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Optimization of Motorcycle Stock and Distribution Using the Apriori Method

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ABSTRACT

Stock management and distribution in motorcycle sales companies often face challenges regarding discrepancies between inventory levels and customer demand. Such conditions can lead to overstocking of certain products or stockouts of high-demand items, resulting in increased holding costs, distribution delays, and diminished customer service quality. Therefore, a method capable of analyzing consumer purchasing patterns based on sales transaction data is required to formulate more effective stock management and distribution strategies. This study aims to optimize stock and distribution strategies by applying the Apriori method to identify relationships between products frequently purchased together. The study benefits the company by enhancing inventory management efficiency, minimizing the risk of overstocking or stockouts, and supporting more accurate, data-driven decision-making. The Apriori method was implemented through stages including transaction data collection, preprocessing, generating frequent itemsets based on minimum support values, calculating confidence values, and formulating association rules to identify product interrelationship patterns. The results indicate that the highest-selling products requiring priority in stock management are engine oil, brake pads, and automatic transmission (matic) gear oil. These three products exhibited the highest frequency of occurrence in transactions, making them top priorities for stocking to prevent inventory shortages and ensure smooth distribution. The application of the Apriori method proved capable of generating valuable insights into purchasing patterns, thereby improving stock management effectiveness, accelerating distribution processes, and enhancing customer service quality.

INTRODUCTION

The rapid growth of Indonesia's automotive industry has led to an increase in motorcycle sales transaction volumes, as well as greater complexity in stock management and distribution for dealers and distributors. Companies frequently face issues such as overstocking certain motorcycle models while experiencing stockouts for high-demand models. These conditions result in higher holding costs, distribution delays, and reduced customer satisfaction. Consequently, companies require stock management strategies that leverage sales transaction data to inform decision-making. Sales transaction data stored within information systems contains purchasing patterns that can be utilized to enhance inventory management efficiency. One widely used technique is Association Rule Mining specifically the Apriori algorithm which identifies relationships between products based on support, confidence, and lift values. This information can be used to determine stock provisioning priorities, distribution strategies, and sales promotions, thereby enabling more accurate, data-driven business decisions. Recent research indicates that the application of the Apriori algorithm can generate association patterns that are useful for optimizing stock and making inventory decisions more effectively (Simamora & Sihotang, 2025).

Several previous studies have demonstrated the effectiveness of the Apriori algorithm across various fields. When applied to motorcycle spare part sales transactions, the Apriori algorithm successfully identified product combinations with a confidence level of 76%, serving as a basis for stock optimization and product bundling strategies. These findings indicate that analyzing purchasing patterns can enhance inventory management efficiency. Applying the Apriori algorithm to store inventory optimization allows for the identification of products frequently purchased together, thereby enabling companies to mitigate the risks of stockouts and overstocking. Furthermore, the analysis supports the formulation of more effective product placement and distribution strategies (Suhardiansyah & Muhammad Iqbal, 2025). The Apriori algorithm is also implemented by various organizations to manage stock. The resulting association rules serve as a foundation for prioritizing inventory, making procurement decisions more targeted and efficient. This approach offers tangible benefits to companies by optimizing inventory costs while simultaneously improving customer service (Retail & Safri, 2024). Association rule analysis reveals patterns of relationships between products that can inform decision-making regarding stock management and sales strategies. Insights derived from frequent itemsets help companies understand consumer behavior, thereby enhancing overall effectiveness. distribution and supply of goods in accordance with market needs (Riadi et al., 2023). Advancements in information technology

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have led to an increase in the volume of data stored in databases. Consequently, methods such as data mining are required to process this data into valuable information and knowledge to support decision-making (Ayu et al., 2024; Triyanto et al., 2024).

LITERATURE REVIEW

Data mining is the process of uncovering hidden patterns and information within datasets stored in databases. As a component of Knowledge Discovery in Databases (KDD), data mining transforms vast amounts of data into valuable information through automated or manual analysis processes. The results of this analysis can serve as a basis for supporting more effective decision-making (Ahmed Arifi Hilman Rahman & Zaehol Fatah, 2025). Data mining employs various statistical, machine learning, and artificial intelligence methods to identify hidden patterns within data (Saputri, 2025).

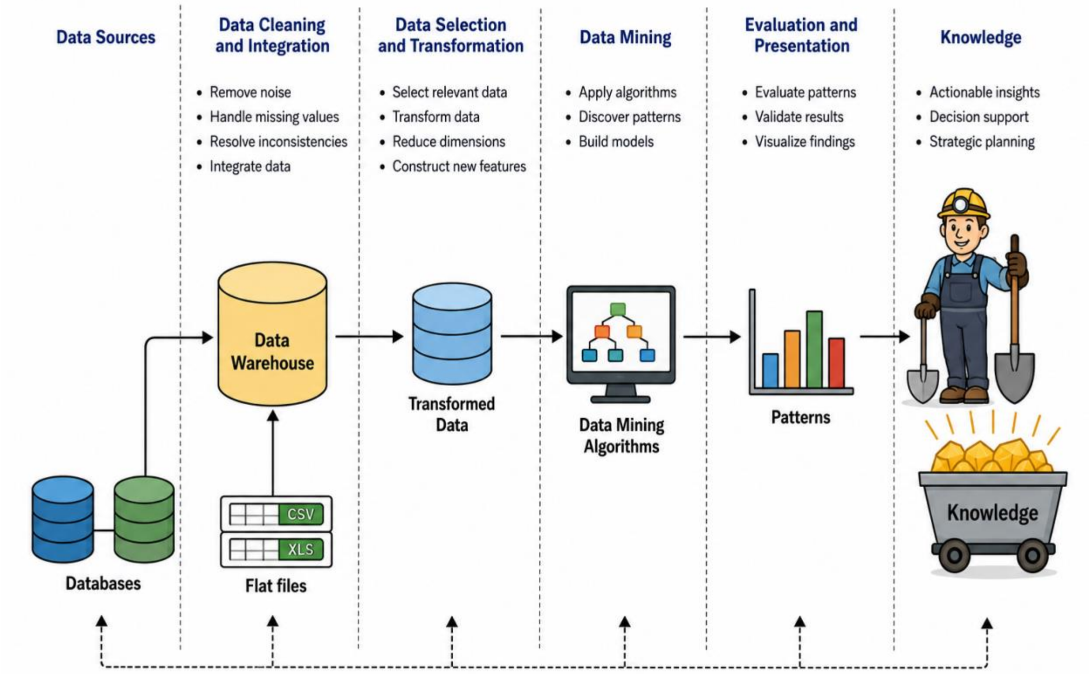

Figure 1. Data Mining Process

1. Data cleaning: the process of cleaning data by correcting errors, removing invalid data, and handling incomplete data.
2. Data integration: the process of combining data from various sources into a unified set ready for processing.
3. Data selection: the process of selecting relevant data based on analysis requirements.
4. Data transformation: the process of converting data into a format suitable for analysis.
5. Data mining: the process of extracting patterns or significant information from data using specific algorithms.
6. Pattern evaluation: the process of evaluating discovered patterns to ensure the information obtained is useful.
7. Knowledge presentation: the process of presenting analysis results in a form that is easily understood by users.

Through these stages, transaction data can be processed into valuable information, thereby supporting business decision-making, understanding customer behavior, identifying sales trends, and enhancing the effectiveness of marketing strategies and operational efficiency. A key characteristic of the KDD process is that it is divided into several stages (Permatasari & Meilani, 2024; Sitama et al., 2023). Data cleaning: the process of cleaning data by correcting errors, removing invalid data, and handling incomplete data. 1. Data integration: the process of combining data from various sources into a unified whole ready for processing. 2. Data selection: the process of selecting relevant data based on analysis requirements. 3. Data transformation: the process of converting data into a format suitable for analysis. 4. Data mining: the process of extracting patterns or significant information from data using specific algorithms. 5. Pattern evaluation: the process of evaluating discovered patterns to ensure the information obtained is useful.6. Knowledge presentation: the process of presenting analysis results in a form that is easily understood by users.

The Apriori algorithm is an association rule mining method used to discover patterns of relationships between products based on their frequency of occurrence in transaction data. This algorithm generates association rules using support and confidence values, enabling companies to identify products frequently purchased together. Such information can be leveraged to formulate marketing strategies, promotions, and product bundling, as well as to

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optimize inventory management (Dewi et al., 2025). Various studies demonstrate the effectiveness of the Apriori algorithm in identifying frequent itemsets, which serve as the foundation for establishing association rules (Saad et al., 2023; Hibnastiar et al., 2025; Perdana & Meri, 2023).

In practice, the Apriori algorithm operates by identifying frequent itemsets that meet a minimum support threshold and subsequently forming association rules that satisfy a minimum confidence threshold (Desi et al., 2022). The primary objective of association rule mining is to identify relationships between items within a transaction. The two key parameters employed are support—representing the percentage of transactions containing a specific combination of items—and confidence—indicating the level of certainty or strength of the relationship between items within an association rule (Jessfry & Siddik, 2024; Ihsan et al., 2022; Zaenal Abidin et al., 2022):

1. Support (supporting value) refers to the percentage of the item combination within the database.

$$Support(A) = \frac{\Sigma\, Jumlah\ Transaksi\ A}{\Sigma\, Total\ Transaksi} x100\%$$

2. Confidence (certainty value), representing the strength of the relationship between items within an association rule.

$$Confidence(A,B) = \frac{\Sigma\, Jumlah\ Transaksi\ A,B}{\Sigma\, Total\ Transaksi\ A} x100\%$$

METHOD

This study employs a quantitative approach, utilizing the Knowledge Discovery in Databases (KDD) method as the primary stage of the data processing workflow. The KDD method was selected for its ability to generate new knowledge from sales transaction data through a systematic process. During the analysis phase, the study applies the Apriori algorithm to identify product association patterns (association rules), which can serve as a basis for decision-making regarding the stock management and distribution of motor vehicles.

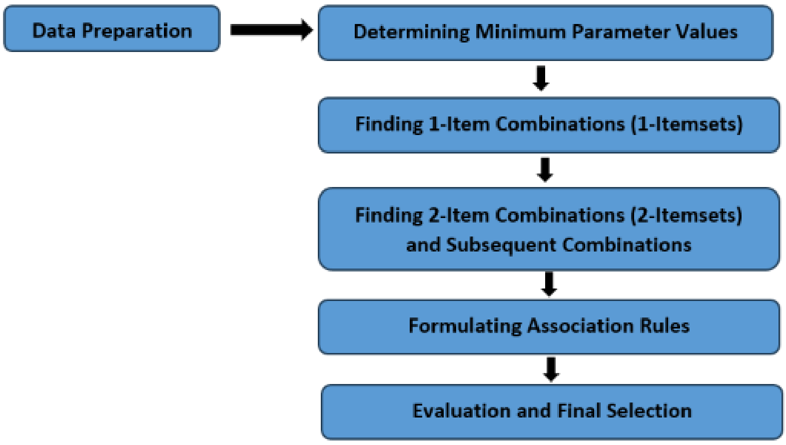

Figure 2. Research Methodology

The data used consists of historical motorcycle sales transaction records obtained from the dealership over a specific period. Each transaction contains information regarding the types of motorcycles sold together, enabling an analysis of relationships between items using the concepts of frequent itemsets and association rules.

Problem Identification

Based on the current situation, the problems addressed in this study can be identified as follows:

1) Motorcycle inventory management does not align with customer demand patterns, frequently resulting in either overstock or stock shortages.
2) Motorcycle distribution to individual branches is not optimized, as it is not based on an analysis of sales data.
3) Sales transaction data is not fully utilized to understand consumer purchasing patterns.
4) The Apriori method has not been implemented to discover association patterns that could support decision-making regarding motorcycle inventory management and distribution.

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Locating relevant reference sources

A literature review is conducted by searching for various references such as scientific journals and books that are relevant to the research topic and the applied methodology. This stage aims to establish the theoretical foundation and references that support the research process.

Data collection

Data collection techniques involve observation, interviews, and the documentation of motorcycle sales transaction data. The collected data is subsequently processed and converted into an "item sheet" format to meet the requirements of the association analysis process using the Apriori algorithm.

Apriori Algorithm

The Apriori algorithm is employed as the primary method for analyzing motorcycle sales transaction data. This algorithm is used to identify patterns of relationships between motorcycle types that frequently appear in the same transactions, thereby generating association rules that serve as a basis for recommendations regarding the optimization of stock management and distribution.

Determination of Attributes and Criteria

This stage involves determining the attributes and criteria used in the analysis process. The selected attributes are derived from sales transaction data, such as transaction number, transaction date, and motorcycle type. These attributes serve as input variables for the application of the Apriori algorithm.

Association Rules

Association rules are used to identify relationships between items based on their frequency of occurrence within transaction data. These rules are formulated by calculating support and confidence values to determine the associations between motorcycle types that are frequently sold together. Association rules that meet the minimum support and confidence thresholds subsequently serve as the basis for recommendations to formulate more effective motorcycle stock and distribution strategies.

RESULT

In the results and discussion phase, the research begins with the collection of motorcycle sales data derived from the company's complete transaction history. This transaction data represents historical records of sales activities with customers over a specific period, serving as the basis for analyzing purchasing patterns. All collected data undergoes a selection and validation process to ensure that only complete and relevant transactions are utilized in the study. Based on this data collection, the researchers utilized sales transaction data spanning ten months—from June to March. This timeframe was selected because it captures sales conditions across various periods, thereby promising more accurate and consistent association patterns. Subsequently, the transaction data was processed using the Apriori algorithm to identify relationships or associations between motorcycle models that frequently appear together in sales transactions. The insights derived from this association analysis serve as a foundation for formulating strategies to optimize vehicle inventory management and prioritize partnerships with distributors. By understanding the prevailing purchasing patterns, the company can anticipate inventory needs, mitigate the risks of stockouts or overstocking, and enhance distribution efficiency, ultimately supporting more informed decision-making. The sales transaction data used in this study is presented in the following table.

Table 1. July 2025 Data

No	Item Name	Amount
1	Engine Oil	100
2	Brake Pads	60
3	Bearing	60
4	Light Bulb	40
5	Motorcycle Tire	30
6	Air Filter	30
7	Spark Plug	50
8	Scooter Gear Oil	100
9	Fuel Filter	20
10	Battery	25

The data used in this study consists of motorcycle sales transaction records showing the highest sales volumes during the study period. This data was selected for analysis to identify purchasing patterns using the Apriori method.

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Table 2. August 2025 Data

No	Item Name	Amount
1	Engine Oil	95
2	Brake Pads	70
3	Bearing	72
4	Light Bulb	45
5	Motorcycle Tire	35
6	Air Filter	36
7	Spark Plug	68
8	Scooter Gear Oil	110
9	Fuel Filter	34
10	AKI	30

The data used in this study consists of motorcycle sales transaction records showing the highest sales volumes during the study period. This data was selected for analysis to identify purchasing patterns using the Apriori method. Table 3. September 2025 Data Based on the collected motorcycle sales transaction data, transaction patterns were subsequently formulated to serve as the basis for analysis using the Apriori method. These transaction patterns are presented in the following table.

Table 3. Sales Transaction Patterns

No	Item Set
1	Engine Oil, Scooter Gear Oil, Brake Pads, Bearings
2	Scooter Gear Oil, Gasoline Engine Oil, Brake Pads, Bearings
3	Scooter Gear Oil, Gasoline Engine Oil, Brake Pads, Bearings
4	Engine Oil, Bearings, Engine Oil, Brake Pads
5	Engine Oil, Brake Pads, Spark Plugs, Bearings
6	Scooter Gear Oil, Gasoline Engine Oil, Filter, Air Filter
7	Gear Oil, Engine Oil, Brake Pads, Motorcycle Tires
8	Spark Plugs, Scooter Gear Oil, Gasoline Engine Oil, Brake Pads
9	Engine Oil, Spark Plugs, Scooter Gear Oil, Brake Pads
10	Engine Oil, Spark Plugs, Scooter Brake Pads, Motorcycle Tires

The research data is derived from motorcycle sales transactions recorded during the observation period. From the available transactions, specific motorcycle models with the highest monthly sales volumes were selected for analysis using the Apriori method to identify association patterns.

Table 4. Tabular Transaction Format

No	Engine Oil	Brake Pads	Bearings	Light Bulbs	Motorcycle Tires	Air Filter	Spark	Scooter Gear Oil	Fuel Filter	Battery
1	1	1	1	0	0	0	0	1	0	0
0	1	1	1	0	0	0	0	1	0	0
3	1	1	1	0	0	0	0	1	0	0
4	1	1	1	0	0	0	0	1	0	0
5	1	1	1	0	0	0	1	0	0	0
6	0	1	0	1	0	1	0	1	0	0
7	0	1	0	1	1	0	0	1	0	0
8	1	1	0	0	0	0	1	1	0	1
9	1	0	0	0	0	0	1	1	1	0
10	1	1	0	0	1	0	1	0	0	0
	8	9	5	2	2	1	4	8	1	1

Based on the motorcycle sales transaction data collected during the research period, the data was organized into a tabular format to facilitate analysis using the Apriori algorithm. This tabular format is presented in the following table.

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Table 5. Item set

Item set	Support
Engine Oil, Brake Pads	70 %
Engine Oil, Bearings	50 %
Engine Oil, Spark Plugs	60 %
Engine Oil, Automatic Scooter Gear Oil	60 %
Brake Pads, Bearings	50%
Brake Pads, Spark Plugs	30%
Brake Pads, Automatic Scooter Gear Oil	70%
Bearings, Spark Plugs	10 %
Bearings, Automatic Scooter Gear Oil	40%
Spark Plugs, Automatic Scooter Gear Oil	20%

The support calculation results for the 1-itemset indicate that several motorcycle models have support values exceeding the minimum threshold of 30%. The items meeting this criterion were then used to form 2-itemset combinations. Subsequently, the support values for the 2-itemsets were calculated using the following formula.

$$\text{Nilai Support } (A, B) = \frac{\Sigma\, Jumlah\ Transaksi\ A\&B}{\Sigma\, Total\ Transaksi} x100\%$$

Nilai Support (Oli Mesin, Kampas Rem) = 7/10 × 100% = 70%
Nilai Support (Oli Mesin, Bearing) = 5/10 × 100% = 50%
Nilai Support (Oli Mesin, Busi) = 4/10 × 100% = 50%
Nilai Support (Oli Mesin, Oli gardan Mertic) = 6/10 × 100% = 60%

Based on the support calculation results for 1-itemsets, several motorcycle models were identified as having support values exceeding the established minimum threshold. The items meeting this minimum support requirement were subsequently used as the basis for forming 2-itemsets. The process of determining support values for the 2-itemsets was carried out using the following formula.

Nilai Support (Kampas Rem, Bearing) = 5/10 × 100% = 50%
Nilai Support (Kampas Rem, Busi) = 3/10 × 100% = 30%
Nilai Support (Kampas Rem, Oli Gardan Matic) = 7/10 × 100% = 70%
Nilai Support (Bearing, Busi) = 1/10 × 100% = 10%
Nilai Support (Bearing, Oli Gardan Matic) = 4/10 × 100% = 40%
Nilai Support (Busi, Oli Gardan Matic) = 2/10 × 100% = 20%

Based on the support calculations for 3-itemsets, no item combinations were found that met the established minimum support value. Therefore, the association rule generation process was carried out using 2-itemset combinations that met the criteria. Subsequently, to determine the strength of the relationships between items, confidence values were calculated using the following formula.

Table 6. Support values

Item set	Support
Engine Oil, Brake Pads	70 %
Engine Oil, Bearings	50 %
Engine Oil, Spark Plugs	50 %
Engine Oil, Automatic Scooter Gear Oil	60 %
Brake Pads, Bearings	50 %
Brake Pads, Spark Plugs	30 %
Brake Pads, Automatic Scooter Gear Oil	70 %
Bearings, Spark Plugs	10 %
Bearings, Automatic Scooter Gear Oil	40%
Spark Plugs, Automatic Scooter Gear Oil	20%

Based on the obtained motorcycle sales transaction patterns, the data was converted into a tabular format to facilitate analysis using the Apriori algorithm. The tabular format of the collected transaction data is presented in the following table.

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Table 7. Support values for 3-item sets

Item sets	Support
Gasoline Oil, Brake Pads, Bearings	50
Gasoline Oil, Brake Pads, Spark Plugs	30
Gasoline Oil, Brake Pads, Metic Axle	50
Brake Pads, Bearings, Spark Plugs	10
Brake Pads, Bearings, Mertic axle oil	40

Table 7 presents the frequent itemsets obtained from the Apriori analysis along with their support values. The results show that the combination of Brake Pads, Bearings, and Spark Plugs has the lowest support value (10%), while Gasoline Oil, Brake Pads, Bearings, and Metric Axle Oil has the highest support value (50%).

Tabel 8. Nilai support 4 Item Set

Item set	Support
Engine Oil, Brake Pads, Bearings, Spark Plugs	10%
Engine Oil, Brake Pads, Bearings, Automatic Transmission Oil	40%

Table 8 presents the itemsets and their corresponding support values obtained from the Apriori analysis. The itemset Engine Oil, Brake Pads, Bearings, and Automatic Transmission Oil has a higher support value of 40%, while Engine Oil, Brake Pads, Bearings, and Spark Plugs has a support value of 10%, indicating that the former combination occurs more frequently in the transaction data.

Tabel 9. Nilai support 5 Item Set

Item set	Support
Engine Oil, Brake Pads, Bearings, Spark Plugs, Mert axle oil	0

Table 9 presents the support value for the five-itemset generated from the Apriori analysis. The combination of Engine Oil, Brake Pads, Bearings, Spark Plugs, and Metric Axle Oil has a support value of 0%, indicating that this item combination does not occur in the analyzed transaction data.

Tabel 10. Confidence Aturan Asosiasi

Rule	Confidence
If buying engine oil and brake pads	7/9=0,77%
If buying engine oil and brake pads	7/5=1,4%
If buying engine oil and brake pads	7/4=1,75%
If buying engine oil and brake pads	7/8=0,875%
If buying engine oil and brake pads	5/5=1%
If buying engine oil and brake pads	5/4=1,25%
If buying brake pads and automatic transmission gear oil	5/8=0,626
If buying bearings and spark plugs	10/4=2,5%
If buying bearings and automatic transmission gears	10/8=1,25%
If buying spark plugs and automatic transmission gears	10/8=1,25%

Based on the confidence value calculations in Table X, several association rules were identified, indicating the degree of association between products purchased by consumers. The confidence value measures the likelihood that the purchase of one product will be accompanied by the purchase of another in the same transaction. A higher confidence value signifies a stronger relationship between the two products. The results show that the rule "IF Buy Engine Oil AND Buy Brake Pads" has a confidence value of 0.77 (77%), indicating that 77% of transactions involving engine oil also included the purchase of brake pads. The rule "IF Buy Engine Oil AND Buy Bearings" yielded a confidence value of 1.40 (140%), while "IF Buy Engine Oil AND Buy Spark Plugs" had a confidence value of 1.75 (175%). Additionally, the rule "IF Buy Engine Oil AND Buy Automatic Scooter Gear Oil" resulted in a confidence value of 0.875 (87.5%), indicating a relatively strong relationship between these two products.

Regarding rules involving brake pads, a confidence value of 1.00 (100%) was obtained for the rule "IF Buy Brake Pads AND Buy Bearings," meaning that every transaction involving brake pads also included the purchase of bearings. Furthermore, the rule "IF Buy Brake Pads AND Buy Spark Plugs" yielded a confidence value of 1.25 (125%), while the rule "IF Buy Brake Pads AND Buy Automatic Scooter Gear Oil" had a confidence value of 0.626 (62.6%). Meanwhile, association rules involving bearings demonstrated a high degree of association. The rule "IF Buy Bearings AND Buy Spark Plugs" resulted in a confidence value of 2.50 (250%), whereas the rule "IF Buy Bearings AND Buy Automatic Scooter Gear Oil" yielded a confidence value of 1.25 (125%). A similar result was observed for the rule "IF Buy Spark Plugs AND Buy Automatic Scooter Gear Oil," which had a confidence value of 1.25 (125%). Based on these

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confidence values, it can be concluded that the strongest association exists in the rule "IF Buy Bearing AND Buy Spark Plug," with a confidence value of 2.50 (250%), followed by the rule "IF Buy Engine Oil AND Buy Spark Plug" at 1.75 (175%). These products show a high likelihood of being purchased together; consequently, this insight can serve as a basis for determining strategies regarding stock provisioning, product placement, and promotional bundling to enhance the effectiveness of inventory management and distribution.

DISCUSSION

Research findings demonstrate that the Apriori algorithm effectively identifies product purchasing patterns based on sales transaction data from a motorcycle dealership. Analysis reveals that engine oil, brake pads, and automatic transmission gear oil appear most frequently in transactions, making them top priorities for inventory management. Furthermore, the calculated support and confidence values indicate strong associations between products—particularly involving combinations of engine oil, brake pads, bearings, spark plugs, and automatic transmission gear oil. This information can serve as a basis for formulating more effective stock management and distribution strategies, mitigating the risks of stockouts or overstocking, and supporting data-driven, accurate decision-making. Consequently, implementing the Apriori algorithm enhances inventory management efficiency, streamlines distribution processes, and improves customer service quality by ensuring product availability aligns more closely with market demand patterns.

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