

Product Layout Determination System Using the Association Rules Method Using the Equivalence Class Transformation Algorithm

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ARTICLE INFO	ABSTRACT
<p>Keywords: Trade competition Strategy Layout Eclat</p>	<p><i>Competition in the business world, specifically in the sales industry, requires companies to analyze the purchases made by customers during transactions in order to find effective business strategies. In the competitive fashion industry, merchants devise marketing strategies to increase sales. One strategy that can attract consumer interest is by organizing and arranging product displays, placing them in perfect layouts that align with customers' buying habits, making it easier for them to find and purchase products. Layout arrangement significantly influences customer satisfaction and purchase intent. The algorithm used in this study is Equivalence Class Transformation (ECLAT). The data used consists of transactional data from Aufco Clothing, specifically fashion products. A total of 1041 transactions were analyzed, using variables such as order number and items sold. The data was processed using JavaScript, with a minimum support of 0.2 and a minimum confidence of 0.7, resulting in 16 rules. The rules ranged from a min. confidence of 70% to a maximum confidence of 100%, forming 6 rules with 9 combinations of items.</i></p>

INTRODUCTION

Competition in the business world, specifically in the sales industry, requires managers to analyze purchases made by buyers when making transactions to be able to find business strategies. In competing in the business world, specifically in the fashion industry, traders have to organize marketing strategies to increase sales (Luhur et al. 2020). One strategy that can increase consumer interest in buying is by arranging and tidying up the location of the product, placing a perfect layout and synchronizing with customer buying habits, which will make it easier for customers to search for and buy products (Angelia et al. 2020). The layout has an important impact on the level of consumer satisfaction and buying interest. The better the layout, the higher consumer satisfaction and their buying interest (Mahasiswa 2014). The speed of information obtained by the company provides benefits for developing a practical and efficient business scheme, with the stored buying and selling transaction data being useful for company management, for example being able to find out what products are frequently sold (FAHRUDIN 2019).

Information technology in a company is very important in determining the company's business strategy to increase sales. A business strategy that aims to provide satisfaction to consumers and increase sales for the company (Suryani & Utami 2021). One strategy that can increase consumer interest in buying is by arranging the product layout, proper product placement can avoid lost opportunities in selling products due to consumers' ignorance of the product's location (Wijaya, Malik & Nurmaini 2020). Sales transaction data can be reprocessed to form useful information for sales or sales mapping. By using transaction data you can find combinations of products that are most popular with customers. Determining product purchasing patterns with the aim of ensuring that the products needed by customers can be met. In this case, a solution is needed to find the pattern of product purchase combinations that consumers are interested in (Pd et al. no date).

Several studies have been conducted in the field of Association Rule techniques to examine the use of sales patterns. One of these studies found that the ECLAT algorithm produced 25 rules, while the Fp-Growth algorithm produced 23 rules. However, the Fp-Growth algorithm requires a longer execution time, namely 11 seconds. Meanwhile, Fp-Growth only takes 1 minute 10 seconds (Algoritma, Dan & Wijaya 2019). In another analysis entitled "Comparison of the Apriori Algorithm and the ECLAT Algorithm in Determining Book Borrowing Patterns at the Bina Darma University Library, Palembang," it can be concluded that the application of data mining techniques with the association rule method in book lending transactions in 2017, the ECLAT algorithm was proven to be superior to the algorithm. A priori. In the tests carried out, the ECLAT algorithm produced 24 rules, while the Apriori algorithm only produced 7 rules (Mayuni et al. 2018). In another study entitled "Implementation of the Association Method Using the Equivalence Class Transformation (ECLAT) Algorithm on Consumer Purchasing Patterns for Goods Recommendations," it was stated that the Delimajaya store faced problems in providing product recommendations to customers, and this problem could be overcome by implementing the ECLAT algorithm. However, this research has a weakness, namely that in the face of a limited amount of data and a lack of variation, the resulting rules are not optimal (Rekomendasi & Rak, n.d.).

Based on the previous explanation, this research will apply a strategy for implementing association rules using the ECLAT algorithm to identify fashion product sales patterns in one transaction. And it is hoped that this research will be a useful reference for other studies that focus on analyzing sales patterns.

METHOD

A research approach is a step used to conduct research so that it can respond to research problems and objectives. In the research method, there are several stages in this research. Starting with inputting transaction data to determine sales data, a data mining process is carried out by applying Association Rules with the Eclat Algorithm.

Data Collection

Research Data

At this stage the aim is to collect information. This research uses the Aufco Distro fashion goods marketing transaction dataset which is raw data. The fields contained in this transaction data are order number, order date, buyer, item name, qty and price. And there are 24 items in inventory.

Data Preprocessing

Data pre-processing is used to reduce data errors before the analysis process is carried out. Data pre-processing is an important step in the knowledge discovery process, because the decisions that will be made must be based on quality data.

Cleaning

Data cleaning is part of pre-processing, namely the process of removing noise and irrelevant data. In this research, a cleaning process will be carried out for missing data, deleting transaction data of less than 2 items in one transaction.

Selection

Selection is carried out to select the data to be used. In this research, the data to be processed is divided into two, namely order numbers and goods sold.

Transformation

Data transformation is a process for changing the form of data into a certain appropriate format and aims to ensure that data processing can be carried out and run well.

Analysis and Results

At this stage, we will explain the data analysis process by applying the ECLAT algorithm. To find out how the stages of forming an ECLAT machine flow in a simple way. The results of the analysis in the form of rules in the analysis process by applying the ECLAT algorithm obtained information on the products most frequently purchased simultaneously that have met the minimum support, minimum confidence and lift ratio values which will be used as references in placing goods.

Consists of research design, details of research implementation including population and sample, instruments and data collection technique, and data analysis technique.

RESULTS AND DISCUSSION

Implementation

Implementation is an action or implementation of a previously prepared plan.

Preparation for implementation

Before running the system or software, there are several things you need to pay attention to, namely system requirements. In this research, testing was carried out stand alone, namely using a personal computer (Motor, Honda & Service 2017). In this research, the software is a web-based application based on needs using the Java Script programming language which is run using the Visual Studio Code application and uses the MonggoDB database and then displays the program using Google Chrome as a Web browser media (Wijaya et al. 2020).

Database implementation

The database implementation is built based on the database design that was designed in CHAPTER III Analysis and Design (Anggrawan & Satria 2021). The database was created using MonggoDB Compass. Implementation of each table contained in the application being built.

a. Implementation of transaction data

The analysis plan for the data table when implemented is in accordance with the analysis carried out in the design that was made previously, which is the result of implementing the dataset table. Explained in Figure 4.1.

#	_id ObjectId	id_pesanan String	items String	tanggal String	qty
1	ObjectId('64911c5a666d1b14f0d...')	"259358"	"["Celana pdl panjang army, k...	"2022-10-03 6:30"	3
2	ObjectId('64911c5a666d1b14f0d...')	"259359"	"["Celana pdl panjang abu, ja...	"2022-10-03 6:56"	2
3	ObjectId('64911c5a666d1b14f0d...')	"259360"	"["Celana Chino pendek hitam,...	"2022-10-03 7:49"	2
4	ObjectId('64911c5a666d1b14f0d...')	"259361"	"["Celana joger pdl abu", "Cel...	"2022-10-03 8:30"	4
5	ObjectId('64911c5a666d1b14f0d...')	"259362"	"["Celana jeans panjang hitam...	"2022-10-03 8:52"	2
6	ObjectId('64911c5a666d1b14f0d...')	"259363"	"["Celana pdl panjang army, K...	"2022-10-03 12:57"	2
7	ObjectId('64911c5a666d1b14f0d...')	"259364"	"["Celana pdl pendek army", "C...	"2022-10-03 13:00"	3

Figure 4. 1 Implementation of transaction data

b. Implementation of results table

The analysis plan for the results table when implemented is in accordance with the analysis carried out in CHAPTER III, where the results of implementing the results table can be seen in Figure 4.2.

#	_id ObjectId	lhsrhs String	minsupport String	confidence String	lif
1	ObjectId('6491c268666d1b14f0d...')	"celana pdl panjang army, swe...	"1"	"1"	"0.16"
2	ObjectId('6491c268666d1b14f0d...')	"kaos polos, sweater-celana ...	"1"	"1"	"0.12"
3	ObjectId('6491c268666d1b14f0d...')	"celana pdl panjang army, cela...	"1"	"1"	"0.16"
4	ObjectId('6491c268666d1b14f0d...')	"kaos polos, celana joger pdl...	"1"	"1"	"0.12"
5	ObjectId('6491c268666d1b14f0d...')	"celana pdl panjang army, cela...	"1"	"1"	"1"
6	ObjectId('6491c268666d1b14f0d...')	"kaos polos, celana joger pdl...	"1"	"1"	"0.25"
7	ObjectId('6491c268666d1b14f0d...')	"celana pdl panjang army, kao...	"1"	"1"	"0.25"

Figure 4. 2 Implementation of calculation results

Interface implementation

The application display is in the form of an interface to make it easier for users to use the system.

Dataset interface page

The dataset interface page displays all the datasets registered in the system, there are transaction data and stock data, there are also actions that can be taken, namely delete and edit.

a. Dashboard page

The dashboard page display has the title of this system as can be seen in Figure 4.3.

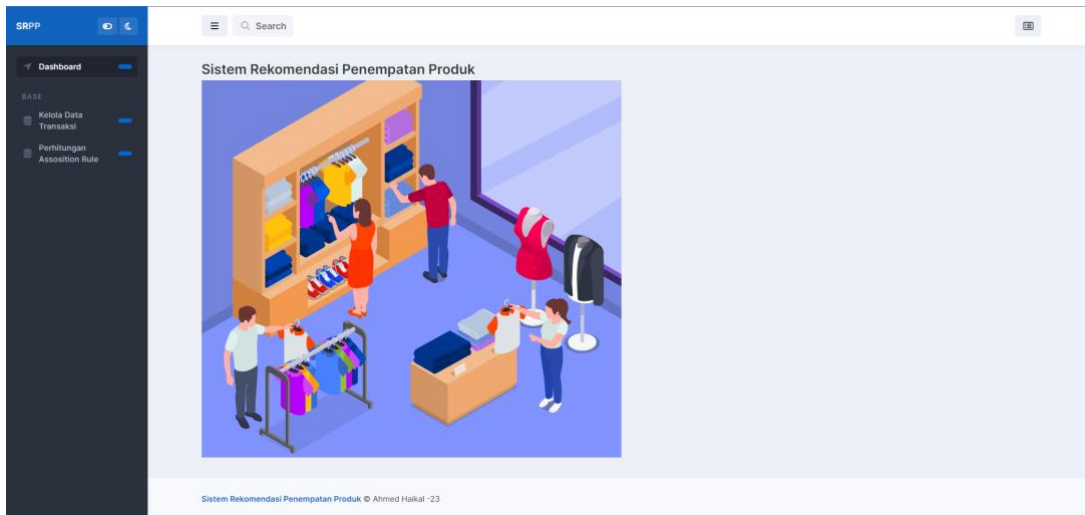


Figure 4. 3 Dashboard Views

b. Manage transaction data display

The transaction data management page display contains information regarding the process of uploading .csv type files, editing and deleting data. as can be seen in Figure 4.4.

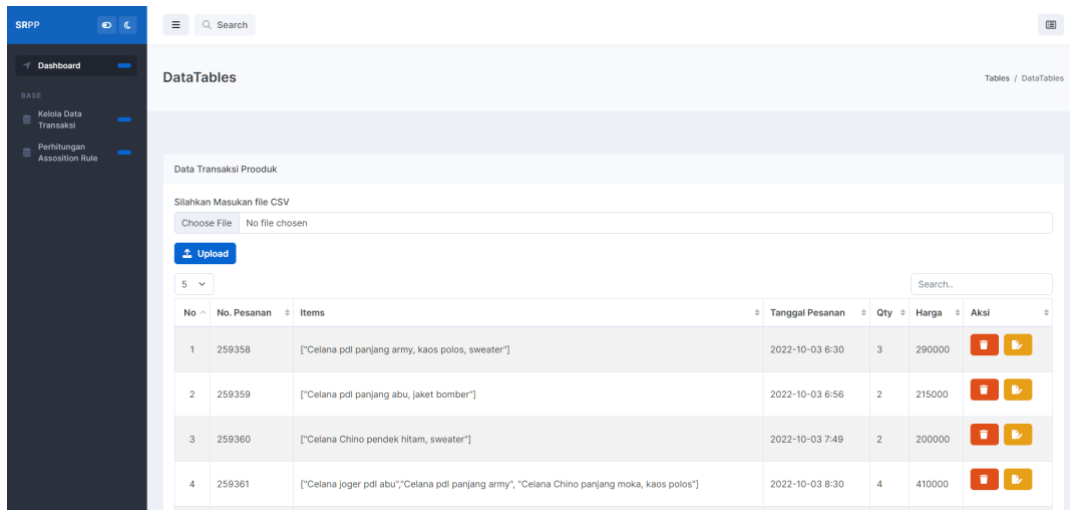


Figure 4. 4 Manage transaction data display

c. Eclat calculation page

The ECLAT calculation process page displays an input option in the form of min. support and min. confidence as shown in Figure 4.5 as well as the calculation results shown in Figure 4.5.

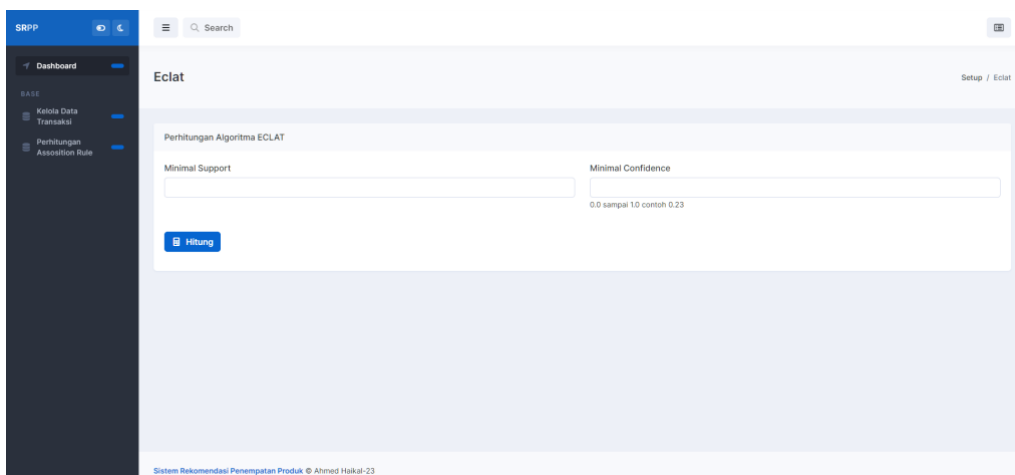


Figure 4.5 Min input display. support and min. confidence

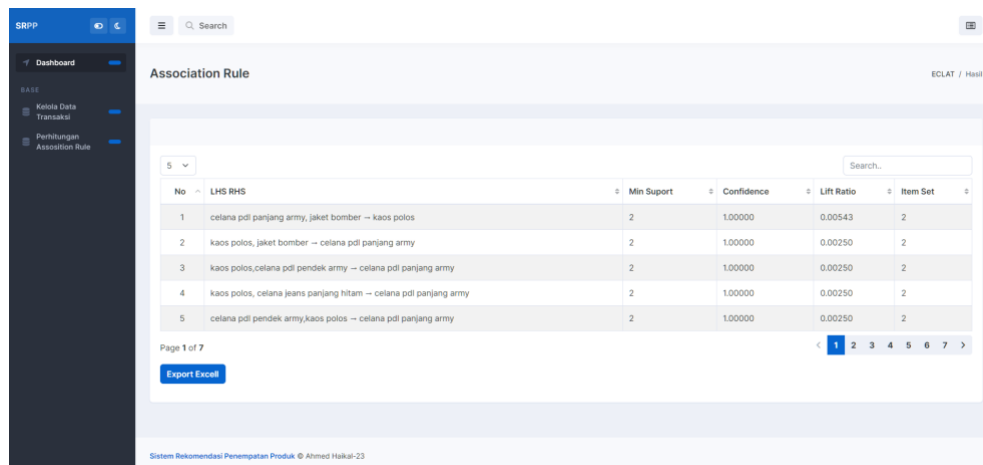


Figure 4. 6 Display of Association rule calculation results

Software Testing

Software testing is based on functional requirements in the system. Which aims to achieve conformity between the design and the results obtained. Software testing also aims to achieve success in design and implementation (Subianto, Ar & P 2018). The testing technique in building this system is using Black Box Testing where this testing focuses on testing the functionality of the system that is already running. This sub-chapter explains matters relating to quality testing of systems using Association Rules including Black Box Testing, testing stages, process grouping based on use case diagrams, quality testing objectives, test success categories, test scenarios, test implementation, and conclusions. Black Box Testing (Huda et al. 2018).

Test Method

Black Box Testing is a method for evaluating the functional performance of software. Black Box Testing consists of analyzing experimental results using data sets and evaluating software functionality. Testing only involves running an entity or module and then determining whether the output is in accordance with the expected business system analysis process or not (Djaoui & Kerkouche 2018). The stages of Black Box Testing are:

1. Group the steps based on the use cases in the design.
2. Determine test quality targets.
3. Determine the category of quality testing results.
4. Design quality testing.
5. Implementation of quality testing.
6. Conclusion from the results of quality testing.

Process Grouping Based on Use Case Diagram

Process grouping is carried out based on the Use Case that has been designed in CHAPTER III which includes use cases, where the process grouping based on the Use Case can be seen in Table 4.1.

Table 4. 1 process grouping based on use case

No.	Use Case	Testing
1.	Manage transaction data	Import transaction data
		View transaction data
		Edit transaction data
		Delete transaction data
2.	Calculation of Association Rules	Input Min Confident & Min support
		View calculation results

3.	Export calculation results	View export results (excel)
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Test Objectives

This stage discusses the objectives of quality testing of the software being built, which can be seen in Table 4.2.

Table 4. 2 Test objectives

No.	Use Case	Testing
1.	Import Data Transactions	Test the process of uploading transaction data into the system
2.	View transaction data	Test the process of viewing transaction data
3.	Edit transaction data	Test the edit of transaction data in the database
4.	Delete transaction data	Carry out tests to delete data in the database
5.	Min input support & min confidence	Testing the input min support and min confidence in the association rule calculation
6.	View association results	Test the display to view association results
7.	Export association calculation results	Test the export of association calculation results (excel).

In determining the quality testing category for this application, it is divided into two categories, namely:

- a. Appropriate
If the quality of the application being tested is in accordance with the planning objectives and its use, then it is included in the appropriate category.
- b. Not Appropriate
If the quality of the application being tested is not in accordance with its planning and usability objectives, then it is included in the unsuitable category.

Test scenarios

Test scenarios are used as a reference for testing software functionality. In other words, scenarios are created before software testing is run. designing test scenarios. can be seen in table 4.3.

Table 4. 3 test scenarios

Use Case	Feature Name	Code Test	Test Cases
Manage transaction data	Import Transaction Data	KU1.1	Add transaction data by importing .csv to the data database
	View transaction data	KU1.2	Display transaction data in the data database
	Edit transaction data	KU1.3	Edit transaction data in the database
	Delete database transaction	KU1.4	Delete transaction data in the database
Association rules calculation	Input min support & min confidence	KU2.1	Input the min value support and min confidence in association rule calculations

Use Case	Feature Name	Code Test	Test Cases
	View association results	KU2.2	Displays association results based on calculations from association rules
Export association calculation results	View Export Results (excel)	KU3.1	Display export results (excel)

Implementation of testing

In carrying out this test, research will be carried out regarding software quality based on transaction data using a predetermined association rule method (Djaoui & Kerkouche 2018). This test will refer to the plan that has been prepared as a guide. The test results will be adjusted to the goals to be achieved in accordance with the plans that have been made. Details of the test implementation can be found in the attached Table 4.4.

Table 4. 4 test implementation

No.	Code Test	System Response	Expected	Results
1.	KU1.1	The system displays the data to be imported and then displays a selection of data to be imported in the form of .csv.	Adding data through the imported data in the database	In accordance
2.	KU1.2	The system displays all transaction data in the form of numbers, items, dates. Data displayed successfully.	Displays data in the database data table.	In accordance
3.	KU1.3	The system carries out the editing process of transaction data contained in the transaction data.	Displays item data in the database on the item data display page	In accordance
4.	KU1.4	The system carries out the process of deleting existing data in transaction data.	Deleting existing data in the Corresponding transaction data table	In accordance
5.	KU2.1	The system performs association rule calculations by first entering the min support value and min confidence.	Displays the results of the association rule calculations to be calculated	In accordance
6.	KU2.2	The system displays the association results of the product combinations that have been calculated.	Displays the association results from the association rule calculation	In accordance
7.	KU3.1	The system displays export results (excel)	Displays export results (excel)	In accordance

Next, the conclusion of the black box testing that has been carried out is in a table with 2 functions, namely Manage transaction data, and Association rule calculations (Sneha & Malle 2017). So the percentage of function suitability in the system can be calculated as follows:

- Number of Test Codes = 7 Test Codes
- Test Codes with Corresponding Results = 7 Test Codes
- Test Codes with Inappropriate Results = 0 Test Codes

Lift Ratio

One method for evaluating the strength of association rules in Association Rules is through the lift ratio. The lift ratio can be calculated using the following formula. It can be seen in Table 4.5.

Table 4. 5 Calculation results

Rules	Confidence	Lift Ratio
black chino shorts → sweater	78%	1.12
navy long pdl pants → army long pdl pants	97%	0.55
long black jeans → plain t-shirt	79%	0.41
black jeans → plain t-shirt	100%	0.67
gray pdl jogger pants → black pdl jogger pants	89%	1.53
black pdl jogger pants → gray pdl joger pants	70%	1.53
black long pdl pants → gray long pdl pants	100%	3.79
plain t-shirt → black trousers	100%	1.64
long black jeans, sweater → plain t-shirt	96%	0.66
black pdl jogger pants, mocha pdl trousers → sweater	100%	1.41
black pdl jogger pants,sweater → mocha long pdl pants	100%	4.00
army long chino trousers, army trousers → plain t-shirts	72%	0.57
army short pdl pants, plain t-shirts → long army pdl pants	100%	0.56
army trousers, bomber jacket → plain t-shirt	83%	0.61
bomber jacket, plain t-shirt → long army trousers	83%	0.51
black long trousers, plain t-shirt → black long chino trousers	87%	1.25

Based on the calculation results, when the average lift ratio value exceeds 1, it shows that the rules formed have strong power. Thus, these rules can be used as information for the best layout. Can be seen in Table

Table 4. 6 Lift ratio above 1 or positive

Rules	Confidence	Lift Ratio
black chino shorts → sweater	78%	1.12
gray pdl jogger pants → black pdl jogger pants	89%	1.53
black pdl jogger pants → gray pdl joger pants	70%	1.53
black long pdl pants → gray long pdl pants	100%	3.79
plain t-shirt → black trousers	100%	1.64

Rules	Confidence	Lift Ratio
black pdl jogger pants, mocha pdl trousers → sweater	100%	1.41
black pdl jogger pants,sweater → mocha long pdl pants	100%	4.00
black long trousers, plain t-shirt → black long chino trousers	87%	1.25

CONCLUSION

Based on this research, we can find out how consumers purchase and the relationship between product layout arrangements according to interrelated products. From the test results using 1041 transaction data in 0.02s, with min. support = 0.2 and minimum confidence = 0.7 produce the following information: In testing with support 0.2 and confidence 0.7 16 rules were formed. The lowest confidence is 70%, there is 1 rule with the product combination black PDL jogger pants → gray PDL jogger pants.

The highest lift ratio figure in this study reached 4.00, while the lowest lift ratio was 0.41. All lift ratio figures greater than 1 indicate that these products have a positive trend and the potential to be repurchased in the future. The high trust value is 100% which is processed using the ECLAT algorithm and produces 6 rules consisting of 9 product combinations. The product combination includes army short PDL trousers, army long PDL trousers, black long PDL trousers, gray long PDL trousers, plain t-shirts, black PDL jogger trousers, mocha long PDL trousers, black jeans and sweaters. With a high level of trust, you can be sure that the item will be purchased. Therefore, the item can be placed in the layout process taking into account its strong association with the purchasing process. This will make it easier for distro owners or entrepreneurs to determine layout placement based on the results of this process.

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