Determination of Breakfast Menu Patterns on the Fast Food Restaurant Using Apriori Algorithm

Anggi Yhurinda Perdana Putri[1], Dzulfiqar Nawa Fauzan[1], Hana' Nabilah[2], Ruli Utami[1] and Suryo Atmojo[2]
[1]*Department of Information System, Institute Technology of Adhi Tama Surabaya, Surabaya, Indonesia*
[2]*Department of Informtics Engineering, University of Wijaya Putra, Surabaya, Indonesia*

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Abstract: Nowadays the workload is increasing and inversely proportional to idle time, everyone is in rush especially in the morning. Whereas breakfast is very important to start the day. Fast food restaurant offers a solution to this problem. Fast food defined as cuisine prepared by restaurant in quick time and ready to consume. Fast food restaurants have growing rapidly in Indonesia. The number of similar restaurants resulted very tight competition, under these conditions fast food restaurant entrepreneurs must consider various ways to survive in competition. Researchers offer collaboration between marketing strategy and computational knowledge for business. One of the computational sciences that can be applied is Apriori algorithm to combine relationships between products from the Fast-Food restaurant transaction data. This algorithm resulted 27 association rules with 12 rules has met minimum confidence requirement. In this research minimum support and confidence for each ≤ 2 and ≤ 75%.

1 INTRODUCTION

Fast food defined as cuisine prepared by restaurant in quick time and ready to consume, such as fried chicken, hamburger, or pizza (Nagarajan et al, 2017) (Smith et al, 2013). Nowadays the workload is increasing and inversely proportional to free time, everyone is in rush especially in the morning. Thus, time kept aside to have breakfast is very limited or sometimes they even skip it (Mardiyati & Nurul, 2017). Whereas breakfast is very important to start the day. Fast food restaurant offers a solution to this problem. Fast Food Restaurant is a type of restaurant that serve fast food cuisine, has minimal table service, offer cheap yet delicious food often lacks much nutritional value (Anwar, 2017). Fast food restaurants become the most popular place for dining, among the public especially at breakfast. It helps rush worker can grab a quick bite from any of the fast-food restaurants around his business, within the span of 10-15 minutes.

Fast food restaurants have growing rapidly in Indonesia, particularly in terms of variation of menu, taste, restaurant facilities, and services. The number of similar restaurants resulted very tight competition, this competition does not only occur between restaurants, but also with other forms such as outlets. Under these conditions fast food restaurant entrepreneurs must consider various ways to survive in competition. Choosing the right marketing strategy can be determined long term success and competitive advantage of restaurant (Tampubolon et al, 2013). Strategy selection and implementation in this marketing is expected to be more helped if collaborated with the application of knowledge computing for business (Utami, 2019) (Marpaung, 2016). Data mining tools predict future trends and behaviors, helps organizations to make proactive knowledge-driven decisions. Data mining tools has the answer of this question (Dongre et al, 2014). One of the data mining method that can be applied is Apriori algorithm to combine relationships between products from the Fast-Food restaurant transaction data. This data mining association technique will assist management to find relationships between items in one transaction (Prakoso et al, 2017). Research related to the Apriori method conducted by (Putra et al, 2019) (Kurnia et al, 2019) (Panjaitan et al, 2019) (Ndruru and Hasugian, 2020) and many more, the application of the Apriori Method in Fast Food restaurant has not much explored yet.

2 RESEARCH METHOD

Apriori Algorithm serves to identify the relationship

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between items in a sales transaction by finding the highest frequency in an iteration and between item set in a transaction data set, where the minimum requirements are support and confidence predetermined. The equation used in the apriori algorithm is as follows (Kusrini & Luthfi, 2009) (Ruswati et al, 2018).

$$Support\ (X) = \frac{\Sigma Tx}{\Sigma T}\ x\ 100\% \qquad (1)$$

$$Support\ (X,Y) = \frac{\Sigma Txy}{\Sigma T}\ x\ 100\% \qquad (2)$$

$$Confidence = \frac{\Sigma Tx}{\Sigma T}\ x\ 100\% \qquad (3)$$

Where:
Support (X): Support value for item X
Tx: Transaction Amount contains item X
Q: Transaction Amount
Support (X,Y) : Support values for item X and item Y
Txy: Transaction Amount contains item X and item Y
Confidence: confidence value of X → Y rule

Figur 1 shows the process stages Figure 1 shows the process stages in the Apriori algorithm after going through the process of data collection and data analysis. Then, we determine the minimum support and confidence.

2.1 Item Set Candidate

The k-item set candidate is formed from a combination (k-1)-item set obtained from the previous iteration. One feature of the Apriori algorithm is the elimination of k-item set candidates whose subsets containing k-1 items are not included in the high frequency pattern with the length of k-1.

2.2 Support Value Calculation

Support Value for each k-item set candidate is obtained by scanning the database to calculate the number of transactions containing all items in the k-item set candidate. It is also a feature of the a priori algorithm, which is the calculation required by scanning the entire data base of the longest k-item set.

2.3 High Frequency

High frequency patterns containing k-items or k-item sets are determined from candidate k-item set whose support is greater than the minimum support. Then calculated confidence in each item combination. Iteration stops when all items have been counted until there are no more item combinations.

2.4 Association Rule

Association Rule provides rules in the form of 'X → Y', where X and Y are sets of items. X and Y can be regarded as the "If" part and the "Then" part respectively which means the causality of X and Y.

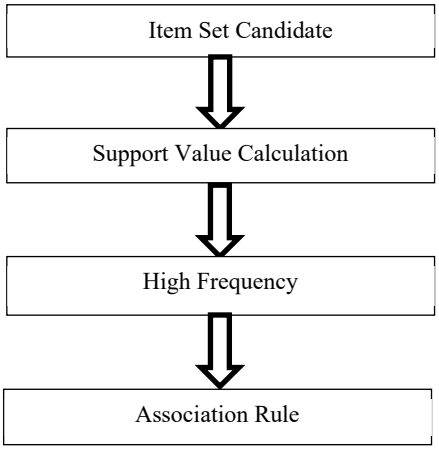

Figure 1: Apriori Method Process Stages

3 RESEARCH AND DISCUSSION

The study begins with the collection of ABC Fast Food Restaurant daily data shown in table 1 and then processed using the Apriori method.

Table 1: Transaction List

Transaction ID	Purchased Menu
T1	Riser, Scramble Egg, Waffle, Hot Coffee, Hot Tea, Hazelnut Coffee
T2	Super Breakfast, Scramble Egg, Waffle, Hot Coffee, Hazelnut Coffee
T3	Riser, Super Break 1, Hot Coffee, Hot Tea
T4	Riser, Pancake, Pom-pom, Hot Coffee, Hazelnut Coffee
T5	Pom-pom, Porridge, Scramble Egg, Hot Coffee, Hot Tea

The apriori method is shown in Table 2 to Table 11. In this study, the minimum support = 2 and minimum confidence = 75% are determined. Table 2 is iteration 1 to get the menu patterns that most often appear in consumer transactions.

Table 2: Iteration 1

Item	Support Count	Support
Riser	3	60%
Scramble Egg	3	60%
Waffle	2	40%
Hot Coffee	5	100%
Hot Tea	4	40%
Hazelnut Coffee	3	60%
Super Break	1	20%
Super Break 1	1	20%
Pancake	1	20%
Pom-pom	2	40%
Porridge	1	20%

Table 3: Result of iteration 1

Item	Support Count	Support
Riser	3	60%
Scramble Egg	3	60%
Waffle	2	40%
Hot Coffee	5	100%
Hot Tea	4	40%
Hazelnut Coffee	3	60%
Pom-pom	2	40%

From the Table 2 above, we found that 1-itemset meets the minimum support is an item with a support value ≥ 2 (the value in bold), there are seven items that are qualify (shown at Table 3). After obtaining the item with the highest frequent pattern, then calculated iteration 2; i.e. looking for the relationship of two items in a concurrent transaction. This is done by combining 2 items that meet the requirements in iteration 1.

At the iteration 2 we found that 2-itemset meets the minimum support is an item with a support value ≥ 2 (the value in bold), there are thirteen items that are qualify (shown at Table 5). After obtaining the item with the highest frequent pattern, then calculated iteration 3; i.e. looking for the relationship of three items in a concurrent transaction. This is done by combining 3 items that meet the requirements in iteration 2. Continuously at the iteration 3 we found that 3-itemset meets the minimum support is an item with a support value ≥ 2 (the value in bold), there are seven items that are qualify (shown at Table 7).

Then calculated iteration 4; i.e. looking for the relationship of four items in a concurrent transaction. This is done by combining 4 items that meet the requirements in iteration 3. At the iteration 4 we found that 4-itemset meets the minimum support is an item with a support value ≥ 2 (the value in bold), there are three items that are qualify (shown at Table 9).

Table 4: Iteration 2

Item	Support Count	Support
Riser, Scramble Egg	1	20%
Riser, Waffle	1	20%
Riser, Hot Coffee	3	60%
Riser, Hot Tea	3	60%
Riser, Hazelnut Coffee	1	20%
Riser, Pom-pom	1	20%
Scramble Egg, Waffle	2	40%
Scramble Egg, Hot Coffee	3	60%
Scramble Egg, Hot Tea	3	60%
Scramble Egg, Hazelnut Coffee	2	40%
Scramble Egg, Pom-pom	1	20%
Waffle, Hot Coffee	2	40%
Waffle, Hot Tea	2	40%
Waffle, Hazelnut Coffee	2	40%
Waffle, Pom-pom	0	0%
Hot Coffee, Hot Tea	4	80%
Hot Coffee, Hazelnut Coffee	3	60%
Hot Coffee, Pom-pom	2	40%
Hot Tea, Hazelnut Coffee	2	40%
Hot Tea, Pom-pom	1	20%
Hazelnut Coffee, Pom-pom	2	20%

Table 5: The Result of iteration 2

Item	Support Count	Support
Riser, Hot Coffee	3	60%
Riser, Hot Tea	3	60%
Scramble Egg, Waffle	2	40%
Scramble Egg, Hot Coffee	3	60%
Scramble Egg, Hot Tea	3	60%
Scramble Egg, Hazelnut Coffee	2	40%
Waffle, Hot Coffee	2	40%
Waffle, Hot Tea	2	40%
Waffle, Hazelnut Coffee	2	40%
Hot Coffee, Hot Tea	4	80%
Hot Coffee, Hazelnut Coffee	3	60%
Hot Coffee, Pom-pom	2	40%
Hot Tea, Hazelnut Coffee	2	40%

Table 6: Iteration 3

Item	Support Count	Support
Riser, Hot Coffee, Hot Tea	2	40%
Riser, Hot Coffee, Scramble Egg	1	20%
Riser, Hot Coffee, Waffle	1	20%

Riser, Hot Coffee, Hazelnut Coffee	2	40%
Riser, Hot Coffee, Pom-pom	1	20%
Riser, Hot Tea, Scramble Egg	1	20%
Riser, Hot Tea, Waffle	1	20%
Riser, Hot Tea, Hazelnut Coffee	1	20%
Riser, Hot Tea, Pom-pom	0	0%
Riser, Scramble Egg, Waffle	1	20%
Riser, Scramble Egg, Hazelnut Coffee	1	20%
Riser, Scramble Egg, Pom-pom	0	0%
Riser, Waffle, Hazelnut Coffee	1	20%
Riser, Waffle, Pom-pom	0	0%
Riser, Hazelnut Coffee, Pom-pom	1	20%
Hot Coffee, Hot Tea, Scramble Egg	3	60%
Hot Coffee, Hot Tea, Waffle	2	40%
Hot Coffee, Hot Tea, Hazelnut Coffee	2	40%
Hot Coffee, Hot Tea, Pom-pom	1	20%
Hot Tea, Scramble Egg, Waffle	2	40%
Hot Tea, Scramble Egg, Hazelnut Coffee	2	40%
Hot Tea, Scramble Egg, Pom-pom	1	20%
Scramble Egg, Waffle, Hazelnut Coffee	1	20%
Scramble Egg, Waffle, Pom-pom	0	0%
Waffle, Hazelnut Coffee, Pom-pom	0	0%

Table 7: The Result of iteration 3

Item	Support Count	Support
Riser, Hot Coffee, Hot Tea	2	40%
Riser, Hot Coffee, Hazelnut Coffee	2	40%
Hot Coffee, Hot Tea, Scramble Egg	3	60%
Hot Coffee, Hot Tea, Waffle	2	40%
Hot Coffee, Hot Tea, Hazelnut Coffee	2	40%
Hot Tea, Scramble Egg, Waffle	2	40%
Hot Tea, Scramble Egg, Hazelnut Coffee	2	40%

At the iteration 5, we found the last combination of five item that meets the minimum support, which is Hot Coffee, Hot Tea, Hazelnut Coffee, Scramble Egg, and Waffle (Shown at table 10). Thus, the iteration process has stopped at fifth iteration. To determine the association rules in table 11 the results are used iteration 5, using equation 3 to calculate the value of confidence. In this case It has been determined that the minimum confidence value in the X → Y association rule is 40%. Where the value of Support {X U Y} is a value that indicates the level of product possibility X and Y are bought simultaneously, while the confidence value indicates the level of trust or the possibility that consumers will buy product Y after purchasing product X.

Table 8: Iteration 4

Item	Support Count	Support
Riser, Hot Coffee, Hot Tea, Hazelnut Coffee	1	20%
Riser, Hot Coffee, Hot Tea, Scramble Egg	1	20%
Riser, Hot Coffee, Hot Tea, Waffle	1	20%
Hot Coffee, Hot Tea, Hazelnut Coffee, Scramble Egg	2	40%
Hot Coffee, Hot Tea, Hazelnut Coffee, Waffle	2	40%
Hot Tea, Hazelnut Coffee, Scramble Egg, Waffle	2	40%

Table 9: The Result of iteration 4

Item	Support Count	Support
Hot Coffee, Hot Tea, Hazelnut Coffee, Scramble Egg	2	40%
Hot Coffee, Hot Tea, Hazelnut Coffee, Waffle	2	40%
Hot Tea, Hazelnut Coffee, Scramble Egg, Waffle	2	40%

Table 10: Iteration 5

Item	Support Count	Support
Hot Coffee, Hot Tea, Hazelnut Coffee, Scramble Egg, Waffle	2	40%

The iteration process stops at the 5th iteration due to there is no longer a support value of less than 40%. So that, it can proceed to the association rule formation from the combination of items obtained in iteration 5 and confidence value calculation that shown on table 11.

Table 11: Confidence Value at The Association Rule

No	Item	B	A	Confidence
1	{Hot Coffee, Hot Tea, Hazelnut Coffee, Scramble Egg} → {Waffle}	40%	40%	100%

2	{Hot Tea, Hazelnut Coffee, Scramble Egg, Waffle} → {Hot Coffee}	40%	100 %	40%
3	{Hot Coffee, Hot Tea, Hazelnut Coffee, Waffle} → {Scramble Egg}	40%	60%	67%
4	{Hot Coffee, Hot Tea, Hazelnut Coffee} → {Scramble Egg, Waffle}	40%	40%	100%
5	{Waffle, Hot Tea, Hazelnut Coffee} → {Scramble Egg, Hot Coffee}	40%	60%	67%
6	{Waffle, Hot Coffee, Hazelnut Coffee} → {Scramble Egg, Hot Tea}	40%	60%	67%
7	{Waffle, Hot Coffee, Hot Tea} → {Scramble Egg, Hazelnut Coffee}	40%	40%	100%
8	{Waffle, Scramble Egg, Hazelnut Coffee} → {Hot Coffee, Hot Tea}	40%	80%	80%
9	{Waffle, Scramble Egg, Hot Tea} → {Hot Coffee, Hazelnut Coffee}	40%	60%	67%
10	{Hot Coffee, Scramble Egg, Hot Tea} → {Waffle, Hazelnut Coffee}	60%	40%	67%
11	{Scramble Egg, Hazelnut Coffee} → {Hot Coffee, Hot Tea}	40%	80%	50%
12	{Waffle, Hazelnut Coffee} → {Hot Coffee, Hot Tea}	40%	80%	50%
13	{Hot Tea, Hazelnut Coffee} → {Scramble Egg, Waffle}	40%	40%	100%
14	{Hot Tea, Hot Coffee} → {Scramble Egg}	80%	60%	75%
15	{Hot Tea, Hot Coffee} → {Waffle}	80%	40%	50%
16	{Hot Coffee, Hot Tea} → {Hazelnut Coffee}	80%	60%	75%
17	{Hot Tea, Scramble Egg} → {Waffle}	0%	0%	67%
18	{Hot Tea, Scramble Egg} → {Hazelnut Coffee}	60%	60%	100%
19	{Scramble Egg} → {Waffle}	60%	40%	67%
20	{Scramble Egg} → {Hot Coffee}	60%	100 %	60%
21	{Scramble Egg} → {Hot Tea}	60%	80%	75%
22	{Scramble Egg} → {Hazelnut Coffee}	60%	60%	100%
23	{Waffle} → {Hot Tea}	40%	80%	50%
24	{Waffle} → {Hazelnut Coffee}	40%	60%	67%
25	{Hot Coffee} → {Hot Tea}	100 %	80%	80%
26	{Hot Coffee} → {Hazelnut Coffee}	100 %	60%	60%
27	{Hot Tea} → {Hazelnut Coffee}	80%	60%	75%

The calculation results in table 11 show that there are twelve items set that meet the value minimum confidence (75%) in the X → Y association rule, that is, the item set with the confidence value be bolded.

4 CONCLUSIONS

There are 12 (twelve) association rules that meets the minimum confidence requirement with a confidence value of ≥75%, which is the rule Association number 1, 4 7, 8, 13, 14, 16, 18, 21, 22, 25, 27. As the example association rule number 22 shows that if the consumer buys menu {Scramble Egg}, then the possibility to buy menu {Hazelnut Coffee} is 100% and so on. So that management staff could manage marketing strategies by offering promo menu that contain two type cuisine according to the results of the discussion above for weekend promotion to increase competitive advantage.

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