	1.452	163
12	{Cake n Bread} => {Dairy Milk}	0.032	0.237	0.136	1.267	118
13	{Biscuit} => {Dairy Milk}	0.034	0.216	0.159	1.150	125
14	{Chips} => {Soft Drink}	0.033	0.251	0.131	1.124	120
15	{Sachet Drink} => {Dairy Milk}	0.031	0.202	0.152	1.079	112
16	{Cigarette} => {Soft Drink}	0.034	0.233	0.148	1.045	126
17	{Candy} => {Soft Drink}	0.038	0.230	0.164	1.032	138
18	{} => {Soft Drink}	0.223	0.223	1.000	1.000	816
19	{Mineral Water} => {Soft Drink}	0.036	0.220	0.164	0.984	132
20	{Biscuit} => {Soft Drink}	0.033	0.209	0.159	0.934	121

Based on table 4.9 above, 20 association rules are formed among subcategories, and 19 rules contain relationships between the two subcategories. Then, using the lift ratio (>1) as the measure of rule validity, 17 valid rules were obtained.

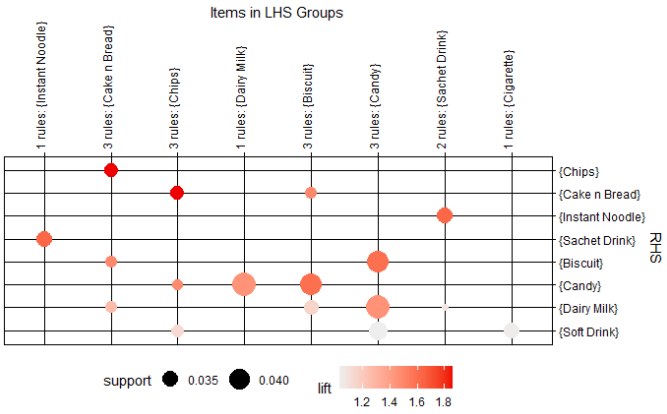


Figure 4. 4 Grouped Matrix of Association Rules by Sub-categories

Figure 4. 5 Mapping of Association Rules by Sub-categories

The image above depicts an association rules matrix based on product categories from transactional data. Figures 4.3 and 4.4 show that the visualizations illustrate the magnitude of association rules based on their lift ratio and support values. The association rule with the highest lift ratio is “Chips => Cake n Bread,” highlighted with the most prominent color. Meanwhile, the association rule with the highest support value is “Candy => Dairy Milk,” indicated by the largest circle shapes.

4.3 Data Processing Clustering of Customers’ Preferences

4.3.1 Multicollinearity Test

The multicollinearity test is an assumption test that needs to be conducted in statistical data processing, especially in implementing clustering methods. The data used is said to be good for a clustering model if it does not experience multicollinearity between variables. Multicollinearity indicates that there are two or more variables with high correlation values,

which can hinder the formation of the model's interpretation, thus resulting in unstable clustering results.

```
> print(vif_values)
       Age       Income        Spent     Exterior     Interior      Display       Layout
  1.161506     1.448189     1.229284     3.808745     2.699231     2.735498     2.423061
Satisfaction Decision        Brand        Color         Size        Price
  1.705883     1.326200     1.155838     1.114958     1.196385     1.132260
```

Figure 4. 6 Multicollinearity Test Result

To determine the presence of multicollinearity among variables can be identified through the Variance Inflation Factor (VIF) rule, which measures how much variance the coefficient estimates. The higher the VIF value for a variable, the greater the likelihood of multicollinearity or high correlation with other variables. Then, there is a rule that the upper limit for VIF is 10 in this multicollinearity test. Therefore, if a VIF's variable value shows > 10, then those variables experience or contain multicollinearity. As seen in Figure 4.5 above, it can be observed that all variables used in the process of clustering customer preferences are at sufficiently low values and below 10. Thus, all variables are free from multicollinearity and can proceed to the following clustering process.

4.3.2 Data Standardization

Data standardization is conducted to normalize the range of data across each attribute variable used. It is necessary because the existing data values vary widely. The result of data standardization is data that is more compact and extremely useful for facilitating the clustering process.

Table 4. 10 Data Standardization Result

No	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
1	0.98	-0.54	-1.21	-0.63	0.32	0.25	-0.06	0.34	-0.04	0.10	-0.72	-0.59	-0.38	0.46
2	-1.02	0.70	0.99	-0.63	0.32	0.25	0.45	0.34	-1.38	0.10	-0.72	-0.59	-0.38	0.46
3	-1.02	0.58	0.26	-1.28	-1.25	-1.23	-1.08	0.34	1.31	0.10	-0.72	-0.59	-0.38	1.65
4	0.98	1.70	0.99	0.03	0.32	-0.74	0.45	-0.10	-0.04	0.10	-0.72	1.68	-0.38	1.65
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
102	0.98	-0.42	-0.47	-0.63	-0.07	0.25	-0.57	0.34	-0.04	0.10	-0.72	1.68	2.63	-0.73
103	0.98	-0.29	0.99	-0.63	-0.86	-0.24	-0.06	-0.54	-1.38	0.10	-0.72	-0.59	-0.38	-0.73
104	0.98	0.33	2.46	1.33	-0.47	-1.23	0.45	-0.54	-0.04	0.10	-0.72	1.68	-0.38	-0.73

4.3.3 Determining the Number of Clusters

The standardized data from the previous stage is utilized for clustering using the k-means algorithm. The k-means approach offers the advantage that researchers can determine the

number of clusters at the beginning of the clustering process. However, determining the optimal number of clusters is also necessary in its implementation. This study employs the Elbow method (WSS) and Silhouette method to determine the optimal number of clusters, as illustrated in Figures 4.8 and 4.9 below.

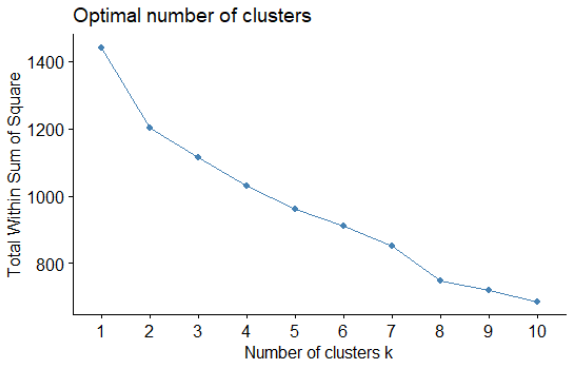


Figure 4. 7 Optimal Number of Clusters - Elbow (WSS)

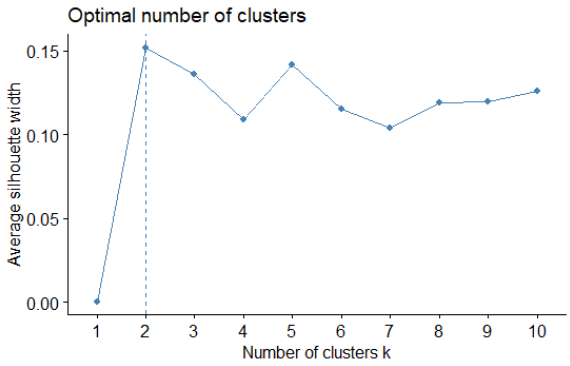


Figure 4. 8 Optimal Number of Clusters – Silhouette

The visualization output in the above figure from the WSS or Elbow method indicates that the first elbow appears at number 2 and reappears at number 8. Meanwhile, the Silhouette method is based on a straight line that appears precisely at number 2. Both methods indicate the number of clusters that can be formed based on the processed data and can subsequently be used for the k-means clustering process.

4.3.4 Cluster Results and Visualization

In the previous stage, the number of clusters was determined, resulting in a total of 2 clusters formed. The processing of these cluster data utilized standardized data, employing the k-means method. Based on the results obtained, cluster 1 contains 66 customers and cluster 2 contains 38 customers.

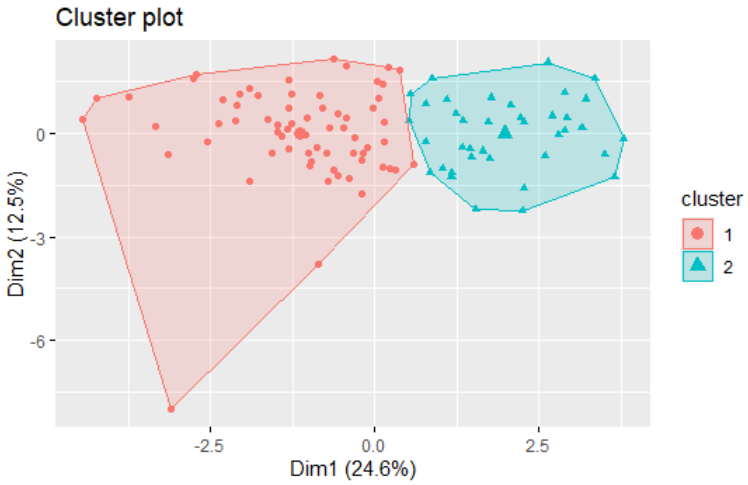


Figure 4. 9 Cluster Visualization

In Figure 4.10 above, the distribution of customers based on the formed clusters can be observed. Cluster 1 is depicted in red, tending to cluster at the top left of the cluster mapping plot, with one member notably distant from the rest of the group. Meanwhile, cluster 2, shown in blue, exhibits a clustered condition on the right side of the figure.

4.3.5 Cluster Profiling

The cluster profiling stages are conducted to ascertain the characteristics of members within each cluster formed based on the specified variables. To achieve this, the average values of each variable can be utilized, and the numbers can be rounded to obtain the results.

Table 4. 11 Cluster Profile Results

Variable	Initial		Rounded	
	Cluster 1	Cluster 2	Cluster 1	Cluster 2
Gender	1.530	1.474	2	1
Age	23.561	25.763	24	26
Income	2.439	3.000	2	3
Spent	2.909	3.053	3	3
Exterior	13.848	17.500	14	18
Interior	10.470	13.263	10	13
Display	10.167	12.763	10	13
Layout	10.000	13.342	10	13
Satisfaction	3.758	4.500	4	5

Variable	Initial		Rounded	
	Cluster 1	Cluster 2	Cluster 1	Cluster 2
Decision	1.985	2.000	2	2
Brand	1.227	1.553	1	2
Colour	1.258	1.263	1	1
Size	1.182	1.026	1	1
Price	1.727	1.421	2	1

In Table 4.10 above, the results of profiling clusters are known, describing their inhabitants' characteristics. Then, the rounding of numbers needs to be performed as indicated in the rounded column to facilitate the analysis process. The purpose of rounding is to simplify identifying or classifying the results based on the established criteria.

Table 4. 12 Cluster Characteristic

Variable	Cluster 1	Cluster 2
Gender	Female	Male
Age	24	26
Income	Rp 500.000 - 1.000.000	Rp 1.000.000 - 2.000.000
Spent	Rp 50.000 - 100.000	Rp 50.000 - 100.000
Exterior	Neutral	Good
Interior	Neutral	Good
Display	Neutral	Good
Layout	Neutral	Good
Satisfaction	Satisfied	Very Satisfied
Decision	Yes	Yes
Brand	Grouped	Mix
Colour	Grouped	Grouped
Size	Sorted	Sorted
Price	Sorted	Mix

In Table 4.11, it is shown that two clusters have been formed, and the detailed characteristics of these clusters have been identified. There are significant differences in several

variables between the clusters. Cluster 1 consists predominantly of male customers, while Cluster 2 consists predominantly of female customers. Regarding expenditure per shopping trip, Cluster 1 has lower spending than Cluster 2. Furthermore, regarding customer satisfaction with the service, Cluster 1 feels satisfied, whereas Cluster 2 feels very satisfied.

The aspects needed for the following process are those related to the design of the sales shelf's planogram. There is a difference between the two clusters regarding product grouping by brand and product grouping by price. This difference in clustering results indicates a difference in customers' preferred design of sales shelves. This difference can then be used as a reference for designing the planogram.

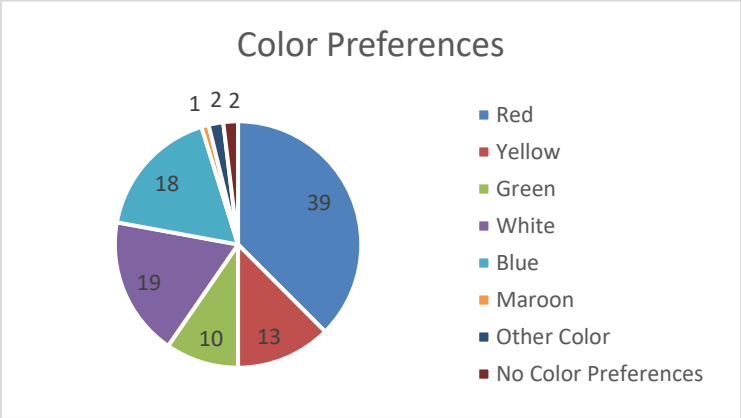


Figure 4. 10 Color Preferences Frequency

Next, in the variable color, there is a question regarding which color is the most striking and easy for customers to notice. The results shown in Figure 4.10 indicate that the three most frequently chosen colors are red (39 responses), white (19 responses), and blue (18 responses). These three colors are used as a reference for developing the planogram design to align with the preferences of most customers.

4.4 Planogram Development

4.4.1 Shelves Size Specifications

The planogram design was carried out considering the conditions and specifications of the sales shelves at Minggir Mart. The specifications required are related to size details such as height, width, depth, and distance between rows of shelves. There are various categories of shelves available and have the function of placing certain items according to their needs as listed in table 4.12.

Table 4. 13 Shelves Specifications

Shelves Category	Height (cm)	Width (cm)	Depth (cm)	Row Spacing (cm)
Front Display	90	55	20	20
	90	160	20	20
Small	137,5	75	30	15
	137,5	75	30	17
Medium	135	90	30	21
	135	90	30	30
Large	180	87,5	30	25
	180	87,5	30	40
Refrigerator	180	125	50	28

Based on Table 4.12 above, it is known that there are 5 categories of shelves along with their detailed sizes. Relatively small shelves are used to store small and light products. On the other hand, if the size of the shelf is large, it is used for storing large products. In this research, information or knowledge from previous methods, namely association rules, is used to determine suitable combinations of items and clustering to determine product arrangement patterns on the shelves. So, as a sample used in this research, the process of making a planogram is adjusted to the product size characteristics that appear in the association rules that are formed.

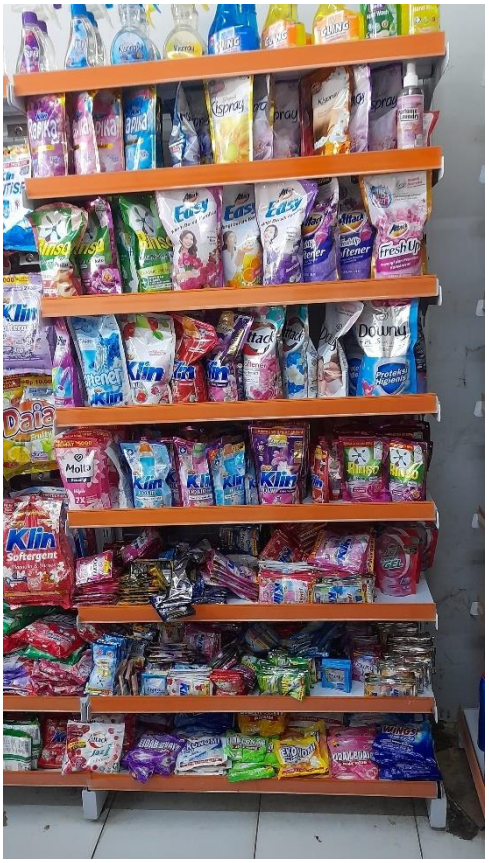


Figure 4. 11 Condition of Sales Shelves in Category Product Cleaning

Figure 4.11 above illustrates the condition of a shelf at Minggir Mart, specifically in the detergent product sub-category. The shelf display in the figure depicts a shelf with a height of 180 cm and an equal distance between each shelf row. The placement of products on each shelf row tends to be messy and inconsistent with the available space. By identifying the dimensions of all available shelves at Minggir Mart, improvements or customizations can be made to the shelves to make them more attractive and optimal for increasing sales.

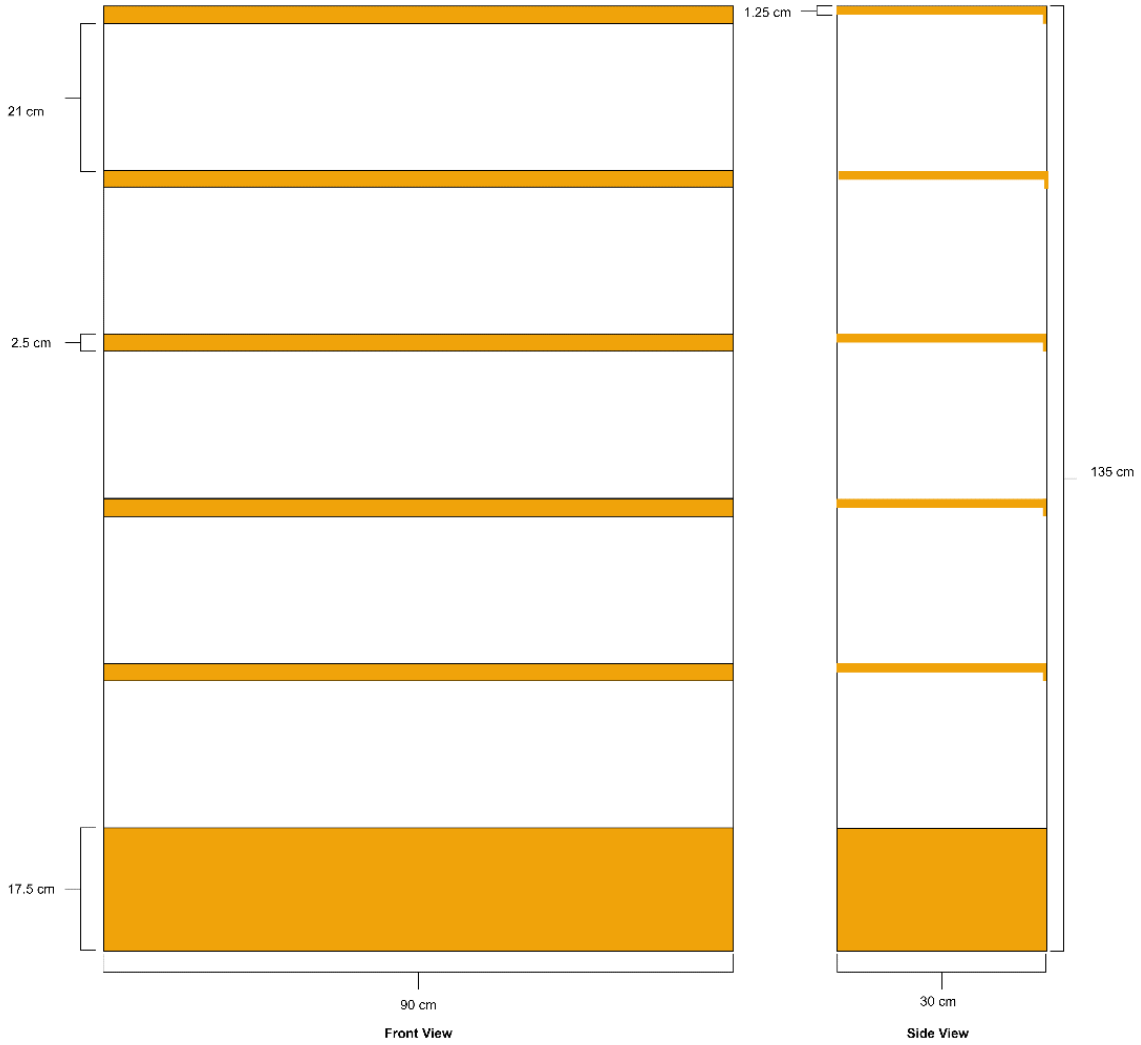


Figure 4. 12 Example of Initial Shelves Design in Minggir Mart

In Figure 4.12 above, we can see an illustration of the specifications of the medium-sized sales shelf at Minggir Mart. This example shows that a shelf consists of 6 rows that can be used to display sales products. The product arrangement implemented by Minggir Mart's retail manager applies grouping based on their functionality. However, there is still some lack of neatness and maximum organization in the arrangement, resulting in a less attractive visual display.

4.4.2 Items Identification

The process of identifying these items is conducted to determine which items will be processed in creating a planogram based on customer preferences. The selected items are derived from data processing using the Apriori algorithm. The selection involves considering the categories and sub-categories of products that appear in several association rules that have been formed, as seen in Table 4.14.

Table 4. 14 Items Identification

Category	Sub-Category
Groceries	Chips
Breakfast	Cake n Bread
Confectionery	Sachet Drink
Food	Instant Noodle
Cigarette	Biscuit
Beverages	Candy
	Dairy Milk
	Cigarette
	Soft Drink

4.4.3 Shelves Layout Preference Identification

There are four main indicator aspects: brand, colour, size, and price of the available products. These four aspects reflect the customers' preferences on how a collection of products placed in a row on a shelf can facilitate the search for items. The development of shelf content arrangement utilizes detailed information related to the size and specifications of the shelf, as explained in the previous data processing section (association rules and clustering). Below is the scheme for applying visual merchandising aspects for the planogram design:

a) Brand: Based on the results obtained, it is known that there are differences in preferences among customers. Therefore, this study arranges products by brand, grouping similar products and mixing various products in a sales shelf row.
b) Size: Customer preference data processing results indicate no difference in interest in product placement based on size. Most customers prefer product arrangements grouped or sorted by size. This size preference is because neatly organized product sizes facilitate the identification process of desired products.
c) Color: Customers will find it easier to locate products if the appearance or color is striking or easily recognizable. Based on the data processing results, it is found that there is no difference in preferences among customers grouped in both clusters. Therefore, the arrangement process will be done by categorizing products based on the product colors in each category.

d) Price: The two groups have differing customer preferences regarding product grouping based on price. Half the customers prefer products arranged in ascending price order, while others prefer random pricing arrangements. Therefore, a combination of both pricing arrangements is necessary.

The findings from data processing are valuable tools or information to be applied to planograms. Thus, it indirectly identifies issues and customer preferences related to ideal product layout or design on shelves. The application of this visual strategy aims to enhance customer satisfaction. This study makes assumptions based on the most vital rules (highest confidence values) to be implemented as objects for planogram development. The stages of creating planograms are documented and visualized in a two-dimensional form to provide a concrete example of shelf design that aligns with customer preferences.

Figure 4. 13. Proposed Planogram

The illustration above represents a display shelf design tailored to customer preferences. The products shown in Figure 4.12 are examples representing the association rules formed using the Apriori algorithm based on product categories or sub-categories. These products are potential items or those frequently purchased together by customers. Consideration was given to grouping products based on four aspects: brand, size, color, and price. The planogram design

of this shelf comprises five rows, each serving a distinct role in representing customer interest and preference in product arrangement. The shelf design specifications are a height of 137.5 cm, a width of 90 cm, and a shelf depth of 30 cm. The distance between the rows is varied to differentiate the product capacity that can be placed on each row.

CHAPTER V
DISCUSSION

5.1 Discussion of Association Rules Results

This research implementation of association rule mining aims to determine the relationships among product items based on sales transaction data. In the processing phase, the Apriori algorithm is utilized to accurately process transaction data, not solely based on the frequency of occurrence. Subsequently, in determining the generated association rules, the researcher considers three essential parameter values: support as a representation of the percentage of items, confidence as the certainty or strength value of the rule, and lift as a measure of the validity of a rule. Researchers can determine the support and confidence values and conduct experiments with various values to generate more rules. Higher support and confidence values indicate that these rules are more likely to occur in a transaction. Meanwhile, the value of the lift ratio is a definite criterion where rules can be considered valid if their lift ratio is greater than 1.

This study generated two types of association rules testing based on product categories and sub-categories. As outlined in the explanation below, the testing was divided into two kinds to obtain more accurate insights:

a) In processing data based on product categories, a minimum support value of 5% and a minimum confidence value of 25% are utilized. With these minimum support and confidence values, 12 association rules are formed and considered as valid. In this data processing of product categories, the first rule with the highest confidence value is “Breakfast, Confectionery => Food” with a confidence level of 67.9%. This rule is supported by a support value of 5.6% of the total transactions and the lift ratio value is 1.135. This rule indicates that the “Breakfast and Confectionery” categories have the potential to trigger customers to make purchases from the “Food” category simultaneously.

   The second rule with the highest confidence value is “Confectionery => Food.” This rule has a confidence value of 65.8% and a support value of 15% of the total transactions. Similar to the first rule this rule is valid because has a lift ratio value of about 1.107. The first category acts as a trigger for the simultaneous purchase, in this

rule, it is evident that if “Confectionery” is purchased, it indirectly triggers the purchase of “Food” in the same transaction.

b) Data processing based on product sub-categories employs a minimum support value of 3% and a minimum confidence value of 20%. These minimum support and confidence values generate 17 valid rules. The rule with the highest confidence value is “Candy => Dairy Milk”, with a confidence value of 27.2%, supported by a 4.5% occurrence rate from all transactions, and had a lift ratio value of 1.452. The sub-category “Candy” acts as a trigger in a transaction and exhibits a relationship with the sub-category “Dairy Milk”, which can be purchased together.

    Furthermore, the second-highest confidence rule is “Biscuit => Candy,” with a confidence value of 26.2%, supported by 4.2% of the data from all transactions, and had a lift ratio value of around 1.599. The sub-category “Biscuit” serves as a primary item or trigger, having followers as secondary sub-categories. These rules indicate that “Biscuit” is a category capable of triggering customers to make purchases of “Candy” products together in a single transaction.

Similarly, for other rules that are formed in each rule definition scheme using the Apriori algorithm, with the condition that the rules are valid (lift ratio > 1), they can be considered as knowledge derived from the application of data mining. In this research, the results obtained from the association rules method are utilized to determine which categories and sub-categories of products are worthy of further consideration in the subsequent stage of creating shelf planogram designs. In the design of planograms, products serve as the primary components that are visualized within the planogram. This planogram concept combines several aspects, including product name or category, size, color, and price. Generally, combinations or association rules can be a reference for retail store managers to enhance their sales.

One example is implementing a cross-selling strategy, which is considered an art to capture customers' interest in multiple products or services simultaneously, enticing them to choose and use two or more items together (Melati & Wahyuni, 2020). When associated with this research, the relationship between categories and sub-categories can be given special treatment through product positioning approaches to achieve higher sales. However, it does not preclude the possibility of implementing other sales strategies such as promotions, bundling, and discounts.

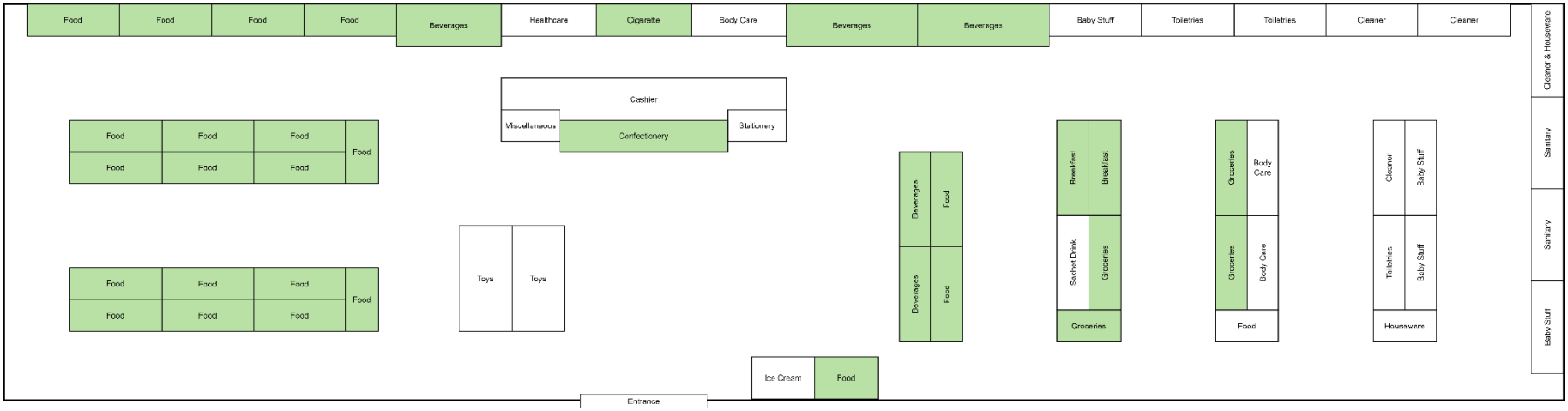


Figure 5. 1 Identified Rules Based on Shelf Layout

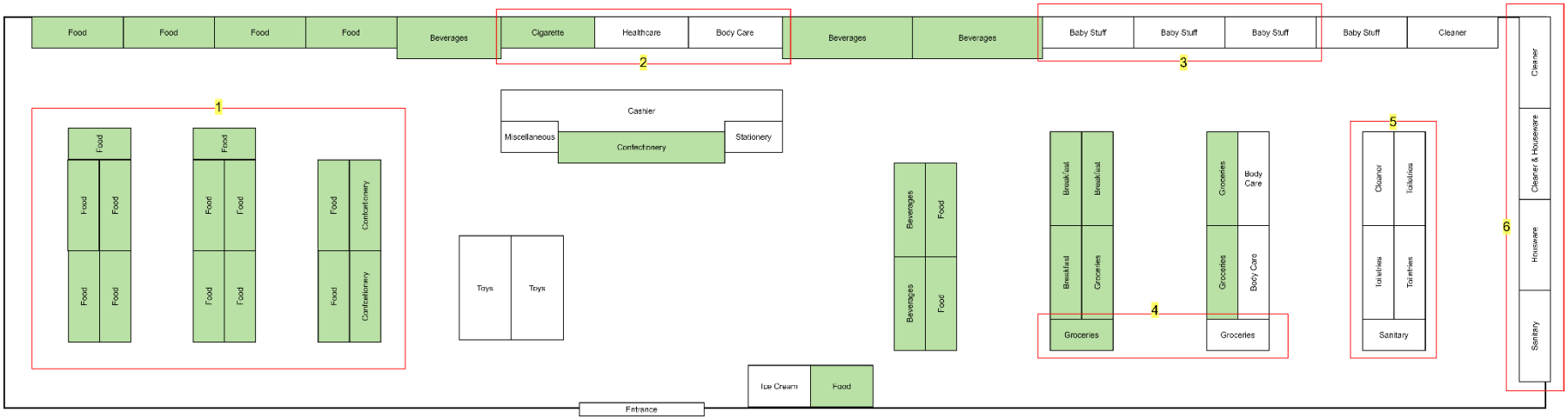


Figure 5. 2 Redesign Shelf Layout

Based on the selected rules, they can be applied to enhance planogram design and combined for cross-selling implementation. Based on the layout conditions, the initial picture indicates irregularities in product arrangement on the shelves. Figure 5.1 illustrates which shelves are involved in the association rules formed during monthly sales transactions at Minggir Mart. It is known that among the product categories, five categories are involved in 12 association rules formed. Meanwhile, nine sub-categories are involved in 17 association rules formed among the sub-categories. The results indicate that items or categories involved in the association rules of customer purchase transactions are items with short shelf life due to high consumer demand. These items have rapid turnover and are typically called Fast Moving Consumer Goods (FMCG). Therefore, products in these categories can be treated specially to maintain sales stability and drive sales of other categories. The goal is to manage stock stability and prevent unsold products from reaching their expiration limits, which would otherwise be detrimental to retail store management regarding operations and budgeting.

Then, in Figure 5.2, several changes in the shelf layout are shown to maximize the available retail store space. The most significant layout change is marked in red box number 1, which previously had a horizontal arrangement. In this layout improvement, the direction of the shelves has been changed to vertical (as shown in the figure) to provide more accessible movement for customers while shopping. Additionally, there is an option to add shelves to accommodate all items that need to be properly displayed. Providing ample space allows customers to shop freely and feel comfortable. Adequate and balanced space is a key indicator of successful retail store layout design. This layout concept will also provide information on customers' traffic flow patterns around the available shelves (Prakash & Mishra Vivek, 2017). Additionally, in the other changes (red box numbers 2-6), there are adjustments in product placement according to their categories. This re-layout strategy is done to provide comfort and ease for customers so that the displayed products are safe to use. Specifically, if products for consumption are found to be placed near products containing hazardous chemicals, it is necessary to move these products to avoid cross-contamination. These changes will have a positive impact on customers as they will feel safe when using consumable items (Castro et al., 2013).

This research focuses on utilizing product information from selected categories with the highest confidence values as the basis for creating planograms. A planogram entails the interconnection of product details (types, color, size, and price) with the respective shelf.

Consequently, the researcher aims to maximize space on the sales shelf, aligning it with product sizes and arranging them appropriately to attract customer interest. The paramount objective is to enhance customer satisfaction by enabling retail store managers to provide optimal service and facilitate customers in finding their desired products. The layout or sales shelf arrangement, encompassing its shape, position, and distance, serves as a crucial indicator to maintain and develop, ensuring that customers feel satisfied and comfortable while shopping (Supariyani & Marpaung, 2013).

5.2 Discussion of Customer Preference Clustering Results

The data clustering process in the previous chapter has resulted in the segmentation of customers into 2 clusters, each with its distinct characteristics. This clustering aims to discern differences in customer preferences regarding shopping experiences and preferred shelf management. Based on the data clustering process using the K-Means method in RStudio, the characteristic outcomes are explained below:

a) In the first cluster, 66 customers are dominated by females with an average age of around 24 years. Members of this cluster have an average income ranging from Rp 500,000 to Rp 1,000,000 and spend between Rp 50,000 to Rp 100,000 each time they shop. Based on the assessment of visual merchandising aspects (exterior, interior, display, and layout) in retail stores, most cluster members are at an average level or feel satisfied. These results indicate that overall, the retail store's visual aspects meet the comfort standards for cluster members. Thus, there is a correlation between customer satisfaction and loyalty. The results show that members of cluster 1 are satisfied and intend to return for shopping. Furthermore, most cluster members are interested in product arrangement in the planogram design, such as grouping products by brand, grouping products by color, arranging products by size, and arranging products by price.
b) In the second cluster, there are 38 members, dominated by males with an average age of around 26. These cluster members have a monthly income ranging from Rp 1,000,000 to Rp 2,000,000 and an average spending of Rp 50,000 to Rp 100,000 each time they shop. Based on the evaluation of visual merchandising aspects (exterior, interior, display, and layout) in retail stores, most cluster members rated it as good. Furthermore, members of this cluster feel delighted with the service and intend to return for shopping again. Additionally, members of this cluster have preferences regarding the arrangement

of products in the design of the sales shelving, namely, arranging product brands randomly, grouping product colors, arranging products in order of size, and arranging products without sorting by price.

Consider the characteristics of customers in a cluster to give them special treatment. Most sales are female, so as a sales strategy, special attention can be given to products that are favored more by females. In a study conducted by Jain et al., (2013), mentions that visual influence helps in the decision-making process for purchasing products. Female customers tend to have impulsive beliefs and ideas about buying a product after seeing its visual presentation. In addition, it is also necessary to consider the financial aspect, which can boost the amount of goods purchased, and this applies to all genders of customers without exception. Sometimes it is also influenced by the amount of monthly income, making it possible to manage spending patterns. Customers will consider their purchasing decisions by ensuring that the expenditure is worth it or equivalent to the quality of the products obtained (Fong et al., 2015). In cluster 2, which consists mainly of male customers, a strategy that uses visually appealing elements should be applied, considering their characteristics. Male customers tend to spend less time shopping compared to female customers. They can compare products and make purchasing decisions quickly. Conversely, female customers have a more sensitive nature regarding prices and quality. Therefore, retail store managers can implement a product layout that facilitates the discovery of products. Implementation of this strategy can be achieved by positioning products in strategic locations and providing detailed information about the store shelves (Haj-Salem et al., 2016).

Based on the discussion of the characteristics of each cluster above, significant differences were found in several aspects or variables. These include demographic differences, visual merchandising assessments, loyalty and satisfaction, and preferences for shelf planogram designs. Since this research focuses on how product placement is manifested on the sales shelf through planogram methods, these differences become valuable insights for further processing. The aim is to enhance customer satisfaction by providing service in the form of visually appealing and aesthetically pleasing product arrangements. Thus, it can create visual appeal and facilitate the search for desired products.

Regarding design preferences and product arrangement on shelves, there is a significant difference between the two clusters, particularly in the “Brand” and “Price” indicator variables. Each cluster has different preferences regarding the grouping of products on a shelf. Members

of cluster 1 prefer products on a shelf to be arranged based on the similarity of the product brand. In contrast, members of cluster 2 prefer not to have products arranged by brand similarity. Regarding the price variable, cluster 1 members want products on a shelf row ordered from the cheapest to the most expensive. In contrast, cluster 2 members do not consider price ordering in product arrangement. The differences between these two clusters highlight that there are varied preferences.

Customers will feel happy and satisfied if they can quickly and easily find their desired products. Retail managers need to pay attention to and improve by considering the application of visual merchandising concepts. Specifically, aspects of interior design, display, and shelf layout are highly relevant to customer activities when searching for products or navigating through all sections of the retail store. As the results indicate, product arrangement on sales shelves focuses on indicators such as brand, size, color, and price grouping. Additionally, information or markers are provided to reflect the different customer preferences regarding product arrangement. This result allows the implementation of strategies to reach potential customers or achieve greater profit from all customers by combining product arrangements. These combinations should be based on habits or patterns identified in previous findings. In this context, they will be integrated with the results of purchasing pattern identification using the Apriori algorithm, as discussed in the previous section.

5.3 Discussion of Planogram Design Results

At Minggir Mart, various types of shelves display products for sale. These shelves vary in height, width, depth, and the spacing between rows. It has been observed that the product placement managed by the retail manager needs to be more neat and pleasant to the eye. This will certainly negatively impact customers' perception and comfort while shopping and looking for products. Customers often react negatively to poorly maintained shelf sales displays. In this case, the disorganization of products on the shelf can create a negative perception. It can lead to the assumption of cross-contamination between different types of products, which is considered dangerous, causing customers to avoid purchasing those products (Castro et al., 2013).

The planogram design considers various aspects, such as the size and visual appeal of the products displayed on the shelves. The more attractive the product arrangement within the planogram, the more it will enhance customer interaction and stimulus. A neat and appealing

arrangement will create a positive impression and increase customers' comfort and satisfaction. According to Clement et al., (2013), visuals are crucial in marketing communication, encompassing elements such as text, brand labels, and easily recognizable color schemes. This research relates to how the arrangement of products on a sales shelf can provide appealing information that makes it easier for customers to find their desired products. Based on the planned planogram design, it has been determined that there are several rows within the shelves. The spacing between shelf rows is designed variably according to the available space at Minggir Mart. This planogram design is done to maximize the allocation of product placement on the shelves. Regarding branding, a specific row can be allocated for a potential brand. It can be implemented to enhance sales of specific branded products that require special attention. Additionally, in terms of size, the shelf rows are functionally divided. Larger-sized products tend to be heavier and are placed on the bottom rows. Products on the lower shelves are easily accessible and visible to customers (Štulec et al., 2016).

Based on the planogram design results, it was determined that there are several rows on the shelves. The spacing between shelf rows is varied according to the availability of shelves at Minggir Mart. This approach maximizes the allocation of products that can be placed on the shelves. In terms of brands, a dedicated row can be provided for a potential brand. This consideration can be implemented to increase sales of certain product brands that need special treatment. Additionally, in terms of size, the function of the available shelf rows is divided. This shelf size distribution involves adjusting the size of the products that can be placed on them, such as products that tend to have larger sizes and weights being placed on the bottom shelf. Products on the bottom shelf will be easily found and reached by customers (Kauppinen-Räisänen, 2014).

From the aspect of product pricing, customers prefer a product arrangement patterned from low to high prices. The customer felt more satisfied with their shopping experiences when products were displayed neatly and in sequence. Price information is crucial and should be prominently displayed near a sales display shelf. Customers base their purchasing decisions on accurate price information, known as price level awareness. Sorting similar products by price category helps provide explicit information about product quality. Thus, customers can easily compare products of the same category based on comparable quality and price (Chandrashekaran & Suri, 2012).

Based on the designed planogram, each row on the sales display shelves plays a distinct role. Regarding product pricing, all available shelf rows implement product sorting from lowest to highest price (left to right). This pricing arrangement facilitates customer decision-making and benefits retail managers by allowing them to implement sales strategies and profit analysis more efficiently (Drèze et al., 1994). Based on field observations at Minggir Mart, it was noted that price information needs to be comprehensively displayed on products. According to one respondent, customers tend to inquire about product prices directly to the cashier on duty. Therefore, this planogram illustrates the importance of displaying price labels to enhance customer comfort and satisfaction. A small piece of information, like a price label, can serve as a communication tool that influences purchasing decisions (Grandi et al., 2021).

In terms of product brand, the second line from the bottom is dedicated to the same brand of products. This product settlement is to cater to and address the preferences of customers who have a specific interest in certain products. Products with a strong brand image or distinct identity are sought after and trusted for their perceived quality by customers. Retail managers play a crucial role in boosting the sales of potential brand products by giving them a dedicated space to attract customer attention (Pesoth, 2015). In terms of color, the designed shelf planogram considers color preferences and arrangement. It is noted that the most favored colors by customers are red, white, and blue. This color aspect is applied to the top second row of shelves for biscuit and wafer products that share blue packaging similarities. Additionally, striking color combinations are utilized to attract customers' attention effectively. The intention behind these combinations is to place contrasting product packaging side by side to facilitate easy product identification. Organizing products based on their colors is considered highly effective in enhancing visual appeal and influencing customer purchasing decisions. This effect happens because color serves as a key branding communication tool for products, and well-designed packaging makes products more visible (Wijaya et al., 2020).

Lastly, regarding the aspect of product dimensions applied comprehensively in the shelf planogram design, standard rack specifications should be considered, which should include varying sizes in terms of height, depth, and width (Hübner et al., 2020). There are variations in the distance between shelf rows, specifically 30 cm, 25 cm, 21 cm, 17 cm, and 15 cm. These different sizes allow for tailored shelf allocation based on the size of the products to be displayed. In the designed planogram, it is noted that the bottom row has a height of 30 cm, suitable for accommodating larger products with potentially heavier loads. The rows on the

upside are adjusted according to their respective capacities. The top rows, with smaller spaces, are allocated for smaller-sized products and can accommodate various product combinations. Organizing products by size is crucial for enhancing shelf aesthetics and tidiness, achieved through the combination of different product types (Drèze et al., 1994).

CHAPTER VI
CONCLUSION

6.1 Conclusion

Below is the conclusion based on the research findings:

1. The purchasing patterns of customers at Minggir Mart, obtained through the apriori algorithm, reveal results in the form of association rules categorized into product categories and sub-categories. In processing the product categories, 12 valid rules were identified, while for the product sub-categories, 17 valid rules were found. It is noted that these rules tend to exhibit interdependencies. For instance, in the product category, rules with the highest confidence values include items such as "Breakfast, Confectionery => Food," followed by rules in the sub-category with the highest confidence, such as "Biscuit => Candy." Products identified in the sub-category rules are part of the rules generated in the association rules based on product categories. This information can be used for evaluating and considering enhancements to Minggir Mart to maximize product sales. In this study, adjustments to the layout of the shelves are provided to maximize the available space and relocate certain products to avoid cross-contamination between them. This result can be involved in designing more effective sales strategies for potential products (as indicated by the rules) or others.
2. Customer clustering at Minggir Mart based on demographic aspects, visual store assessment, and planogram design preferences resulted in two selected clusters. Each cluster exhibits distinct characteristics, notably influenced by gender differences discovered in this study. The cluster analysis outcomes are valuable for understanding customer satisfaction with Minggir Mart's overall visual aspects. Both clusters express satisfaction with the service and store visuals and intend to return to shopping at Minggir Mart. These findings align with visual merchandising concepts aimed at branding a store to maximize its appearance, positively impacting customer satisfaction and comfort. Furthermore, based on planogram design preferences, differences in product placement preferences by brand and price were identified. This information is crucial for shelf management, accommodating various placement strategies to enhance visual appeal.
3. Positive and convenient customer service enhanced a comfortable shopping experience. This service is implemented by optimizing shelf designs tailored to customer

preferences and purchasing patterns identified from transaction data. Customers appreciate well-organized product layouts that cater to their buying habits. Four aspects guide product placement: grouping by brand similarity, size, color, and price. Designing this planogram emphasizes the importance of attractive visuals, achieved through combining these design aspects. It also considers shelf availability, size specifications, and store layout, facilitating improvements through established planogram designs on specific shelves for Minggir Mart.

6.2 Suggestion

Below are the recommendations that can be provided based on the research findings:

1. Suggestions that can be given for further research are:
   a) Conducting more extensive data mining on processed transactions to identify association rules accurately and applying alternative methods or algorithms for developing these association rules.
   b) Expanding variable scope in visual aspects and design preferences of planograms involved in clustering methods and the necessity to broaden respondent targets to obtain more data.
   c) Implementing a 3D visualization-based approach and cutting-edge technologies capable of monitoring the effectiveness of planogram design implementation in retail stores in real-time, encompassing both stock management and sales profit calculations.
2. Retail store managers, especially at Minggir Mart, can be suggested to utilize the research's findings and recommendations as considerations for future retail store development. This can be achieved by improving and designing sales strategies by optimizing the visual appearance of the store and display shelves.

REFERENCES

Andriani, M. N., & Ali, M. M. (2013). KAJIAN EKSISTENSI PASAR TRADISIONAL KOTA SURAKARTA. *Jurnal Teknik PWK*, *2*(2), 252–269. http://www.pu.go.id

Arifianti, R. (2017). Analisis Tata Letak Dalam Perspektif Ritel. *AdBispreneur*, *1*(3). https://doi.org/10.24198/adbispreneur.v1i3.11216

Armia, S. (2016). Pengaruh Dimensi Kualitas Pelayanan Ritel Terhadap Kepuasan Pelanggan Dan Dampaknya Pada Loyalitas Pelanggan Sinbun Sibreh Banda. *SI-MEN (Akuntansi Dan Manajemen) STIES*, *7*(1). http://jurnal.stiesabang.ac.id/index.php/simen/article/view/54%0Ahttp://jurnal.stiesabang.ac.id/index.php/simen/article/download/54/41

Arora, V. P. S., Sharma, S., & Singh, N. K. (2007). Nature and Functioning of Visual Merchandising in Organized Food Retailing. *Agricultural Economics Research Review*, *20*(June), 441–456.

Badan Pusat Statistik BPS. (2023). *Berita Resmi Statistik - Pertumbuhan Ekonomi Indonesia Triwulan II-2023*. *55*, 1–16.

Berman, B., & Evans, J. R. (2013). *Retail Management A Strategic Approach*. Pearson Education India.

Bermúdez, J., Rodríguez, K. A., & Abad, A. G. (2016). Layout Optimization and Promotional Strategies Design in a Retail Store based on a Market Basket Analysis. *LACCEI International Multi-Conference for Engineering, Education, and Technology*, *June*. https://doi.org/10.18687/laccei2016.1.1.307

Bilgic, E., Cakir, O., Kantardzic, M., Duan, Y., & Cao, G. (2021). Retail analytics: store segmentation using Rule-Based Purchasing behavior analysis. *International Review of Retail, Distribution and Consumer Research*, *31*(4), 457–480. https://doi.org/10.1080/09593969.2021.1915847

Castro, I. A., Morales, A. C., & Nowlis, S. M. (2013). The influence of disorganized shelf displays and limited product quantity on consumer purchase. *Journal of Marketing*, *77*(4), 118–133. https://doi.org/10.1509/jm.11.0495

Chandrashekaran, R., & Suri, R. (2012). Effects of gender and price knowledge on offer evaluation and channel transition in retail and e-tail environments. *Journal of Product and Brand Management*, *21*(3), 215–225. https://doi.org/10.1108/10610421211228838

Chaniago, H. (2020). Investigation of Factors Influencing Traditional Retail Success in Small Cities in Indonesia. *Journal of Applied Economic Sciences*, *1*(67), 65–75. https://doi.org/10.14505/jaes.v15.1(67).05

Chaniago, H. (2021). *Manajemen Ritel & Implementasinya* (Y. Efawati (ed.); 1st ed.). Edukasi Riset Digital.

Clement, J., Kristensen, T., & Grønhaug, K. (2013). Understanding consumers' in-store visual perception: The influence of package design features on visual attention. *Journal of Retailing and Consumer Services*, *20*(2), 234–239. https://doi.org/10.1016/j.jretconser.2013.01.003

Cordova, G. I., Del Rosario Guerreros Surichaqui, S., Del Pilar Palomino Ricaldi, F., & Vicente-Ramos, W. (2020). Impact of visual merchandising on the purchase decision of consumers from retail stores in central Peru. *Management Science Letters*, *10*(11), 2447–2454. https://doi.org/10.5267/j.msl.2020.4.005

Czerniachowska, K. (2022). A genetic algorithm for the retail shelf space allocation problem with virtual segments. In *Opsearch* (Vol. 59, Issue 1). Springer India. https://doi.org/10.1007/s12597-021-00551-3

Drèze, X., Hoch, S. J., & Purk, M. E. (1994). Shelf management and space elasticity. *Journal of Retailing*, *70*(4), 301–326. https://doi.org/10.1016/0022-4359(94)90002-7

Ebster, C., & Garaus, M. (2011). *Store design and visual merchandising: Creating store space that encourages buying*. Business Expert Press.

Fachrurozi, A., Junaedi, M., Putra, J. L., & Gata, W. (2020). Algorithm Implementation Of Interest Buy Apriori Data On Consumer Retail Sales In Industry. *Journal of Informatics and Telecommunication Engineering*, *4*(1), 48–56. https://doi.org/10.31289/jite.v4i1.3775

Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). From data mining to knowledge discovery in databases. *AI Magazine*, *17*(3), 37–53. https://doi.org/10.1609/aimag.v17i3.1230

Feijó, F. R., & Botelho, D. (2012). Effect of factors related to merchandising on retail sales. *RAE Revista de Administracao de Empresas*, *52*(6), 628–642. https://doi.org/10.1590/S0034-75902012000600005

Felycia, N. L. P. M., & Genoveva, G. (2021). Analisis Keputusan Pembelian Konsumen Di Toko Tradisional Dalam Menghadapi Pertumbuhan Ritel Modern. *JIMFE (Jurnal Ilmiah Manajemen Fakultas Ekonomi)*, *7*(2), 141–152. https://doi.org/10.34203/jimfe.v7i2.3540

Firmansyah, F., & Yulianto, A. (2021). Market Basket Analysis for Books Sales Promotion using FP Growth Algorithm, Case Study : Gramedia Matraman Jakarta. *Journal of Informatics and Telecommunication Engineering*, *4*(2), 383–392. https://doi.org/10.31289/jite.v4i2.4539

Fong, S. W. L., Kian, T. P., Fern, Y. S., & Vincent, W. (2015). Monetary and Image Influences on the Purchase Decision of Private Label Products in Malaysia. *Journal of Advanced Management Science*, *December*, 312–318. https://doi.org/10.12720/joams.3.4.312-318

Gilchrist, M., Mooers, D. L., Skrubbeltrang, G., & Vachon, F. (2012). Knowledge Discovery in Databases for Competitive Advantage. *Journal of Management and Strategy*, *3*(2). https://doi.org/10.5430/jms.v3n2p2

Grandi, B., Burt, S., & Cardinali, M. G. (2021). Encouraging healthy choices in the retail store environment: Combing product information and shelf allocation. *Journal of Retailing and Consumer Services*, *61*(April 2020), 102522. https://doi.org/10.1016/j.jretconser.2021.102522

Haj-Salem, N., Chebat, J. C., Michon, R., & Oliveira, S. (2016). Why male and female shoppers do not see mall loyalty through the same lens? The mediating role of self-congruity. *Journal of Business Research*, *69*(3), 1219–1227. https://doi.org/10.1016/j.jbusres.2015.09.011

Hanaysha, J. R. (2018). An examination of the factors affecting consumer's purchase decision in the Malaysian retail market. *PSU Research Review*, *2*(1), 7–23. https://doi.org/10.1108/PRR-08-2017-0034

Hübner, A., Schäfer, F., & Schaal, K. N. (2020). Maximizing Profit via Assortment and Shelf-Space Optimization for Two-Dimensional Shelves. *Production and Operations Management*, *29*(3), 547–570. https://doi.org/10.1111/poms.13111

Jain, V., Sharma, A., & Narwal, P. (2013). Impact of Visual Merchandising on Consumer Behaviour towards Women's Apparel. *International Journal of Research in Management*, *5*(2). http://www.ijmrbs.com/currentissue.php

Jamal, & Yanto, D. (2019). Analisis RFM dan Algoritma K-Means untuk Clustering Loyalitas Customer RFM Analysis and K-Means Algorithm for Customer Loyalty Clustering. *Journal ENERGY (Jurnal Ilmiah Ilmu-Ilmu Teknik)*, *9*(1), 18. https://doi.org/10.51747/energy

Kauppinen-Räisänen, H. (2014). Strategic Use of Colour in Brand Packaging. *Packaging and*

Technology and Science, *27*(8), 663–676. https://doi.org/10.1002/pts

Kaur, K., & Saini, H. K. (2022). Retailer's awareness regarding use of visual merchandising in apparel retail stores. *International Journal of Home Science*, *8*(1), 103–108. http://www.homesciencejournal.com

Kumbhare, T. A., & Chobe, P. S. V. (2014). An Overview of Association Rule Mining Algorithms. *International Journal of Computer Science and Information Technologies (IJCSIT)*, *5*(1), 927–930. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=d4058d9f3f66c53ddea776c974fbd740afd994b4

Kusumo, H., Marlina, D., Novita, M., & Anwar, M. T. (2021). Analysis of transaction patterns at drug store with Apriori Algorithm. *Journal of Physics: Conference Series*, *1869*(1). https://doi.org/10.1088/1742-6596/1869/1/012070

Lakshmi, B. N., & Raghunandhan, G. H. (2011). A Conceptual Overview of Data Mining. *Proceedings of the National Conference on Innovations in Emerging Technology-2011Technology-2011*, 27–32.

Law, D., Wong, C., & Yip, J. (2012). How does visual merchandising affect consumer affective response?: An intimate apparel experience. *European Journal of Marketing*, *46*(1), 112–133. https://doi.org/10.1108/03090561211189266

Leolita, L. (2012). Perancangan Layout Toko dan Planogram pada Rak 16 di Unit Swalayan Koperasi Wanita. *Jurnal Ilmiah Mahasiswa Manajemen*, *1*(6), 7.

Listiono, F. I. S., & Sugiarto, S. (2015). Pengaruh Store Atmosphere Terhadap Loyalitas Konsumen Dengankepuasan Konsumen Sebagai Variabel Intervening Di Libreria Eaterysurabaya. *Jurnal Manajemen Pemasaran PETRA*, *1*(1), 1–9.

Lusiani, M. (2011). Optimasi Alokasi Produk Pada Ruang Rak Association Rules. *Journal of Industrial Engineering & Management Systems*, *4*(2), 15–32.

Madhulatha, T. S. (2012). An overview of clustering methods. *IOSR Journal of Engineering*, *2*(4), 719–725. https://doi.org/10.3233/ida-2007-11602

Melati, D., & Wahyuni, T. S. (2020). Association Rule Dalam Menentukan Cross-Selling Produk Menggunakan Algoritma Fp-Growth. *Voteteknika (Vocational Teknik Elektronika Dan Informatika)*, *7*(4), 102. https://doi.org/10.24036/voteteknika.v7i4.106499

Mulyono, R., Ndini, A. S., Kharisma, G., & Heikal, J. (2023). Segmentation K-Means Clustering Model With SPSS Program Case Study Customer The Park Mall Sawangan.

Syntax Literate; Jurnal Ilmiah Indonesia, *8*(2), 1300–1314.

Naldy, E. T., & Andri, A. (2021). Penerapan Data Mining Untuk Analisis Daftar Pembelian Konsumen Dengan Menggunakan Algoritma Apriori Pada Transaksi Penjualan Toko Bangunan MDN. *Jurnal Nasional Ilmu Komputer*, *2*(2), 89–101. https://doi.org/10.47747/jurnalnik.v2i2.525

Nattakrannuwat, V., & Cui, Y. (2023). Visual Merchandising Approaches: A Comparative Study of High-End and Fast-Fashion Window Dressing Design. In *Linnaeus University, Sweden*. https://doi.org/10.5040/9781501365287.3010

Nurmayanti, W. P., Sastriana, H. M., Rahim, A., Gazali, M., Hirzi, R. H., Ramdani, Z., & Malthuf, M. (2021). Market Basket Analysis with Apriori Algorithm and Frequent Pattern Growth (Fp-Growth) on Outdoor Product Sales Data. *International Journal of Educational Research & Social Sciences*, *2*(1), 132–139. https://doi.org/10.51601/ijersc.v2i1.45

Padillah, A., Satria Tambunan, H., Nasution, R. A., & Artikel, G. (2022). Application of the FP-Growth Algorithm in Analyzing Patterns and Layout of Foodstuffs. *JOMLAI: Journal of Machine Learning and Artificial Intelligence*, *1*(4), 2828–9099. https://doi.org/10.55123/jomlai.v1i4.1673

Peraturan Presiden Indonesia No. 112, (2007).

Pesoth, M. C. (2015). Pengaruh kualitas produk, packaging, dan brand image terhadap kepuasaan pelanggan pada perusahaan rokok dunhill di Kota Manado. *Jurnal EMBA*, *3*(3), 1101–1112. https://ejournal.unsrat.ac.id/index.php/emba/article/view/10115

Prakash, B. M., & Mishra Vivek. (2017). Impact of Store Location and Layout on Consumer Purchase Behavior in Organized Retail. *Anvesha*, *10*(1), 10–21.

Pranata, B. S., & Utomo, D. P. (2020). Penerapan Data Mining Algoritma FP-Growth Untuk Persediaan Sparepart Pada Bengkel Motor (Study Kasus Bengkel Sinar Service). *Bulletin of Information Technology (BIT)*, *1*(2), 83–91.

Pratama, A., Mulyawan, B., & Sutrisno, T. (2020). Implementation of improved apriori algorithm for drug planograms in XYZ pharmacies and analysis of medicinal procurement planning using ABC critical index methods. *IOP Conference Series: Materials Science and Engineering*, *1007*(1). https://doi.org/10.1088/1757-899X/1007/1/012186

Rahmi, A. N., & Mikola, Y. A. (2021). Implementasi Algoritma Apriori Untuk Menentukan Pola Pembelian Pada Customer (Studi Kasus : Toko Bakoel Sembako). *Information System Journal*, *4*(1), 14–19. https://jurnal.amikom.ac.id/index.php/infos/article/view/561

Rooderkerk, R. P., & Lehmann, D. R. (2021). Incorporating Consumer Product Categorizations into Shelf Layout Design. *Journal of Marketing Research*, *58*(1), 50–73. https://doi.org/10.1177/0022243720964127

Sachdeva, I., & Goel, S. (2015). Retail store environment and customer experience: a paradigm. *Journal of Fashion Marketing and Management*, *19*(3), 290–298. https://doi.org/10.1108/JFMM-03-2015-0021

Sarwoko, E. (2008). Dampak Modernisasi Keberadaan Pasar Modern terhadap Pedagang Pasar Tradisional di Wilayah Kabupaten Malang. *Jurnal Ekonomi Modernisasi*, *4*(2), 97–115. https://doi.org/10.21067/jem.v4i2.880

Scheffer, T. (2005). Finding association rules that trade support optimally against confidence. *Intelligent Data Analysis*, *9*(4), 381–395. https://doi.org/10.3233/ida-2005-9405

Sidhu, S., Kumar Meena, U., Nawani, A., Gupta, H., & Thakur, N. (2014). FP Growth Algorithm Implementation. *International Journal of Computer Applications*, *93*(8), 6–10. https://doi.org/10.5120/16233-5613

Silalahi, M. (2018). Analisis Clustering Menggunakan Algoritma K-Means Terhadap Penjualan Produk Pada PT Batamas Niaga Jaya. *Computer Based Information System Journal*, *6*(2), 20–35. https://doi.org/10.33884/cbis.v6i2.709

Štulec, I., Petljak, K., & Kukor, A. (2016). The Role of Store Layout and Visual Merchandising in Food Retailing The synchronized swimming club Medveščak. *European Journal of Economics and Business Studies*, *2*(1), 139–152.

Supariyani, E., & Marpaung, B. S. (2013). Pengaruh Tata Letak Terhadap Kepuasan Pelanggan Ritel. *Jurnal Ilmiah Manajemen Kesatuan*, *1*(1), 13–22. https://doi.org/10.37641/jimkes.v1i1.251

Surjandari, I., & Seruni, A. C. (2010). Design of Product Placement Layout in Retail Shop Using Market Basket Analysis. *MAKARA of Technology Series*, *9*(2). https://doi.org/10.7454/mst.v9i2.379

Utomo, T. J. (2009). Fungsi dan Peran Bisnis Ritel dalam Saluran Pemasaran (The Function and the Role of Retail Business in Marketing Line). *Fokus Ekonomi*, *4*(1), 44–55. https://ejournal.stiepena.ac.id/index.php/fe/article/view/50

Wijaya, B. S., Shihab, M. S., Wijaya, S. A., Rudianto, D., & Sugandi, A. (2020). In-Store Brand Communication: When Shelf-Space and Display Seduce Consumers. *Humanities & Social Sciences Reviews*, *8*(4), 984–998. https://doi.org/10.18510/hssr.2020.8495

Wu, W. T., Li, Y. J., Feng, A. Z., Li, L., Huang, T., Xu, A. D., & Lyu, J. (2021). Data mining in clinical big data: the frequently used databases, steps, and methodological models. *Military Medical Research*, *8*(1), 1–12. https://doi.org/10.1186/s40779-021-00338-z

ATTACHMENT

```r
# Install and load required packages
install.packages("readxl")
install.packages("arules")
install.packages("arulesviz")
library(readxl)
library(arules)
library(arulesViz)
library(writexl)

# Baca data dari sheet ke-8
DataDEPT <- read_excel("C:/Users/WF/Documents/Department.xlsx", sheet=8)

#Split Data
transaction_list <- strsplit(DataDEPT$Items, split = ",\\s*")

#Transaction Data
trans_DEPT <- as(transaction_list, "transactions")
inspect(trans_DEPT)
summary(trans_DEPT)

# Scheme 1
rules1 <- apriori(trans_DEPT, parameter = list(support = 0.3, confidence = 0.5))
rules1 = sort(rules1, by="lift")
inspect(rules1)
```

```r
# Scheme 2
rules2 <- apriori(trans_DEPT, parameter = list(support = 0.1, confidence = 0.25))
rules2 = sort(rules2, by="lift")
inspect(rules2)

# Scheme 3
rules3 <- apriori(trans_DEPT, parameter = list(support = 0.05, confidence = 0.2))
rules3 = sort(rules3, by="lift")
inspect(rules3)

rules_df3 <- as(rules3, "data.frame")
View(rules_df3)

write_xlsx(rules_df3, "rules-category.xlsx")

valid_rules <- sort(subset(rules3, subset = lift > 1), by = "lift", decreasing = TRUE)
inspect(valid_rules)

valid_rulesdf <- as(valid_rules, "data.frame")
View(valid_rulesdf)

write_xlsx(valid_rulesdf, "rules-category-fix.xlsx")

# Visualization association rules
```

```r
# Visualization association rules
plot(valid_rules, method = "grouped")
plot(valid_rules, method = "graph", control = list(type = "items"))
```

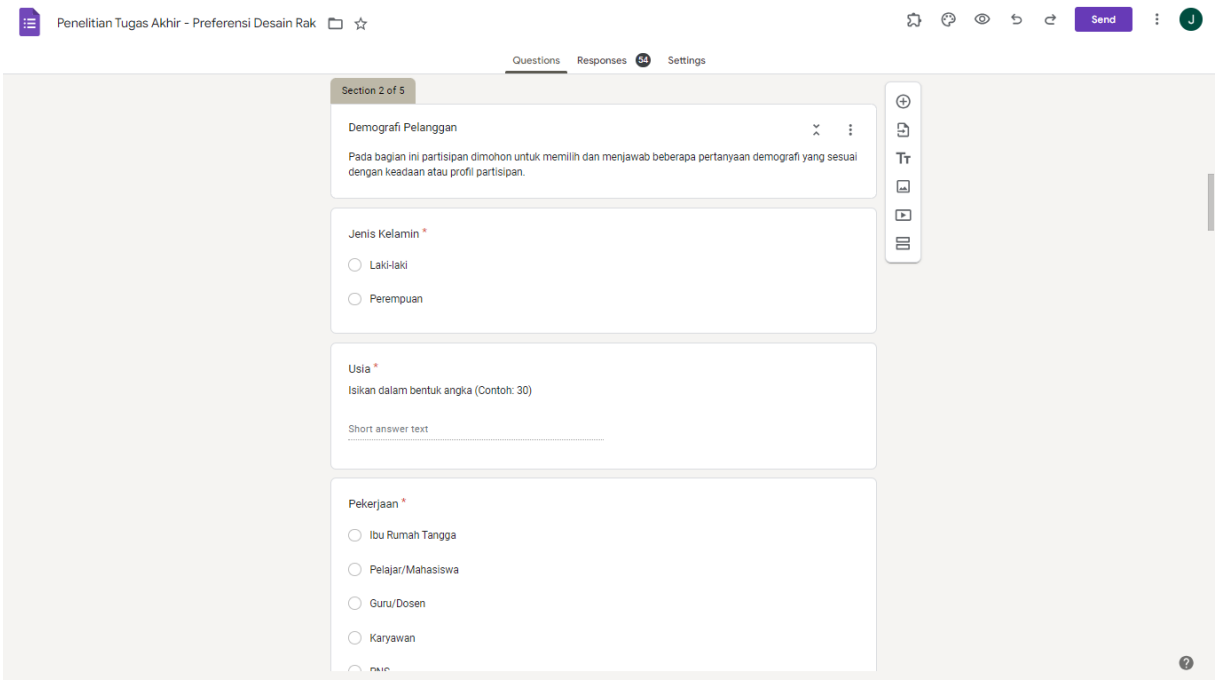
code	transaction_type	staff_name	tgl_transaksi	name	sku	qty	price
7437	cash	Siti	10/1/2023 8:13	Beverages	8.996E+12	1	3500
7438	cash	Siti	10/1/2023 8:13	Beverages	8.99298E+12	1	2500
7438	cash	Siti	10/1/2023 8:13	Food	8.996E+12	1	2000
7439	cash	Siti	10/1/2023 8:17	Breakfast	8.99301E+12	1	3000
7439	cash	Siti	10/1/2023 8:17	Confectionery	8.99274E+12	4	500
7439	cash	Siti	10/1/2023 8:17	Beverages	8.99299E+13	2	2300
7440	cash	Siti	10/1/2023 8:19	Food	8.99887E+12	1	3000
7440	cash	Siti	10/1/2023 8:19	Food	8.99887E+12	2	2000
7441	cash	Siti	10/1/2023 8:29	Food	8.99887E+12	1	5000
7441	cash	Siti	10/1/2023 8:29	Food	8.99887E+12	1	5000
7442	cash	Siti	10/1/2023 8:43	Breakfast	8.99887E+12	2	1600
7443	cash	Siti	10/1/2023 8:57	Body Care	78922233622	2	3000
7444	cash	Siti	10/1/2023 9:14	Beverages	8.99722E+12	1	9000
7444	cash	Siti	10/1/2023 9:14	Beverages	8.99722E+12	1	8000
7445	cash	Siti	10/1/2023 9:25	Confectionery	8.99508E+12	1	8500
7445	cash	Siti	10/1/2023 9:25	Confectionery	89686598025	3	5300
7445	cash	Siti	10/1/2023 9:25	Beverages	permen lunak	3	2000
7445	cash	Siti	10/1/2023 9:25	Beverages	3101202302	1	13000
7445	cash	Siti	10/1/2023 9:25	Food	8.996E+12	2	2000
…	…	…	…	…	…	…	…
13752	cash	Siti	10/31/2023 21:26	Beverages	8.996E+12	1	3000
13752	cash	Siti	10/31/2023 21:26	Food	8.99887E+12	1	2000
13753	cash	Siti	10/31/2023 21:27	Breakfast	8.99275E+12	1	17500
13753	cash	Siti	10/31/2023 21:27	Breakfast	31102023	1	8000
13753	cash	Siti	10/31/2023 21:27	Food	89686598018	1	2000
13753	cash	Siti	10/31/2023 21:27	Food	8.9932E+12	1	3000
13753	cash	Siti	10/31/2023 21:27	Food	8.9932E+12	1	8800
13754	cash	Siti	10/31/2023 21:28	Cigarette	8.99523E+12	1	34000
13755	cash	Siti	10/31/2023 21:30	Beverages	3101202303	1	11000
13755	cash	Siti	10/31/2023 21:30	Food	8.99276E+12	1	6000
13755	cash	Siti	10/31/2023 21:30	Toiletries	8.99356E+12	1	7200
13756	cash	Siti	10/31/2023 21:31	Food	5486782	1	12500
13756	cash	Siti	10/31/2023 21:31	Food	89686010947	2	3100
13756	cash	Siti	10/31/2023 21:31	Food	89686041767	1	3900
13756	cash	Siti	10/31/2023 21:31	Groceries	3.72015E+12	1	2000
13757	cash	Siti	10/31/2023 21:32	Cigarette	8.99191E+12	1	9500
13758	cash	Siti	10/31/2023 21:33	Cigarette	76164217	1	39000
13759	cash	Siti	10/31/2023 21:38	Beverages	9.556E+12	1	6500
13759	cash	Siti	10/31/2023 21:38	Beverages	8.99523E+12	1	6000
13760	cash	Siti	10/31/2023 21:39	Cigarette	8.99275E+12	1	17000
13760	cash	Siti	10/31/2023 21:39	Houseware	8.99991E+12	2	29000
13761	cash	Siti	10/31/2023 21:42	Cigarette	1.25537E+11	1	4500
13761	cash	Siti	10/31/2023 21:42	Confectionery	155087	1	1500

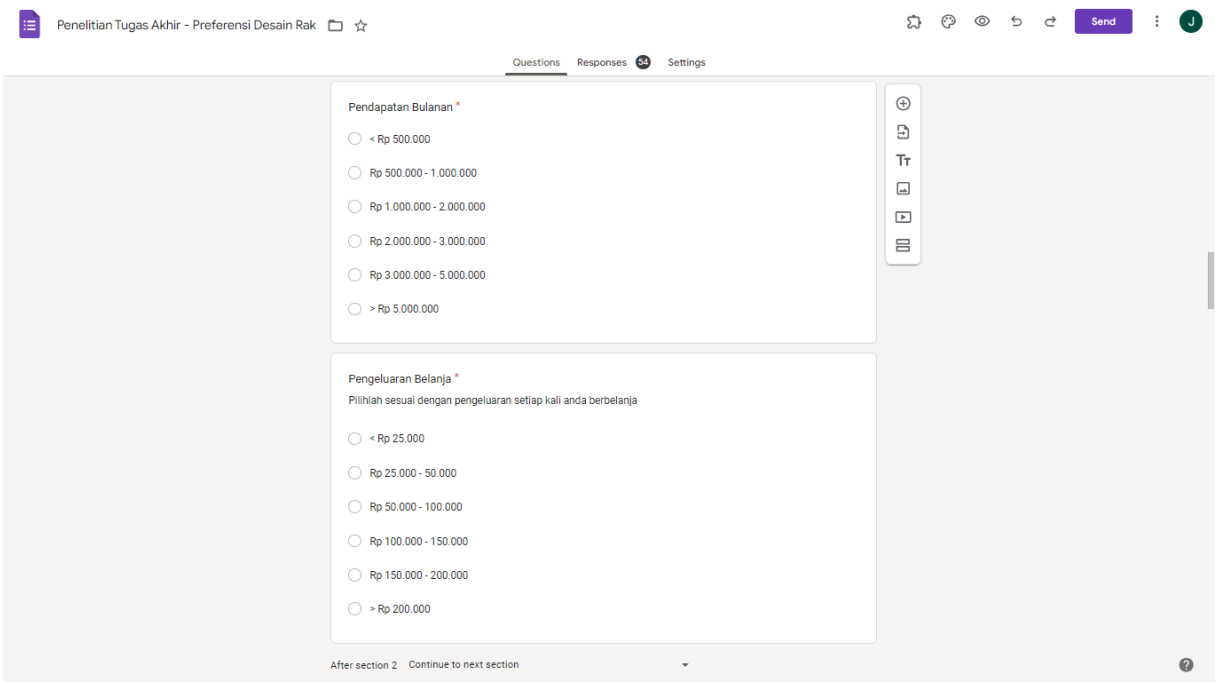
```r
#Install and load required packages
install.packages("readxl")
install.packages("arules")
install.packages("arulesViz")
library(readxl)
library(arules)
library(arulesviz)

#Read data from the 8th sheet
DataCAT <- read_excel("C:/Users/WF/Documents/Category2.xlsx", sheet=8)

#Split Data
transaction_list <- strsplit(DataCAT$Items, split = ",\\s*")

#Transaction Data
trans_CAT <- as(transaction_list, "transactions")
inspect(trans_CAT)
summary(trans_CAT)

# Scheme 1
rules1 <- apriori(trans_CAT, parameter = list(support = 0.1, confidence = 0.2))
rules1 = sort(rules1, by="lift")
inspect(rules1)
```

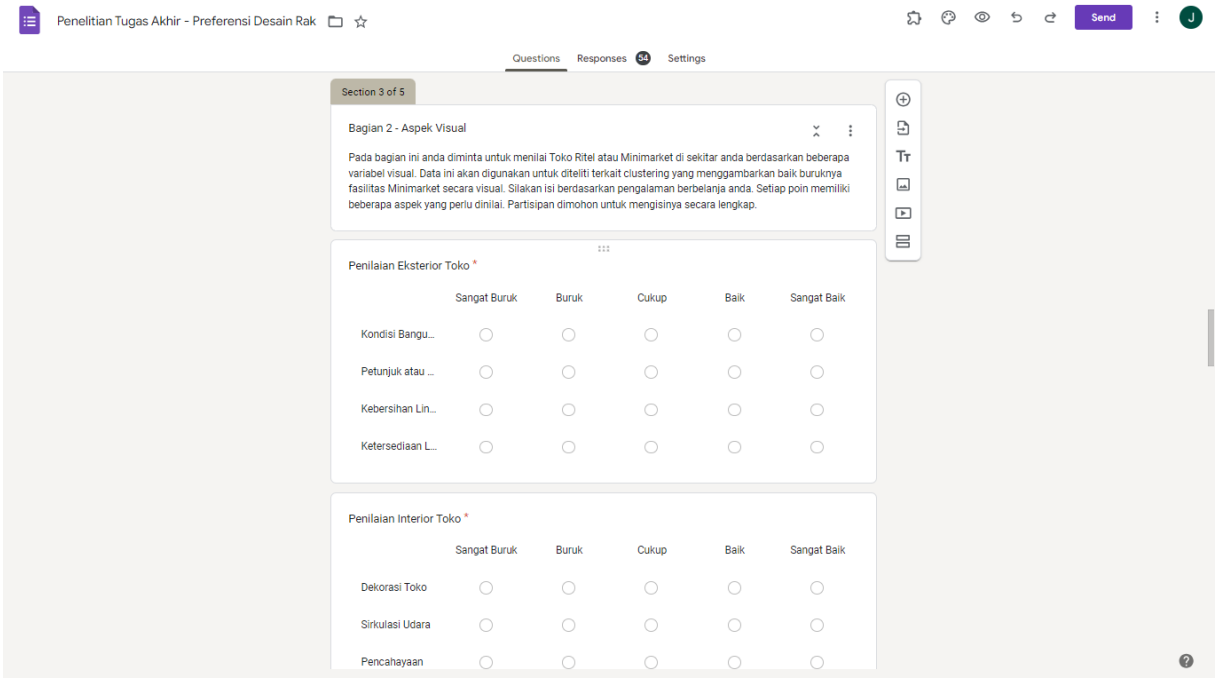
```r
# Scheme 2
rules2 <- apriori(trans_CAT, parameter = list(support = 0.075, confidence = 0.2))
rules2 = sort(rules2, by="lift")
inspect(rules2)

# Scheme 3
rules3 <- apriori(trans_CAT, parameter = list(support = 0.04, confidence = 0.2))
rules3 = sort(rules3, by="lift")
inspect(rules3)

# Scheme 4
rules4 <- apriori(trans_CAT, parameter = list(support = 0.03, confidence = 0.2))
rules4 = sort(rules4, by="lift")
inspect(rules4)

rules_df4 <- as(rules4, "data.frame")
View(rules_df4)

write_xlsx(rules_df4, "rules-subcategory.xlsx")

valid_rules <- sort(subset(rules4, subset = lift > 1), by = "lift", decreasing = TRUE)
inspect(valid_rules)

valid_rulesdf <- as(valid_rules, "data.frame")
```

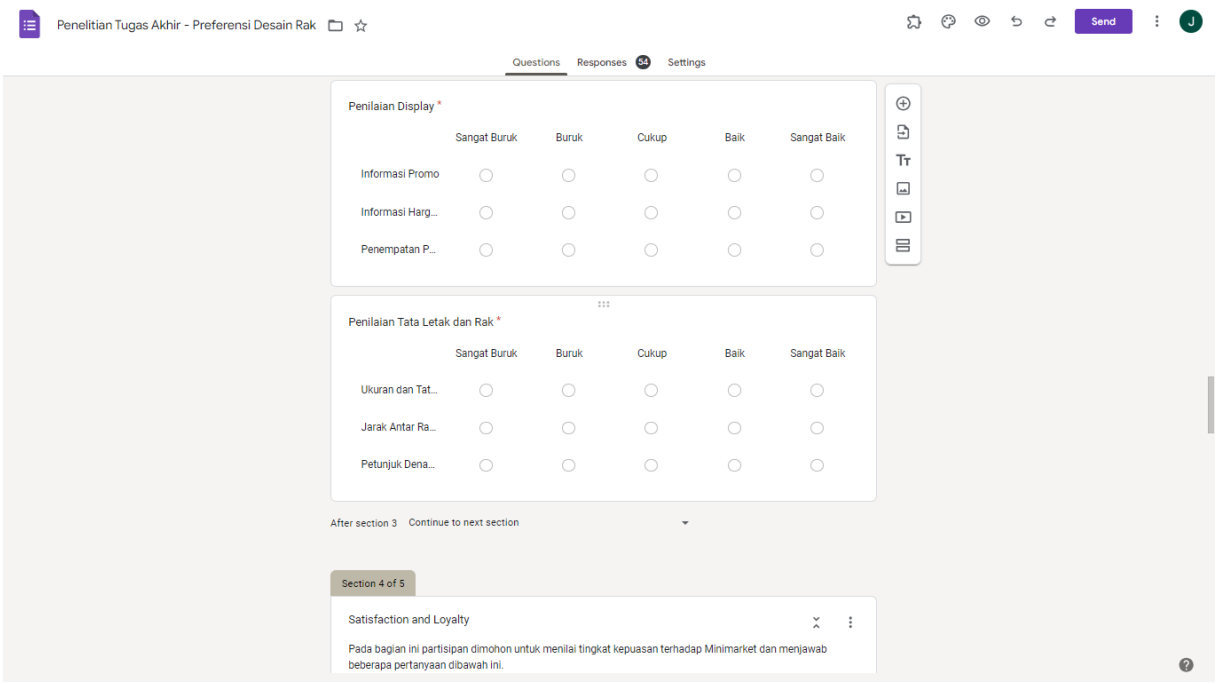
```r
valid_rulesdf <- as(valid_rules, "data.frame")
View(valid_rulesdf)

write_xlsx(valid_rulesdf, "rules-subcategory-fix.xlsx")

# Visualization association rules
plot(valid_rules, method = "grouped")
plot(valid_rules, method = "graph", control = list(type = "items"))
```

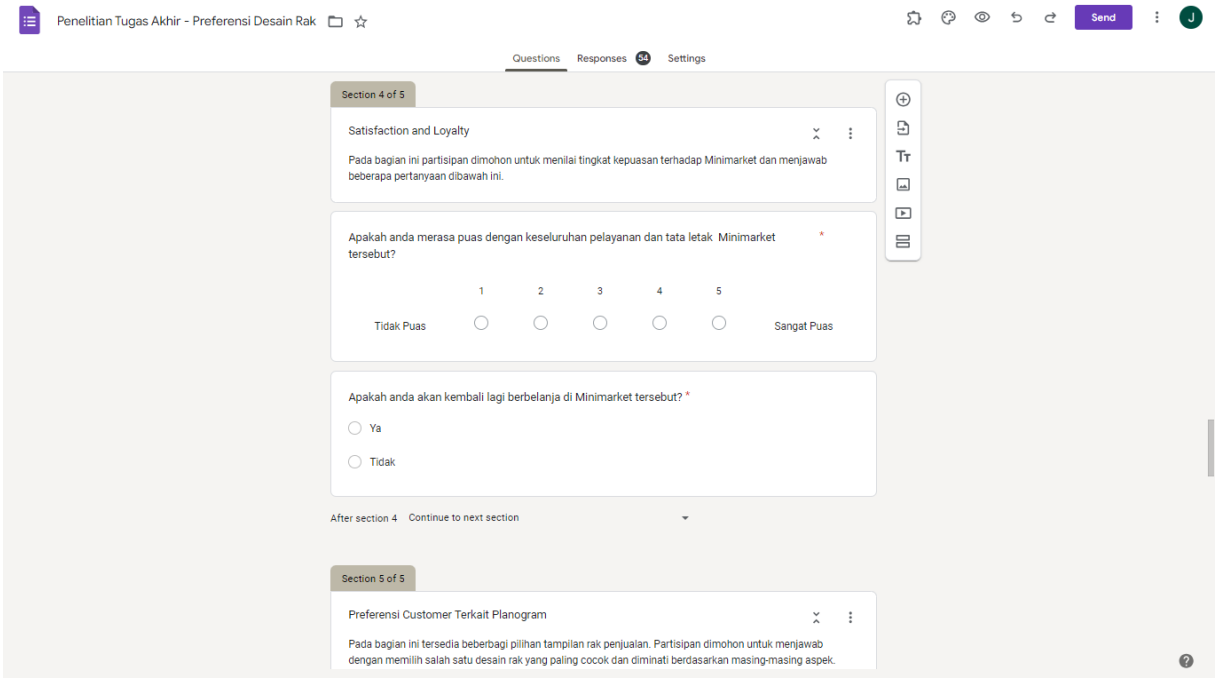

Penelitian Tugas Akhir - Minggir Mart
Assalamu'aikum Warahmatullahi Wabarakatuh
Perkenalkan saya Jundi Nourfateha Elquthb mahasiswa Universitas Islam Indonesia. Saat ini saya sedang melakukan proses penyusunan Tugas Akhir/Skripsi. Data dari pengisian kuesioner ini akan dijadikan sebagai data utama dalam penelitian saya. Sehingga besar harapannya Anda/Saudara/i dapat membantu saya untuk mengisi dan menjawab beberapa pertanyaan dibawah ini:
*Syarat & Ketentuan: Anda pernah melakukan transaksi belanja di Minggir Mart
Melalui penelitian ini akan diketahui perilaku dan karakteristik pelanggan dengan menggunakan metode Clustering. Selain itu juga akan diketahui preferensi pelanggan terhadap pengalaman belanja terkait penataan produk penjualan (planogram). Sehingga diharapkan dapat memberikan rekomendasi yang bermanfaat bagi pengelola dan meningkatkan pelayanan yang berfokus pada kepuasan pelanggan.
Apabila Saudara/i memiliki pertanyaan terkait penelitian ini, silahkan hubungi saya melalui email: jundi.elquthb@students.uii.ac.id atau melalui 085859410005 (WhatsApp). Semoga Allah Subhanahu Wa Ta'ala membalas kebaikan saudara/i sekalian, Aamiin.
Seluruh informasi yang diperoleh melalui kuesioner ini bersifat rahasia dan hanya akan digunakan untuk kepentingan Penelitian Skripsi saya.
20522091@students.uii.ac.id Switch account
Not shared

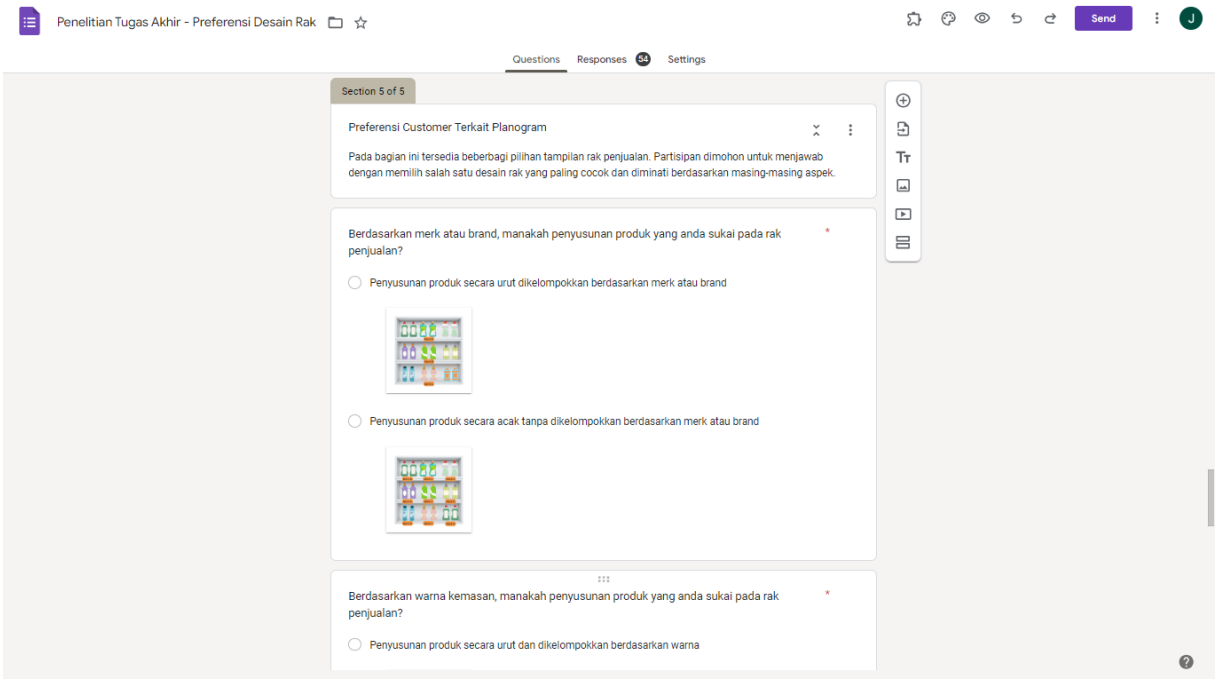

Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Section 2 of 5
Demografi Pelanggan
Pada bagian ini partisipan dimohon untuk memilih dan menjawab beberapa pertanyaan demografi yang sesuai dengan keadaan atau profil partisipan.
Jenis Kelamin *
Laki-laki
Perempuan
Usia *
Isikan dalam bentuk angka (Contoh: 30)
Short answer text
Pekerjaan *
Ibu Rumah Tangga
Pelajar/Mahasiswa
Guru/Dosen
Karyawan

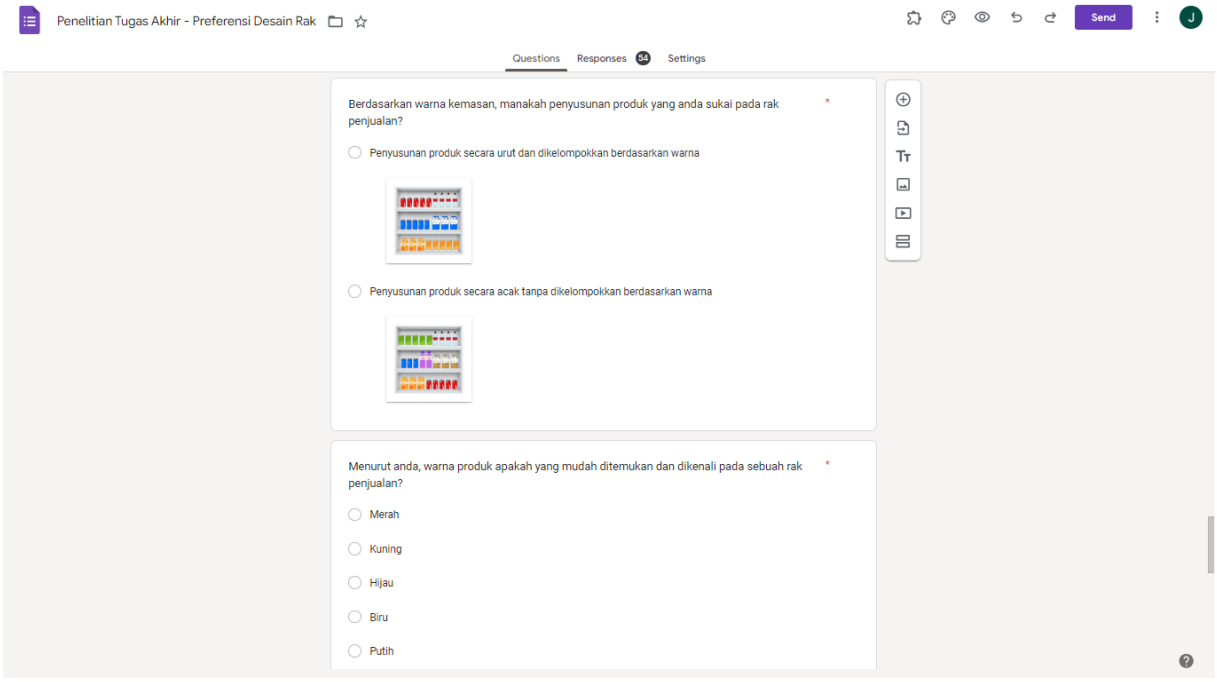

Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Pendapatan Bulanan *
< Rp 500.000
Rp 500.000 - 1.000.000
Rp 1.000.000 - 2.000.000
Rp 2.000.000 - 3.000.000
Rp 3.000.000 - 5.000.000
> Rp 5.000.000
Pengeluaran Belanja *
Pilihlah sesuai dengan pengeluaran setiap kali anda berbelanja
< Rp 25.000
Rp 25.000 - 50.000
Rp 50.000 - 100.000
Rp 100.000 - 150.000
Rp 150.000 - 200.000
> Rp 200.000
After section 2 Continue to next section

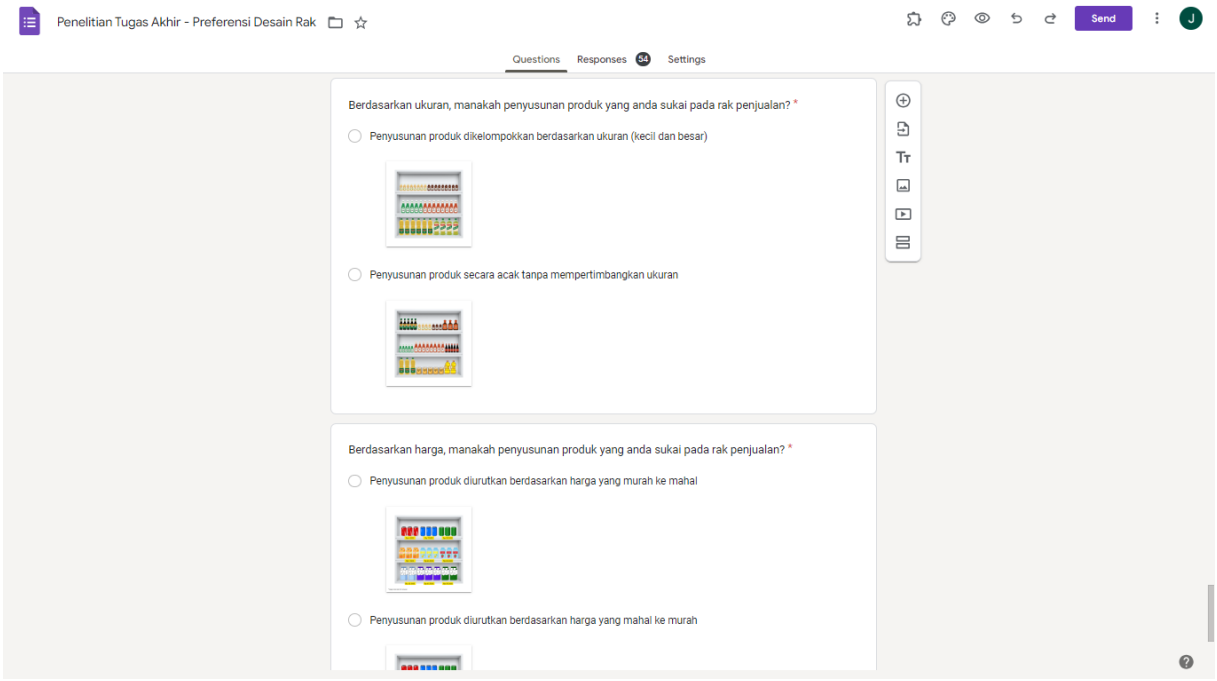

Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Section 3 of 5
Bagian 2 - Aspek Visual
Pada bagian ini anda diminta untuk menilai Toko Ritel atau Minimarket di sekitar anda berdasarkan beberapa variabel visual. Data ini akan digunakan untuk diteliti terkait clustering yang menggambarkan baik buruknya fasilitas Minimarket secara visual. Silakan isi berdasarkan pengalaman berbelanja anda. Setiap poin memiliki beberapa aspek yang perlu dinilai. Partisipan dimohon untuk mengisinya secara lengkap.
Penilaian Eksterior Toko *
Sangat Buruk
Buruk
Cukup
Baik
Sangat Baik
Kondisi Bangu...
Petunjuk atau ...
Kebersihan Lin...
Ketersediaan L...
Penilaian Interior Toko *
Sangat Buruk
Buruk
Cukup
Baik
Sangat Baik
Dekorasi Toko
Sirkulasi Udara
Pencahayaan

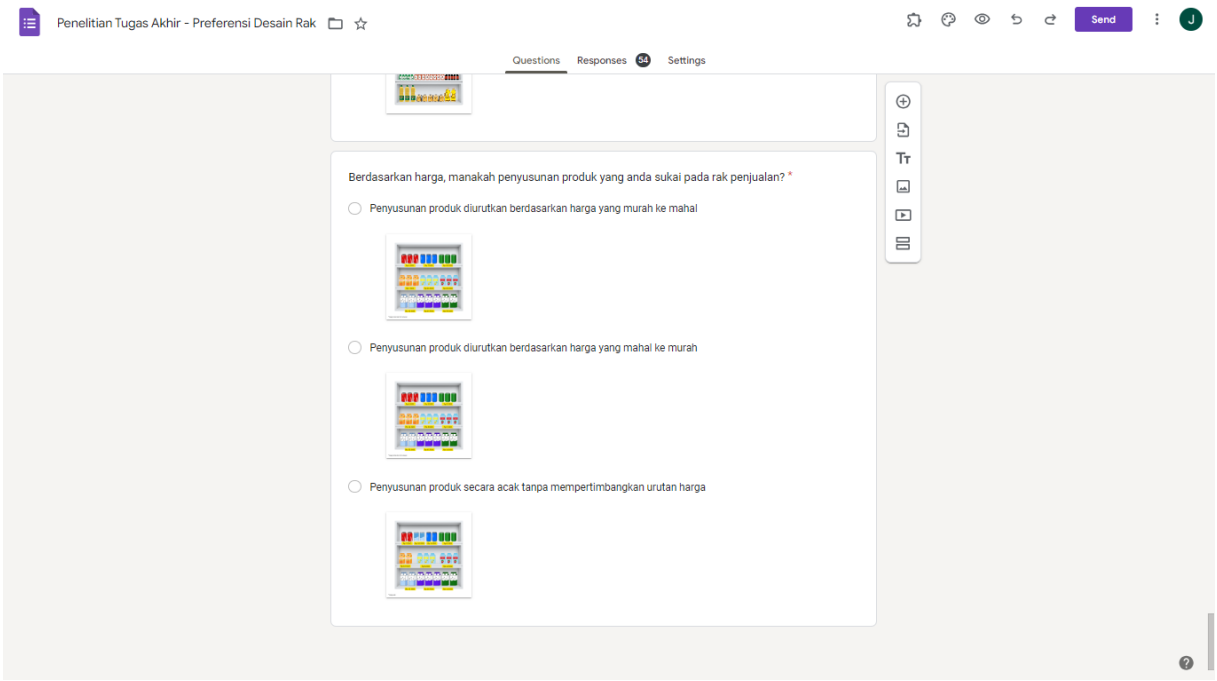

Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Penilaian Display *
Sangat Buruk
Buruk
Cukup
Baik
Sangat Baik
Informasi Promo
Informasi Harg...
Penempatan P...
Penilaian Tata Letak dan Rak *
Sangat Buruk
Buruk
Cukup
Baik
Sangat Baik
Ukuran dan Tat...
Jarak Antar Ra...
Petunjuk Dena...
After section 3
Continue to next section
Section 4 of 5
Satisfaction and Loyalty
Pada bagian ini partisipan dimohon untuk menilai tingkat kepuasan terhadap Minimarket dan menjawab beberapa pertanyaan dibawah ini.


Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Section 4 of 5
Satisfaction and Loyalty
Pada bagian ini partisipan dimohon untuk menilai tingkat kepuasan terhadap Minimarket dan menjawab beberapa pertanyaan dibawah ini.
Apakah anda merasa puas dengan keseluruhan pelayanan dan tata letak Minimarket tersebut? *
1
2
3
4
5
Tidak Puas
Sangat Puas
Apakah anda akan kembali lagi berbelanja di Minimarket tersebut? *
Ya
Tidak
After section 4
Continue to next section
Section 5 of 5
Preferensi Customer Terkait Planogram
Pada bagian ini tersedia beberbagi pilihan tampilan rak penjualan. Partisipan dimohon untuk menjawab dengan memilih salah satu desain rak yang paling cocok dan diminati berdasarkan masing-masing aspek.


Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Section 5 of 5
Preferensi Customer Terkait Planogram
Pada bagian ini tersedia beberbagi pilihan tampilan rak penjualan. Partisipan dimohon untuk menjawab dengan memilih salah satu desain rak yang paling cocok dan diminati berdasarkan masing-masing aspek.
Berdasarkan merk atau brand, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk secara urut dikelompokkan berdasarkan merk atau brand
Penyusunan produk secara acak tanpa dikelompokkan berdasarkan merk atau brand
Berdasarkan warna kemasan, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk secara urut dan dikelompokkan berdasarkan warna


Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Berdasarkan warna kemasan, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk secara urut dan dikelompokkan berdasarkan warna
Penyusunan produk secara acak tanpa dikelompokkan berdasarkan warna
Menurut anda, warna produk apakah yang mudah ditemukan dan dikenali pada sebuah rak penjualan? *
Merah
Kuning
Hijau
Biru
Putih


Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Berdasarkan ukuran, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk dikelompokkan berdasarkan ukuran (kecil dan besar)
Penyusunan produk secara acak tanpa mempertimbangkan ukuran
Berdasarkan harga, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk diurutkan berdasarkan harga yang murah ke mahal
Penyusunan produk diurutkan berdasarkan harga yang mahal ke murah


Penelitian Tugas Akhir - Preferensi Desain Rak
Send
Questions
Responses 94
Settings
Berdasarkan harga, manakah penyusunan produk yang anda sukai pada rak penjualan? *
Penyusunan produk diurutkan berdasarkan harga yang murah ke mahal
Penyusunan produk diurutkan berdasarkan harga yang mahal ke murah
Penyusunan produk secara acak tanpa mempertimbangkan urutan harga

```r
# Load libraries
library(cluster)
library(factoextra)
library(tidyverse)
library(readxl)
library(car)
library(writexl)

# Load data
DataCluster <- read_excel("C:/Users/WF/Documents/Customer Minggir Mart.xlsx",
                          sheet="Revision")

# Standardize data
DataA <- DataCluster[, 3:16]
DataB = scale(DataA)
view(DataB)

# Multicollinearity Test (VIF)
vif_values <- vif(lm(as.data.frame(DataA)))
print(vif_values)

while(any(vif_values > 10)) {
  max_vif_var <- names(which.max(vif_values))
  DataA <- DataA[, !names(DataA) %in% max_vif_var]
  vif_values <- vif(lm(as.data.frame(DataA)))
  print(vif_values)
}

# Standardize data after removing multicollinearity variables
DataB_reduced <- scale(DataA)
DataB_reduced <- round(DataB_reduced, digits = 3)
colnames(DataB_reduced) <- c("X1", "X2", "X3", "X4", "X5","X6", "X7", "X8","X9",
                             "X10","X11","X12","X13", "X14")
view(DataB_reduced)
STD_Data = data.frame(DataB_reduced)
write_xlsx(STD_Data,"C:\\Users\\WF\\Documents\\Data Standardization.xlsx")

# Finding the distance between clusters
distance = get_dist(DataB_reduced)
view(distance)

# Optimal number of clusters - elbow method
fviz_nbclust(DataB_reduced, kmeans, method="wss")

# Optimal number of clusters - silhouette method
fviz_nbclust(DataB_reduced, kmeans, method = "silhouette")

# Determining clusters using the k-means method
final = kmeans(DataB_reduced, 2)

# Clustering result
print(final)

# Clustering Graphs
fviz_cluster(final, data=DataB_reduced, ggtheme = theme_grey(), geom = "point")

# Clustering tables
finalakhir = data.frame(DataA, final$cluster)
view(finalakhir)
write_xlsx(finalakhir,"C:\\Users\\WF\\Documents\\Cluster Result Rev.xlsx")

# Clustering Description
profile <- DataA %>%
  mutate(Cluster = final$cluster) %>%
  group_by(Cluster) %>%
  summarise_all("mean")

# View Result
print(profile)
View(profile)
write_xlsx(profile,"C:\\Users\\WF\\Documents\\Profile Result Rev.xlsx")
```

No	Gender	Age	Income	Spent	Exterior	Interior	Display	Layout	Satisfaction	Decision	Brand	Color	Size	Price
1	2	20	1	2	16	12	11	12	4	2	1	1	1	2
2	1	30	4	2	16	12	12	12	3	2	1	1	1	2
3	1	29	3	1	12	9	9	12	5	2	1	1	1	3
4	2	38	4	3	16	10	12	11	4	2	1	2	1	3
5	1	25	5	5	18	13	12	12	5	2	1	1	1	1
6	2	25	3	6	11	9	9	13	5	2	1	2	1	2
7	2	24	3	5	12	9	9	9	4	2	1	1	1	1
8	1	23	3	2	18	12	12	14	4	2	2	1	1	2
9	1	28	4	2	16	12	12	12	5	2	1	2	1	3
10	2	38	6	6	16	12	12	15	5	2	2	1	1	1
11	2	38	3	5	16	12	12	12	5	2	2	1	1	2
12	2	25	2	3	13	10	7	6	2	2	1	2	1	1
13	1	28	4	3	16	10	11	10	4	2	1	2	1	1
14	1	49	5	2	17	10	13	10	4	2	2	1	1	1
15	2	21	1	1	15	13	11	8	4	2	1	1	1	1
16	1	25	2	2	15	10	8	8	3	2	1	1	1	1
17	1	30	5	3	13	11	8	8	3	2	2	1	1	2
18	1	21	3	2	18	12	12	12	4	2	2	2	1	1
19	2	60	3	2	15	12	12	11	4	2	2	1	1	2
20	2	67	2	2	14	11	13	10	4	2	1	1	1	1
21	2	21	3	2	15	12	10	11	4	2	1	2	1	3
22	1	32	3	2	19	14	13	14	5	2	1	1	1	1
23	2	22	3	5	16	13	13	11	5	2	1	1	1	1
24	2	22	1	2	16	12	12	12	4	2	1	1	1	1
25	2	21	3	4	12	15	9	15	5	2	1	1	1	1
26	2	21	3	2	13	11	8	9	4	2	1	1	1	1
27	2	23	1	1	15	11	11	11	4	2	1	1	1	1
28	2	22	1	3	12	9	9	9	3	2	1	1	1	1
29	2	21	3	3	19	12	14	14	4	2	2	1	1	1
30	1	22	3	1	12	9	9	9	5	2	1	1	1	1
31	2	22	2	6	15	9	12	11	5	2	1	1	1	3
32	2	15	1	2	16	11	11	11	5	2	2	1	1	1
33	2	15	1	1	12	9	9	12	5	2	2	2	1	1
34	2	22	2	2	15	14	12	13	4	2	1	1	1	1
35	1	23	6	5	16	12	12	15	5	2	2	2	1	1
36	1	25	5	5	18	12	11	14	4	2	2	1	1	3

No	Gender	Age	Income	Spent	Exterior	Interior	Display	Layout	Satisfaction	Decision	Brand	Color	Size	Price
37	1	45	3	2	12	9	9	12	4	2	1	1	1	1
38	1	19	2	2	17	14	13	15	5	2	2	2	1	1
39	2	21	1	2	19	15	15	14	4	2	1	1	1	1
40	2	45	2	3	19	15	9	15	4	2	2	1	1	1
41	1	21	3	3	16	12	12	12	4	2	1	1	1	1
42	1	24	2	2	19	15	14	15	5	2	1	1	1	1
43	2	22	1	6	12	9	10	12	4	2	1	1	1	3
44	2	22	1	6	12	11	8	11	3	2	1	2	1	1
45	1	22	4	3	16	12	12	12	4	2	2	2	1	1
46	1	22	3	2	16	11	11	12	4	2	1	2	2	3
47	1	19	6	3	14	9	11	10	4	2	2	2	2	3
48	1	21	2	2	16	13	13	13	4	2	1	1	1	1
49	1	23	3	1	16	9	12	12	4	2	2	1	1	3
50	1	24	1	1	16	12	8	7	3	2	1	2	1	1
51	1	20	2	6	15	10	12	12	4	2	1	1	1	3
52	1	21	1	2	11	8	7	8	4	2	1	1	1	3
53	1	22	2	6	16	12	12	9	4	2	1	1	1	3
54	2	21	2	2	10	8	8	6	3	2	1	1	2	1
55	2	20	2	3	16	13	11	12	5	2	1	2	2	3
56	1	21	3	3	11	10	11	11	4	2	2	1	1	1
57	2	20	2	6	13	8	11	9	4	2	2	1	1	1
58	1	22	2	4	9	8	10	11	3	2	1	1	2	1
59	2	22	4	4	13	9	9	9	3	2	1	1	1	1
60	2	21	2	2	16	12	10	11	4	2	1	1	2	1
61	2	23	2	2	13	11	10	9	4	2	2	1	1	3
62	1	22	3	2	13	10	9	7	3	2	1	2	1	2
63	2	21	3	3	15	12	10	8	3	2	1	1	1	3
64	2	22	1	2	15	13	12	11	4	2	1	1	1	1
65	2	21	5	2	20	15	13	13	5	2	1	1	1	2
66	1	20	1	1	10	13	8	8	3	2	1	1	1	1
67	2	20	2	2	20	15	13	14	5	2	1	1	1	2
68	2	23	4	6	18	11	13	14	4	2	1	2	1	1
69	1	24	1	2	13	8	11	10	4	2	2	1	2	1
70	2	22	2	4	12	7	8	7	2	2	1	1	1	1
71	2	21	1	3	14	10	11	9	4	2	1	1	1	2
72	1	22	3	3	16	12	10	10	4	2	1	1	2	3

No	Gender	Age	Income	Spent	Exterior	Interior	Display	Layout	Satisfaction	Decision	Brand	Color	Size	Price
73	1	20	1	1	14	11	11	10	3	2	1	1	1	1
74	2	21	2	1	18	15	15	12	5	2	2	1	2	3
75	1	20	6	4	11	10	10	9	3	1	2	1	2	3
76	2	21	2	1	19	15	15	15	5	2	2	2	1	3
77	1	21	1	2	16	12	12	9	4	2	2	1	1	2
78	1	23	3	4	16	12	12	15	4	2	1	2	1	3
79	1	22	1	2	11	10	8	11	4	2	1	1	1	1
80	1	22	1	1	16	12	12	15	4	2	2	1	1	2
81	1	20	1	1	14	10	12	12	2	2	2	1	1	2
82	2	22	3	2	15	12	11	11	4	2	1	2	1	1
83	2	21	2	3	17	14	14	13	4	2	1	2	1	1
84	1	21	3	3	16	10	12	8	4	2	1	1	1	3
85	1	21	3	1	14	14	10	11	4	2	1	2	2	3
86	2	20	2	2	15	12	12	11	4	2	1	1	1	1
87	1	20	1	6	16	10	10	12	5	2	2	1	1	3
88	1	19	1	6	18	15	12	12	4	2	2	1	1	1
89	1	21	2	2	14	13	9	10	4	2	2	1	1	1
90	2	21	3	3	16	12	10	10	3	2	1	1	1	1
91	2	21	3	4	20	14	15	12	3	2	2	1	1	1
92	2	20	5	6	14	10	11	9	4	2	2	1	1	1
93	2	21	4	5	16	9	12	9	4	2	1	1	2	1
94	1	20	2	3	14	11	8	11	4	2	1	1	1	2
95	1	35	4	4	19	14	14	15	5	2	2	2	1	1
96	2	22	2	2	20	15	14	15	5	2	1	1	1	1
97	1	23	2	3	19	14	14	14	5	2	2	1	1	1
98	1	27	4	3	20	14	14	14	5	2	2	1	1	1
99	1	24	3	3	18	15	15	13	5	2	1	1	1	1
100	1	41	4	4	13	10	9	10	4	2	1	1	1	1
101	2	20	1	4	15	11	12	9	3	2	2	2	1	2
102	2	21	2	2	15	12	10	12	4	2	1	2	2	1
103	2	22	4	2	13	11	11	10	3	2	1	1	1	1
104	2	27	6	5	14	9	12	10	4	2	1	2	1	1