Published online on the journal's webpage: **http://journal.ittelkom-pwt.ac.id/index.php/dinda**

Journal of Dinda

Data Science, Information Technology, and Data Analytics

Vol. 5 No. 1 (2025) 76 - 83 E-ISSN: 2809-8064

Sandal Product Inventory Prediction System Using Apriori Algorithm on Web-Based Home Industry Dlioshoes

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Abstract

Sales of sandal products at Home Industry Dlioshoes are often faced with the problem of insufficient product inventory. This research aims to build a web-based sales information system by applying the Apriori algorithm to analyze purchasing patterns and predict product inventory needs. By utilizing sales transaction data, this system can identify product combinations that distributors often buy together. By implementing the Apriori Algorithm, it can help industry owners in making decisions regarding product inventory and can predict sales in the next period, thereby reducing the risk of product excess or shortage. The research results show that the types or models of sandals that are most popular with distributors are Heels, Flat Shoes, Mules, Ballet Shoes, High Heels, Ankle Strap and Pumps. With the highest Support value of 42% and Confidence value of 71.18%.

Keywords: System; Inventory Predictions; Apriori Algorithma; Home Industry; Web

1. Introduction

In the modern era like today, technological developments have made society easier with various forms of information technology, making many things that were previously difficult easier and faster to do and creating a global interaction network that is instant and limitless [1]. Now it will be more meaningful if you have developed the technology needed in the field of data mining. In the field of business or trade, the results of implementing the apriori algorithm data mining can help business people in making decisions about what is related to inventory [2].

Home Industry Dlioshoes is a business engaged in the manufacture and sale of women's sandals. This industry produces various types of women's sandals such as heels, flat sandals, ankle strap sandals, mules and various other types. Sandals produced in this industry are sold to sandal wholesalers and online shop sellers. In its sales, the demand for sandals always changes depending on the season and the needs of buyers, sometimes experiencing a spike in demand for some types of sandals [3]. Industry owners are required to be able to produce products that are ordered within a specified time period [4]. In producing the sandal product, it takes one to two days per dozen, the more difficult the model ordered, the longer the product manufacturing process is needed because there are orders from other distributors that also need to be produced. The long production time and limited number of employees create obstacles faced by industry owners, namely often experiencing a shortage of products ready for sale so that they cannot meet demand and can disappoint distributors. Another obstacle is that sales transactions are only recorded in the sales notebook, so sales data will increase over time so that industry owners have difficulty in determining which products are most in demand by distributors. This certainly requires an application that can analyze sandal sales transaction data, namely by applying the apriori algorithm. The apriori algorithm is an association method in data mining that is used to identify frequent itemsets [5]. The combination of itemsets in products with sandal models or types as a benchmark for determining support and confidence values [6].

The results of data processing using the apriori algorithm can be used to analyze sandal products based on which models are the most popular or in demand. The advantage of the apriori algorithm lies in its ability to explore frequency patterns and associations in complex and diverse data. In this context, the apriori algorithm can be used to group data and produce valuable information for the industry. Especially in determining

Received: 09-02-2025 | Accepted: 21-02-2025 | Published: 28-02-2025

the inventory pattern of sandal products based on distributor demand needs [7].

Research conducted by Dzikri Sajidan, Nana Suarna, Tati Suprapti discusses analyzing shoe sales patterns by implementing the apriori algorithm. In stock management and data understanding by traders slows down productivity and efficiency. Abundant data has not been optimally utilized to increase sales, so this study developed a sales classification system based on data mining using the Apriori Algorithm through RapidMiner to identify the best-selling types of shoes. With the resulting model, it can optimize data, process sales efficiently and help record stock of goods and also help identify goods that are in demand and less in demand. The results found that the highest association rules occurred between Canvas Sneakers with a support x confidence value of 87.50% [8].

In another study by Wahyu Wijaya Kristiano and Charist Rudianto at the Kakikaki Shoe Store by applying the K-Means Clustering method to find product trends that are most in demand by consumers. By producing 2 products that are in high demand, 7 products that are quite popular, and 1 product that is less in demand. This analysis provides a strong basis based on sales transaction data to make the right decisions. With this exposure, stores can be more precise in making decisions in stocking products with market trends and customer needs. And reduce the risk of loss [9].

Further research was conducted by Doli Alamsah Pohan, Muhammad Halmi Dar and Irmayanti which aimed to design a data mining implementation system to predict sales of popular shoe products in order to better utilize sales transaction data. This analysis determines the linear relationship between independent and dependent variables, projecting the dependent value when free to change. This study aims to predict sales of popular shoes with existing transaction data. The data mining system developed uses PHP and MySQL for implementation. Through this method, PT. Sepatu Bata seeks to gain deeper insight into shoe sales and prepare more effective strategies based on the understanding obtained from historical data analysis. The prediction results can be used as very valuable information in decision making to determine the amount of shoe product inventory to be sold in the following month [10].

The research conducted by Danilla Oktaviyana Nurlyta Eka Saputri and Endang Lestariningsih discusses Implementing Data Mining on sales using the Apriori Algorithm at the 3Stripedsid shoe store. Where there is often an empty stock of one of the items purchased by customers, due to the lack of information regarding inventory control habits. Therefore, this study uses an apriori algorithm to extract information from transaction data to increase shoe sales. This apriori algorithm explains a method for finding patterns of relationships between one or more items in a dataset. The results obtained from the apriori algorithm process are a combination of items or rules with association values in the form of support values and confidence values [11]. The purpose of this study is to design a web-based software platform. This system is designed to enable industry owners to easily predict product inventory through web-based applications and predict sales in the following period so that there is no shortage or excess of product inventory.

2. Research Methods

2.1 Research Stages

The stages of this research were carried out in several stages starting from the assessment method used, which is the quantitative method, then to the data collection stage consisting of observations at the Dlioshoes Home Industry research site, then conducting interviews with the industry owner, then literature studies. Furthermore, at the system development stage, the researcher used the waterfall method starting with a needs analysis, namely the analysis of the running system at the Dlioshoes Home Industry, then creating a proposed system to be built. Furthermore, the application of the method using the apriori algorithm to predict the inventory of sandal products in the coming period, then creating a UML system design continued with the creation of the program code. Which is presented in the following image:

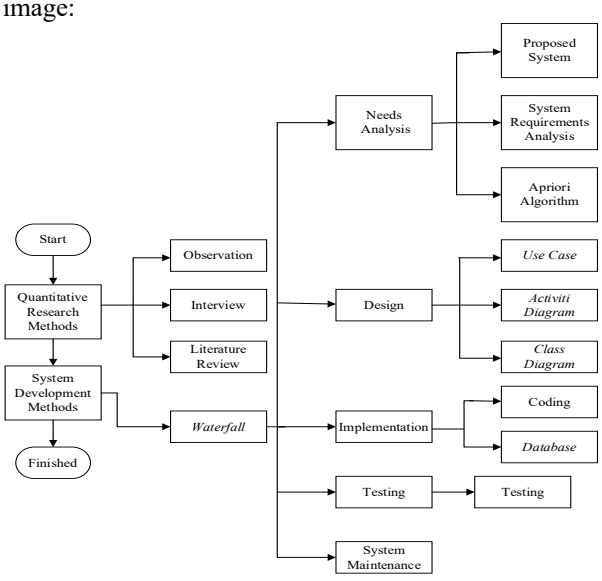

Figure 1. Research Stages

2.2 Research Method

This research uses a quantitative method with the application of data mining on sandal sales using the apriori algorithm. According to Sugiyono, it is called a quantitative method because the research data is in the

form of numbers and the analysis uses statistics. According to Siregar, the problem-solving procedure in the descriptive research method is by describing the research object at the current state based on the facts as they are, then analyzed and interpreted [12].

2.3 Apriori Algorithm

The Apriori algorithm in this study is used to generate relevant and meaningful association rules from the given dataset [13]. The Apriori algorithm can assist in the sales process by providing a relationship between sales transaction data that has been made by buyers so that customer purchasing patterns are obtained [14]. By using a step-by-step approach, the Apriori algorithm is able to find high-frequency patterns that describe the relationship between items in a dataset [15].

The Apriori algorithm is commonly referred to as a market basket because the use of its algorithm is commonly used on transaction data. Knowledge of attribute frequencies obtained previously helps the Apriori algorithm in filtering out irrelevant itemsets or those that have little impact on the formation of association rules. Minimum support and minimum confidence are key parameters in the Apriori algorithm used to generate relevant and meaningful association rules from the given dataset. After a frequency pattern appears, an item is found, confidence can be calculated by measuring the proportion of transactions containing both items compared to transactions containing only the first item.

Determining the number of rules taken based on the largest result of the multiplication of support and confidence helps optimize the selection of the most informative and meaningful rules. The frequency of itemset shows itemsets that show a frequency of occurrence of more than or equal to 2 times are called frequent. The set of frequent k-itemsets is denoted by FK. After all frequency patterns are found, association rules that meet the minimum requirements for confidence are sought by calculating the confidence of the associative rule A → B.

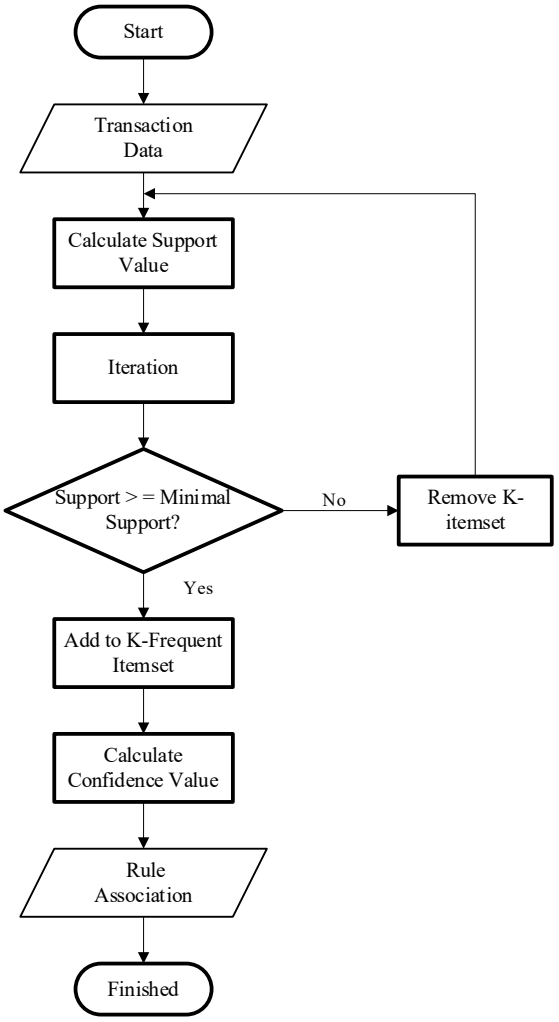

Figure 2. Apriori Algorithm Flowchart

2.4 Data Collection Method

The data collection carried out in this study can be used by researchers to obtain the desired data. Data collection carried out in this study includes:

a. Observation, at this stage the author took data at Home Industry Dlioshoes. The purpose of data collection is to strengthen research data and to make it easier to continue to the system development stage.
b. Interview, at this stage the author interviewed the owner of Home Industry Dlioshoes, Mr. Rio Afdal, to obtain data and criteria that will later be used as samples and entered into the system to be built.
c. Literature Study, Data collection through this literature study is by studying many journals and books related to apriori algorithm data mining.

2.5 System Development Method

In conducting this research, the author uses the waterfall method as a system development method and uses the waterfall model to build an information system. The waterfall method follows a systematic and sequential approach because each stage that is passed must wait for the previous stage to complete so that it runs sequentially [16]. In system development, it is hoped that its creation will be easier so that system development can be carried out. The following is the flow of the waterfall method stages:

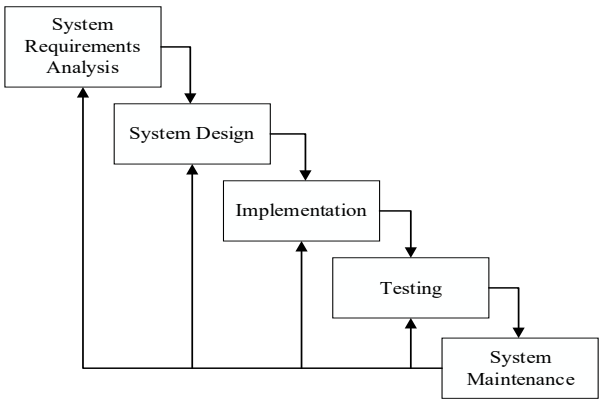

Figure 3. Waterfall Development Method

3. Results and Discussion

The research results presented in this discussion explain the process of analyzing sandal sales transaction data using the Apriori Algorithm. To find and predict the most popular items in the Dlioshoes Home Industry. The data used in this study is sales transaction data from the last three years.

Table 1. Sales Transaction Data

No	Distributor	Product	Number Sold
1	Diyah	Heels, Mules, High Heels, Ankle Strap	340
2	Arnis	Flat Shoes Hak, Slip On, Mules, Heels	210
3	Fitri	Flat Shoes Hak, High Heels, Balet Shoes, Mules	132
4	Purnama	High Heels, Balet Shoes, Flat Shoes Hak, Mules, Heels, Slip On	350
5	Romantik	Mules, Balet Shoes, Ankle Strap	100
…	…	…	…
1200	Diyah	Flatbed, Flat Shoes, Pumps, Ankle Strap, Heels, Flat Shoes Hak	180

3.1 Frequency Pattern Analysis

3.1.1 Formation of 1-itemset

The first process is carried out to form a candidate 1-itemset (C1) from the transaction data and to find the amount of support for each candidate. This approach involves calculating the ratio between the number of occurrences of an item and the total number of transactions in the dataset with the minimum amount of support specified is 38%. The results obtained are as follows:

$$\text{Support (Heels)} = \frac{\text{(Number of Heels transactions)}}{\text{Total Transactions}} \times 100$$

$$= \frac{1031}{1200} \times 100 = 85{,}91\%$$

Table 2. Candidate 1-itemset

No	Item	Number of Transactions	Support (%)
1	Heels	1031	85,91%
2	Flat Shoes Hak	769	64,08%
3	High Heels	744	62%
4	Balet Shoes	656	54,66%
5	Mules	762	63,5%
6	Pumps	644	53,66%
7	Flat Shoes	1025	85,41%
8	Slip On	657	54,75%
9	Ankle Strap	766	63,83%
10	Flatbed	366	30,5%

Based on the table above, the items that continue to the formation of candidate number 2 are nine items that meet the minimum support of 38%, namely Heels, Flat Shoes, High Heels, Ballet Shoes, Mules, Pumps, Flat Shoes, Slip On, and Ankle Strap.

3.1.2 Formation of 2-itemset

The second formation of candidate C2 contains two itemsets and then seeks support for each candidate with

a minimum support of 38%. The next iteration is carried out with a similar method as in the first iteration and the results obtained are as follows:

$$\text{Support (Heels, Flat Shoes Hak)} = \frac{\text{Number of transactions Heels and Flat Shoes Hak}}{\text{Total Transactions}} \times 100$$

$$= \frac{699}{1200} \times 100\% = 58{,}25\%$$

Table 3. Candidate 2-itemset

No	Item	Number of Transactions	Support (%)
1	Heels, Flat Shoes Hak	699	58,25%
2	Heels, High Heels	744	62%
3	Heels, Balet Shoes	569	47,41%
4	Heels, Mules	673	56,08%
5	Heels, Pumps	607	50,58%
6	Heels, Flat Shoes	912	76%
7	Heels, Slip On	574	47,83%
8	Heels, Ankle Strap	673	56,08%
9	Heels, Flatbed	252	21%
10	Flat Shoes Hak, High Heels	530	44,16%
…	…	…	…
45	Ankle Strap, Flatbed	131	10,91%

3.1.3 Formation of 3-itemset

The third formation of candidate C3 contains three itemsets and then seeks support for each candidate with a minimum support of 38%. The next iteration is carried out with a similar method as in the second iteration and the results obtained are as follows:

$$Support\ (Heels, Flat\ Shoes\ Hak, High\ Heels) = \frac{\text{Number of transactions Heels, Flat Shoes Hak, High Heels}}{\text{Total Transactions}} \times 100$$

$$= \frac{530}{1200} \times 100\% = 44{,}16\%$$

Table 4. Candidate 3-itemset

No	Item	Number of Transactions	Support (%)
1	Heels, Flat Shoes Hak, High Heels	530	44,16%
2	Heels, Flat Shoes Hak, Balet Shoes	400	33,33%
3	Heels, Flat Shoes Hak, Mules	513	42,75%
4	Heels, Flat Shoes Hak, Pumps	449	37,41%
5	Heels, Flat Shoes Hak, Flat Shoes	699	58,25%
6	Heels, Flat Shoes Hak, Slip On	428	35,66%
7	Heels, Flat Shoes Hak, Ankle Strap	446	37,16%
8	Flat Shoes Hak, High Heels, BaletShoes	371	30,91%
9	Flat Shoes Hak, High Heels, Mules	444	37%
10	Flat Shoes Hak, High Heels, Pumps	351	29,25%
…	…	…	…
28	Flat Shoes, Slip On, Ankle Strap	348	29%

3.2 Formation of Association Rule

After determining all high frequencies, the next step is to find association rules that meet the minimum confidence requirements by calculating the confidence or association A → B, with a minimum confidence of 62%. So that the formation of association rules that do not meet the minimum will be eliminated.

Table 5. Association Rule Results

No	Rule	Confidence	
1	[Heels] ⟹ [Flat Shoes Hak] ⟹ [High Heels]	44,16/85,91	51,40%

2	[High Heels] ⟹ [Heels] ⟹ [Flat Shoes Hak]	44,16/62	71,22%
3	[Heels] ⟹ [Flat Shoes Hak] ⟹ [Mules]	42,75/85,91	49,76%
4	[Mules] ⟹ [Heels] ⟹ [Flat Shoes Hak]	42,75/63,5	67,32%
5	[Heels] ⟹ [Flat Shoes Hak] ⟹ [Flat Shoes]	58,25/85,91	67,80%
6	[Flat Shoes] ⟹ [Heels] ⟹ [Flat Shoes Hak]	58,25/85,41	68,20%
7	[Flat Shoes Hak] ⟹ [High Heels] ⟹ [Flat Shoes]	44,16/64,08	68,91%
8	[Flat Shoes] ⟹ [Flat Shoes Hak] ⟹ [High Heels]	44,16/85,41	51,70%

3.3 Final Association

Based on the association rules, those that meet the minimum support of 38% and minimum confidence of 62% can be seen in the table:

Table 6. Final Association Results

No	Rule	Support	Confidence
1	[High Heels] ⟹ [Heels] ⟹ [Flat Shoes Hak]	44,16	71,22%
2	[Mules] ⟹ [Heels] ⟹ [Flat Shoes Hak]	42,75	67,32%
3	[Heels] ⟹ [Flat Shoes Hak] ⟹ [Flat Shoes]	58,25	67,80%
4	[Flat Shoes] ⟹ [Heels] ⟹ [Flat Shoes Hak]	58,25	68,20%
5	[Flat Shoes Hak] ⟹ [High Heels] ⟹ [Flat Shoes]	44,16	68,91%

The final result produces 5 association rules that meet the minimum support value specified, namely 38% and the minimum confidence value of 62%, which is the highest with a confidence value of 71.22%, namely if you buy High Heels, you will buy Heels and Flat Shoes.

3.4 System Implementation

1. Sales Data Page Display
This page contains sales data for the last three years and displays the name of the distributor and the sandal products ordered.

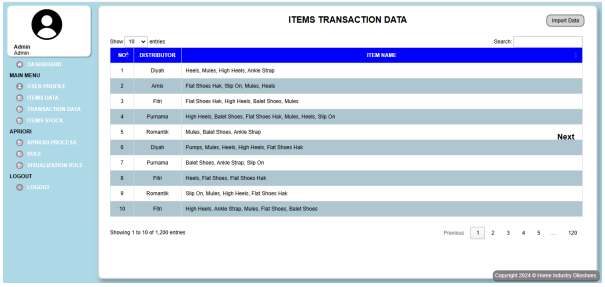

Figure 4. Sales Data Display

2. Apriori Process Page Display
This page contains a combination of sandal products from 1-itemset to a combination of 3-itemset products that produce support values.

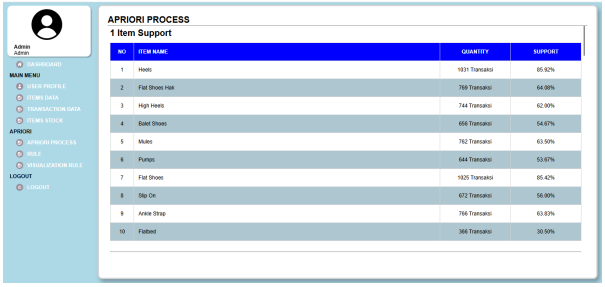

Figure 5. Apriori Process Display

3. Apriori Rule Page Display
This page displays reference products, target products and confidence from the results of the apriori calculation rule.

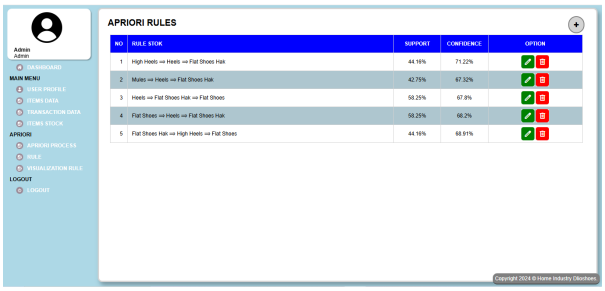

Figure 6. Apriori Rule Display

4. Rule Visualization Display
This page displays the rule results in the form of graphs.

Figure 7. Rule Visualization Display

4. Conclusion

Based on the research that has been done, the Apriori Algorithm can be used to determine the most popular sandal products or the most frequently purchased together with seeing the distributor's tendency in making transactions. By producing five association rules that meet the minimum support value specified, namely 38% and the minimum confidence value of 62% which is the highest with a confidence value of 71.22%, namely if you buy High Heels, you will buy Heels and Flat Shoes. And the use of a web-based system is useful for making it easier to access by Industry owners.

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