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Item Layout for Building Materials Management with Apriori Algorithm

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Abstract

The initial stage of opening a business is one of the business activities that can have an impact on the economy. TB. Jasa Manis is a trading business that sells various kinds of building materials, electrical equipment, materials and others. A sales strategy is needed to maintain business and marketing. Data Mining answers this problem by analyzing customer transaction data, then creating a certain rule, pattern or model. Products that are frequently purchased by customers will be used as a reference point in viewing consumer spending patterns. The association technique that can be used is an a priori algorithm designed to find item combinations. The a priori algorithm is guided by the min support and min confidence values. The combination pattern of sales transaction data itemset for two months on TB. Jasa Manis, it can be found that with a combination pattern the minimum support value is 14% and the minimum confidence is 40%. The rules for the highest association or goods that are often purchased together by customers are found in the Lotus Geese/LBR and Roof Nails. Through the analysis of customer shopping habits obtained, the layout of building materials can be adjusted to the customer's shopping pattern. With the data mining socialization rules, patterns of consumer shopping behavior can be identified and can increase sales at TB. Sweet Service.

Keywords : Data Mining, Support, Apriori Algorithm, Association, Layout.

1. Introduction

In the business world, every company must be able to compete and think about how the company can continue to grow and expand its business scale. Therefore companies need to apply data mining. Data mining provides real solutions for decision makers in the business world [1]. Data mining aims to find relationships that allow it to produce useful manifestations [2]. One form of implementation of data mining that is widely used is in the field of sales of tools and building materials [3].

Data mining is often applied in sales such as frequent itemset search. In previous research, there was the application of data mining for setting the layout pattern of goods at a supermarket blessing for sales strategies using the Apriori Algorithm, where the application of data mining in determining the layout of goods can help in setting the layout pattern of goods for sales strategies [4]. Data research mining by applying the Apriori Algorithm is also used for the layout of goods [5]. Data Mining can help in solving problems at the company [6]. The layout of goods greatly influences consumer interest in shopping as well as an important key to unplanned purchases made by consumers [7]. Consumer habits in buying products somewhere need to be known so that it makes it easier for marketers to set marketing strategies [8]. The result of the research is that Data Mining with the Apriori Algorithm can solve problems in the layout of goods [9].

Placement of goods layout on TB. Jasa Manis is not in accordance with consumer shopping patterns, the placement of the layout at this store often makes it difficult for buyers to find the items they want to buy, for this reason it is necessary to conduct research in building and overcoming these problems, namely by utilizing data mining techniques to draw conclusions, namely produce a layout of building materials which will also be in the system. For this reason, it is necessary to have research in building and developing data mining by applying the a priori algorithm to produce association rules with an "if then" pattern that functions to form possible item combinations, so that buyers have no difficulty in finding the item they want to buy. This algorithm can be defined as a process to find all if-then association rules (if the customer buys A , then the customer also buys B) that meets the minimum support value and minimum confidence value. The Apriori algorithm is an algorithm for finding association rules between items [5].

Data mining is an iterative and interactive process to find perfect, useful and understandable new patterns or models in a very large database (massive database). Data mining consists of searching for desired trends or patterns in large databases to assist decision makers in the future, these patterns are identified by certain tools that can provide a useful and insightful analysis of data which can then be studied more thoroughly, which may use other decision support tools [10].

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Data Mining is the process of obtaining useful information from a large database and needs to be extracted so that it becomes new information and can assist in decision making [11]. From a commercial point of view, the use of data mining can be used to deal with exploding data volumes. Data mining is necessary to solve problems or answer business needs [12]. Association rule mining is a data mining method used to extract useful patterns between data [13].

By applying the Apriori Algorithm so that consumer behavior patterns can be known and it is expected to increase sales at TB companies. Sweet Services [14]. The Apriori algorithm is a form of the association rule concept for transaction operations and can also be used in real time applications by collecting items purchased by consumers from time to time so that a frequent itemset can be generated [15].

The Apriori algorithm is an algorithm that is well known for searching for combinations of an itemset that has a certain number of occurrences according to predetermined criteria [16] . The a priori algorithm includes the types of association rules found in data mining. The rules stating the association or association rule mining is a data mining technique to find the rules for a combination of items [17].

According to Zayida Mustafa (2021) the advantages of the a priori algorithm are simpler and can handle large data. While other algorithms have weaknesses in memory usage when the amount of data is large, of course it affects the number of items processed and the work structure and implementation are easy to understand [18].

A priori has the disadvantage of having to scan the database every time it is done, so the time required increases with more iterations [19].

2. Research methodology

This research framework is the order in which the research is carried out. The steps of this research do not deviate from the subject matter. The research framework that the authors conducted in the research will be described in Figure 1.

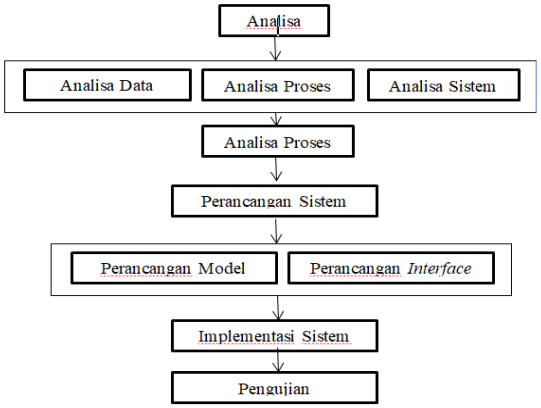

Figure 1. Research Framework

Based on the analysis of the results of interviews with TB owners. The Sweet Services were carried out in October 2021. So it can be concluded that the problems faced by TB. Jasa Manis in sales is because there is no website media that supports the current promotion, so it is still not optimal. In addition, bookkeeping is only done manually which allows for loss of transaction data

2.1 System analysis

At the system analysis stage it is carried out to design or build a system that will be made using the Data Mining method with the Apriori Algorithm, the design of this system includes designing a user interface, designing a database for the system so that file management is more organized, designing a coding program, and the program will designed using the PHP and MySQL programming languages, and then formed a system that can be used.

Association analysis is defined as a process to find all association rules that meet the minimum requirements for support (minimum support) and requirements for confidence (minimum confidence).

The basic method of association analysis is divided into 2 stages

1. High Frequency Pattern Analysis

This stage looks for item combinations that meet the minimum requirements of the support value from the database. The support value of an item is obtained by the following formula:

$$Support\ (A) = \frac{\sum Jumlah\ Transaksi\ Mengandung\ A}{\sum Total\ Transaksi} \times 100\%$$

The formula above is to find itemset 1, while to find itemset 2 with the following formula.

$$Support\ (A \cap B) = \frac{\sum Jumlah\ Transaksi\ Mengandung\ A\ dan\ B}{\sum Total\ Transaksi} \times 100\%$$

2. Formation of *Associative* Rules

After all frequency patterns are found, then the associative rules that meet the minimum requirements for confidence are sought by calculating *the confidence associative* rules A → B obtained from the following formula:

$$Confidence\ P\left(\frac{B}{A}\right) = \frac{\sum Hasil\ Support\ Mengandung\ A\ dan\ B}{\sum Total\ Support} \times 100\%$$

In the Apriori algorithm, it determines the possible candidates by paying attention to the minimum support and minimum confidence [18].
The concept of the Apriori Algorithm is:

1. The a priori algorithm is one of the classic data mining algorithms.
2. The a priori algorithm is used so that the computer can learn association rules, look for patterns of relationships between one or more items in a dataset.
3. A priori algorithm is widely used in transaction data or commonly called market basket. With the a priori algorithm, shop owners can find out a consumer's buying pattern, if a consumer buys items A, B, he has a 50% chance he will buy C, this pattern is very significant with the existence of transaction data so far.
4. The importance of an associative rule can be determined by two parameters, *support* (support value), which is the percentage of the combination of these items in the database, and *confidence* (certainty value), namely the strength of the relationship between items in the associative rule.
5. The associative rule is usually expressed in the form: (bread, butter) -> (milk) (support = 40%, confidence = 50%) This means " *a consumer buys bread and butter and is 50% likely to also buy milk*".

3. Results and Discussion

The following is sample data from the pattern of purchasing building materials with data calculations for 61 transactions.

Table 1. Sales Transaction Pattern Data Table

Transaction	Purchase Items
1	Cement, Small Latches, Bricks, AD Sand, Gravel, 4 Thick Plywood, 3 Kangaroo Thick Plywood, Size 1-2 Regular Nails, Electrical Pipe, Elbow Les
2	LT Connection 1/2, Slate Plywood, 4 LKS Thick Plywood, Large Latches (3 x 4), 4 x 6 Timber, Size 2.5-5 Common Nails, Transparent Roofing, Roofing Nails, Ceramic 25 x 25, Tinner Bottles, Cok Raun cable
3	Cement, Ceramic 40 x 40 Black, LT Connection 1, Batako, Small Wall Putty Primer, Lestelo (4 BH/M)
4	Fine Sand, Ansamas/LBR, Transparent Roof, Cement, 10 Watt Platinum Lamp, Small Battens, Regular Size 1-2 Nails, Rattan Basket
5	Bricks, 1 set of brushes, 6 regular thick plywood, 3 regular thick plywood, 2.5-5 regular nails, 5 kg matrix, 25 kg matrix, tinner cans, 1 Inc Ceylon pipe, fine sand
6	Pebbles, Stones, Plain 40 x 40 Ceramic, Ceramic Flour B, Round 5 Watt Sunfree Lamp, Small Wall Putty Primer
7	Wood 4 x 6, Brick, Fine Sand, Cement, Plywood Thick 4 Ordinary, 2 Inc Ceylon Pipe, Square Pipe Glue, Wood Pipe Glue
8	Lamber, 4 LKS Thick Plywood, Small Battens, Large Latches (3 x 4), Concrete Nails, Stone, Common Toilet, Bricks

High Frequency Analysis

$$Support\ (A) = \frac{\sum Jumlah\ Transaksi\ Mengandung\ A}{\sum Total\ Transaksi} \times 100\%$$

Looking for 1 Itemset candidate with the following Support values:

Table 2. Table of Formation of Candidates 1 Itemset

Name of goods	Amount	support
Cement	31	50.82%
Small Reng Wood	13	21.31%
Concrete brick	30	49.18%
Sand AD	14	22.95%
Gravel	13	21.31%
Regular 4 Thick Plywood	5	8.20%
3 Kangaroo Thick Plywood	2	3.28%
Regular Nails Size 1-2	10	16.39%
Electrical Pipe	3	4.92%
Elbow Lessons	7	11.48%
LT Connection ½	2	3.28%
Blackboard Plywood	2	3.28%

From the process of forming the itemset in table 2 with a Minimum Support of 14% it can be seen that meets the Minimum Support standard

Table 3 . Itemset Table 1 (14%)

Name of goods	Amount	support
Cement	31	50.82%
Small Reng Wood	13	21.31%
Concrete brick	30	49.18%
Sand AD	14	22.95%
Gravel	13	21.31%
Regular Nails Size 1-2	10	16.39%
Large Battens (3 x 4)	10	21.31%
4 x 6 lumber	13	62.30%
Transparent Roof	9	14.75%
Roofing Nails	20	32.79%
Ceramic 25 x 25	11	18.03%
bottle tinner,	9	14.75%
Lestelo (4 BH/M)	14	22.95%
Fine Sand	19	31.15%
Ansamas/LBR	10	16.39%
Tinner Cans	13	21.31%
Rock	20	32.79%
Ceramic 40 x 40 Plain	10	16.39%
Square Pipe Glue	10	16.39%
Regular Nails Size 1-5	14	22.95%
Wire Basket	9	14.75%
Lotus Swan/LBR	12	19.67%

Then from the results of 1 *Itemset*, 2 Itemset combinations will be carried out .

Formation of Two Itemset Combination Patterns

The process of forming 2 *Itemsets* with a *Minimum Support of* 14% can be completed with the following formula:

$$Support\ (A \cap B) = \frac{\sum Jumlah\ Transaksi\ Mengandung\ A\ dan\ B}{\sum Total\ Transaksi} \times 100\%$$

The explanation of the formula above can be described as the table below.

Table 4 . Combination Table 2 *Itemset*

Name of goods	Amount	support
Cement, Small Battens	6	9.84%
Cement, Brick	21	34.43%
Cement, Sand AD	9	14.75%
Cement, Gravel	5	8.20%
Cement, Ordinary Nail Size 1-2	8	13.11%
Cement, Battens (3 x 4)	5	8.20%
Cement, Timber 4 x 6	8	13.11%
Cement, Transparent Roof	2	3.28%
Cement, Roofing Nails	11	18.03%
Cement, Ceramic 25 x 25	3	4.92%

From the combination of two *Itemsets* with *a Minimum Support of* 1.4 %, it can be seen that the combination of two *Itemsets* that meet the *Minimum Support standards* can be seen in table 4 , namely Cement with Brick, Cement with AD Sand, Cement with Roofing Nails, Brick with 4 x 6 Wood, Brick with Fine Sand, Roof Nails with Lotus Swan/LBR. The combination of two *Itemsets* that fulfill the association formation can be seen in the table below

Table 5. Combination Table 2 Itemset 14% 1

Name of goods	Amount	support
Cement, Brick	21	34.43%
Cement, Sand AD	9	14.75%
Cement, Roofing Nails	11	18.03%
Bricks, Wood 4 x 6	9	14.75%
Batako, Fine Sand	9	14.75%
Roof Nail, Lotus Swan/LBR	10	16.39%

Formation of association rules using itemset 2 because itemset 3 does not meet the specified minimum support. From itemset 2 and calculate the confidence value. Calculations are performed with a combination of itemset 2 alternately in order to get the *confidence value* for each association rule that is formed.

Table 6. Knowledge table

Rule	Confidence	support
If consumers buy cement, consumers will buy bricks	67.74%	34.43%
If consumers buy Batako, then consumers will buy Cement	70.00%	34.43%
If consumers buy Sand AD, then consumers will buy Cement	64.29%	14.75%
If consumers buy Roofing Nails, consumers will buy Cement	55.00%	18.03%
If consumers buy 4 x 6 wood, consumers will buy bricks	69.23%	14.75%
If consumers buy fine sand, consumers will buy bricks	47.37%	14.75%
If a consumer buys roof nails, then the consumer will buy the Lotus Geese/LBR	50.00%	16.39%
If consumers buy Lotus Geese/LBR, then consumers will buy roof nails	83.33%	16.39%

Based on Table 6, the materials most frequently purchased by consumers are cement, wood, bricks, nails and plywood. By knowing the materials most frequently purchased by *customers* , the company can develop a strategy in arranging the layout of materials based on the *item set combinations* formed.

3.1 Data Testing with Excel

Based on the data already provided on building materials data, the formation of the first *itemset or C1 is by determining a minimum support of* 14% , as shown in Figure 2 below:
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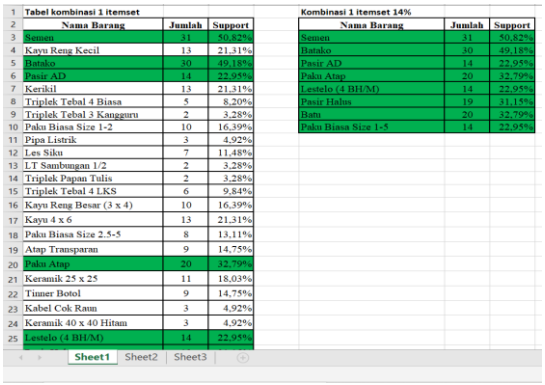


Tabel kombinasi 1 itemset		
Nama Barang	Jumlah	Support
Semen	21	34,43%
Kayu Reng Kecil	13	21,31%
Batako	30	49,18%
Pasir AD	14	22,95%
Kerikil	13	21,31%
Triplek Tebal 4 Biasa	5	8,20%
Triplek Tebal 3 Kangguru	2	3,28%
Paku Biasa Size 1-2	10	16,39%
Pipa Listrik	3	4,92%
Les Siku	7	11,48%
LT Sambungan 1/2	2	3,28%
Triplek Papan Tulis	2	3,28%
Triplek Tebal 4 LKS	6	9,84%
Kayu Reng Besar (3 x 4)	10	16,39%
Kayu 4 x 6	13	21,31%
Paku Biasa Size 2.5-5	8	13,11%
Atap Transparan	9	14,75%
Paku Atap	20	32,79%
Keramik 25 x 25	11	18,03%
Timner Botol	9	14,75%
Kabel Cok Raun	3	4,92%
Keramik 40 x 40 Hitam	3	4,92%
Lestelo (4 BH/M)	14	22,95%

Kombinasi 1 itemset 14%		
Nama Barang	Jumlah	Support
Semen	21	34,43%
Batako	30	49,18%
Pasir AD	14	22,95%
Paku Atap	20	32,79%
Lestelo (4 BH/M)	14	22,95%
Pasir Halus	19	31,15%
Batu	20	32,79%
Paku Biasa Size 1-5	14	22,95%

Figure 2. Formation of *Itemset 1*

In Figure 2, which is the process of forming itemset 1, what is being done is calculating the *frequent number* of building materials purchased from the 148 existing data. Then the support for each product is calculated, if each product is suitable or more than 14% then it passes to become itemset 1. After that, determine which building materials meet the minimum *support.*

After forming the first itemset or C1 then forming the second itemset or C2 with a minimum support value of 14% , as shown in Figure 3 .

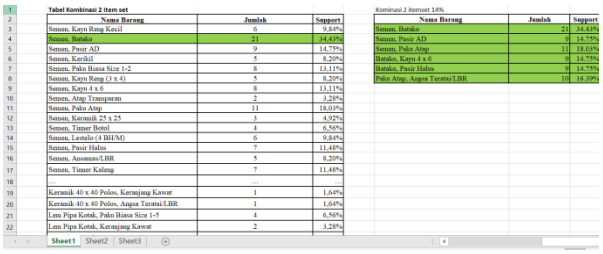
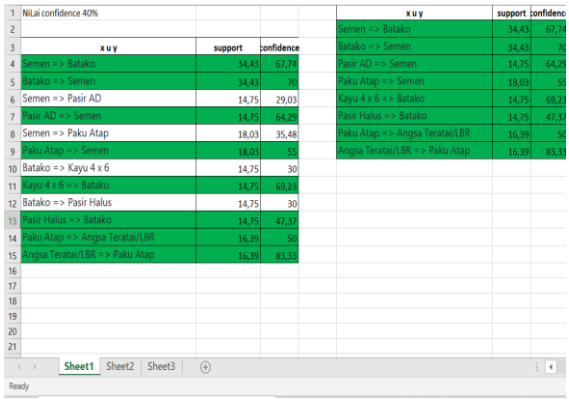


Figure 3. Formation of *Itemset* 2

Figure 3 shows the formation of an itemset 2 is done by calculating the number of combinations of 2 building materials that are formed based on predetermined itemset combinations. From the frequent obtained, then the support is calculated for each combination of the resulting frequent itemset 2. After that determine which building materials meet the minimum support.

After all high-frequency patterns are found, then look for association rules that meet Minimum Confidence = 40% Rule Value from rules A→B



NiLai confidence 40%		
x u y	support	confidence
Semen => Batako	34,43	67,74
Batako => Semen	34,43	70
Semen => Pasir AD	14,75	29,03
Pasir AD => Semen	14,75	64,29
Semen => Paku Atap	18,03	35,48
Paku Atap => Semen	18,03	55
Batako => Kayu 4 x 6	14,75	30
Kayu 4 x 6 => Batako	14,75	69,23
Batako => Pasir Halus	14,75	30
Pasir Halus => Batako	14,75	47,37
Paku Atap => Angsa Teratai/LBR	16,39	50
Angsa Teratai/LBR => Paku Atap	16,39	83,33

x u y	support	confidenc
Semen => Batako	34,43	67,74
Batako => Semen	34,43	70
Pasir AD => Semen	14,75	64,29
Paku Atap => Semen	18,03	55
Kayu 4 x 6 => Batako	14,75	69,23
Pasir Halus => Batako	14,75	47,37
Paku Atap => Angsa Teratai/LBR	16,39	50
Angsa Teratai/LBR => Paku Atap	16,39	83,33

Figure 4. Formation of Association Rules

Formation of association rules using itemset 2 because itemset 3 does not meet the specified minimum support. From itemset 2 and calculate the confidence value. Calculations are performed with a combination of itemset 2 alternately in order to get the *confidence value* for each association rule that is formed .

3.2 Testing with WEKA

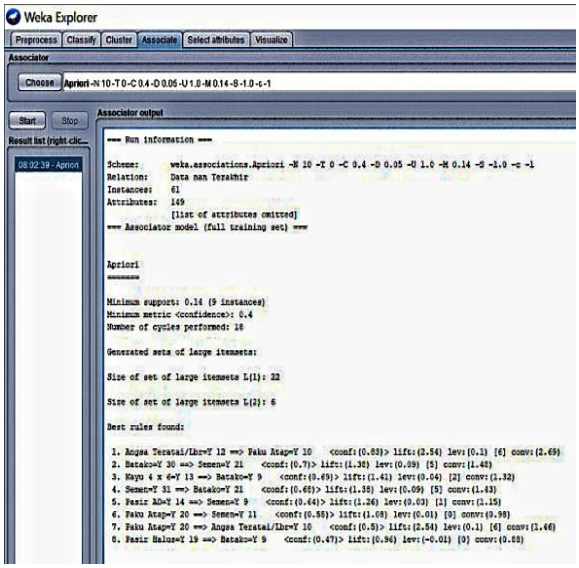


Figure 5. WEKA Apriori Calculation Results

In Figure 5, the results of the Apriori Weka calculation explain that from the data entered there are 149 data with minimum conditions *support* 14% and a minimum *confidence of 40%.* From the results of Apriori, 8 rules were produced with different levels *of confidence* . An example of rule 1, when there is no Lotus Swan, there are Roof Nails. There are Y and N, where from the initial data it is positioned that Y states there is while N states not.

3.3 Interface Implementation

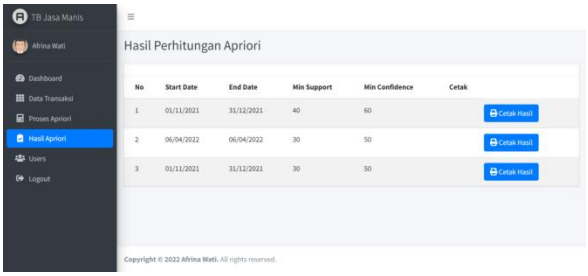


Figure 6 . Results Page Display

From Figure 6, a menu of a priori results is displayed which can be managed by the manager. Where the manager can print the results of the Apriori Algorithm calculations. As for

4. Conclusion

With the design of the Data Mining system with the Apriori Algorithm, it has been able to display the layout of building materials with sales transaction data at TB. Sweet Services based on the frequency of the itemset with a combination pattern of a minimum support value of 14% and a minimum confidence of 40%. With the existence of a system built using the Apriori algorithm, it is able to provide information from the results of an analysis of customer purchasing patterns so that it can be used as a consideration in managing building material inventory at TB. Sweet Service. The implementation of the Apriori Algorithm is able to adjust to consumer spending patterns taken from the highest association rules or goods that are often purchased together by consumers in the Lotus Geese/LBR and Roof Nails, then TB. Sweet Services can provide convenience to consumers in choosing related ingredients

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