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The Application of Fuzzy Association Rule on Co-Movement Analyze of Indonesian Stock Price

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Abstract

One type of investments in securities is stock as a sign of ownership for individual or corporation within a company. For making investment strategy and portfolio, investors should pay more attention to the co-movement of the stock price. Several methods can be used to see moving of the stock price, one of them is data mining. In this paper, association rule mining algorithm is used to find the stock movement relationship of inter-company in Indonesia. Fuzzy approach is used as tools to categorize data based on the time and transactions sequence. Experimental results show that association rule method can solve the problems. By using some values of minimum support, some strong association rules among companies can be obtained.

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Keywords: Co-Movement, Stock Price, Data Mining, Fuzzy, Association Rule;

1. Introduction

Investment is a commitment to money or other resources in order to obtain benefits in the future. One type of investments in securities is stock[2]. Stock is the most popular of financial market instruments. It can be defined as a sign of capital participation of a person or an enterprise in a company or a limited liability company[6]. The prediction of stock price is used to decide the future value of companies' stock or other financial instruments which are marketed in financial exchanges. One problem which is the most important in modern finance is how to find the way to visualize the data of stock market for investment decision. In order to create investment strategy and portfolio, investors should pay more attention to the movement of stock price[9].

Stock Price Index is an indicator or reflection of stock price movement. Index is a guidance for investors to do investment in capital market, especially stock[6]. Stock Price Index is used by investors as stock data to predict stock price soon. Nowadays, Indonesia Stock Exchange has 11 types of stock price index and 483 listed stocks, which spread continuously in both printed and electronic media. Jakarta Composite Index (JCI) is indicator of price changes

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from all stocks which are marketed in Indonesia Stock Exchange.

Rhee and Wang [8], in their study, elucidated that, from January 2002 to August 2007, roughly 70% of free-float value had been organized by foreign institutions in Indonesia Stock Exchange, or 41% of total market capitalization. During the period, liquidities in Jakarta Stock Exchange increased significantly with an average purchase price and selling price spread more than half and the average depth of more than two-fold. Henker and Husodo [15] also argued about the information related to shares traded on the Indonesia Stock Exchange that the quality of the market improved in 2004 by looking at the positive correlation of the ratio of the variance, so that it implied transaction risk level interconnected with increased superior information.

It also supported the data of shares development in Indonesia obtained from annual reports [7], which stated that JCI increase from 4,346.48 in early 2013 to the level of 5,214.98 on May 20^{th}, 2013, or it is equivalent to an increase of about 20.81% for five months. Factor expectations of waning economic outlook for Indonesia, the weakening rupiah and concerns about tapering off then pressed the stock market performance. This causes the stock index fell from 5,214 (the highest level) on May 20th, 2013 to 3,967 (the lowest level) on August 27^{th}, 2013, or declined by 31% for three months. Although JCI recorded a decline compared to the previous year, other indicators still show a positive development.

All this time, stock analysis presented in the form of quantitative data with methods of forecasting, to see the pattern of movement of a particular stock and movement patterns between stocks. One way to get interesting patterns is using tasks in data mining. Data mining is a process to discover patterns or information from large data [5]. The implementation of data mining in the process of analyzing the movement of stocks is expected to gather information in order to improve the efficiency to determine the next investment strategy. Based on previous research, Liao et al showed the correlation between stock price movements by mutual funds in terms of evaluating the movement of shares for each risk by using a classification method and Apriori algorithm to analyze correlation. From the result, the risk level of stock movement of a company tends to have more risk which means that when companies are at high risk, the investment companies is also high [9]. Furthermore, Liao and Chou [11] continued their study by applying data mining using association method and cluster with k-means algorithm to see the movement of the stock market in Taiwan and China, where the result can provide an alternative portfolio to investors, especially in Taiwan and China.

However, in some of the papers search association between parameters still used quantitative and to determine the relationship between the company needed a more specific categorization of the rise and fall of stock movement. In this paper we will be developed categorization process which is fuzzy. Several studies using fuzzy parameters in data mining, among others, Aprianti and Mukhlash for the classification of weather data [1], and Cheng with the fuzzy time series models that incorporate adaptive expectations models in the forecasting process for modifying the forecasting error [3].

Based on the aforementioned description, this study has analyzed the movement of stock prices in Indonesia by applying the association rule method with fuzzy approach: (1) analyzing the movement of stock prices by using fuzzy, (2) analyzing the relationship between companies on the stock price movement by using association rule, (3) The result of this study can be a recommendation to the investment portfolio and management as follow-up for referral.

2. Basic Concepts and Related Works

2.1. Association Rule Mining

Assume that $I = \{I_1, I_2, I_3, ..., I_n\}$ is a set of itemset. Let D, the relevant data in the data transactions where each transaction T is not empty in a itemset written $T \subseteq I$ for each transaction associated with the identifier, is called TID. Let A becomes a set of itemset. Transaction T is said to contain A if $A \subseteq T$ with the association rule is an implication of the form $A \Rightarrow B$, where $A \subset I$, $B \subset I$, $A \neq \phi$, $B \neq \phi$, and $A \cap B = \phi$. Rule $A \Rightarrow B$ on the transaction set D with the support, where s is the percentage of transactions in D that contains $A \cup B$ (i.e., the union of sets A and B say, or, both A and B). It is said to be an opportunity, $P(A \cup B)$. Rule $A \Rightarrow B$ has confidence in the transaction set D, where c is the percentage of transactions in D containing A which also contains B. It is taken as a conditional probability, $P(B|A)$, those are,

$$Support(A \Rightarrow B) = P(A \cup B) \tag{1}$$

$$Confidence(A \Rightarrow B) = P(A|B) \tag{2}$$

A set of items is called itemset. Itemset that contains k item is k-itemset. Suppose $\{computer, antivirus\_software\}$ is 2-itemset. The frequency of occurrence of an itemset is the number of transactions containing the itemset. It is also known as simple, such as frequency, support count, or count of the itemset. It can be seen that support itemset is defined in equation (1) which is referred to this as the relative support, while the frequency of occurrence is called absolute support. If the relative support of an itemset I meets a minimum support threshold which has been specified (absolute support of I meet appropriate minimum support count threshold), then I is a frequent itemset. k-itemset is generally denoted by Lk of equation (3) we have,

$$confidence(A \Rightarrow B) = \frac{support(A \cup B)}{SupportA} = \frac{support\_count(A \cup B)}{support\_count(A)} \tag{3}$$

Equation (3) shows that the confidence rule $A \Rightarrow B$ can be easily obtained from a number of support A and $A \cup B$, further support counts of A, B and $A \cup B$ in order to obtain the corresponding association rules $A \Rightarrow B$ and $B \Rightarrow A$, and to examine each strength. Thus, the problem of mining association rules can be reduced by frequent itemset mining. To explore the association rules, many researchers use the Apriori algorithm[4].

In this study, Weka is used as a data mining tool for analysis. Weka is an abbreviation of Waikato Environment for Knowledge Analysis, which was made at the University Waikato[13]. Weka is a software tools that include several machine learning algorithms that can be applied to solve data mining problems. Weka is based on GUI (Graphical User Interface) and can be used to integrate new methods made itself with some provisions.

Apriori algorithm: (Han & Kamber, 2006)
Input:
D, transaction database
Min_sup, minimum support threshold

Output: L, frequent itemsets D
Method:

(1) $L_1 = find\_frequent\_1 - itemsets(D);$
(2) **for**$(k = 2; L_{k-1} \neq \emptyset; k++)\{$
(3) $C_k = apriori\_gen(L_{k-1});$
(4) **for each** *transaction* $t \in D\{$ *//scan D for counts*
(5) $C_t = subset(C_k, t);$ *//get the subsets of t that are candidates*
(6) **for each** *candidate* $c \in C_t$
(7) $c.count++;$
(8) $\}$
(9) $L_k = \{c \in C_k | c.count \geq \min\_sup\}$
(10) $\}$
(11) *return* $L = \cup_k L_k;$

Fig. 1. Apriori algorithm

2.2. *Fuzzy Sets*

Lotfi A. Zadeh (1965) introduced the fuzzy set for the first time as a mathematical way to present inaccuracies. If X is a set of objects which are denoted by x, the set of fuzzy A in X is the set of pairs in sequence:

$$A = \{(x, \mu_A(x))|x \epsilon X)\} \tag{4}$$

$\mu_A(x)$ is called the function / degree of membership or membership level (also the level of suitability or truth level) of x in A which maps X membership universe space M (when M only contains two points 0 and 1, then A is not fuzzy

and $\mu_A(x)$ is identical to the characteristic function of the set of non-fuzzy). Range of membership function is a subset of the real numbers that have limited supremum. Members with zero degrees of membership are generally not listed or mentioned.

Linguistic variable is a fuzzy variable that is made as reference to assess a given case. For example, the linguistic variable "age" has three assessment or linguistic terms: young, mature and old, each of which has its own membership functions.

Membership function (MF) is a function that shows the mapping of points of data input into the degree of membership, such as triangular, trapezoidal, Gaussian, and others[14]. The membership function curve representation triangle is basically a combination of two lines (linear). As shown in Figure 2:

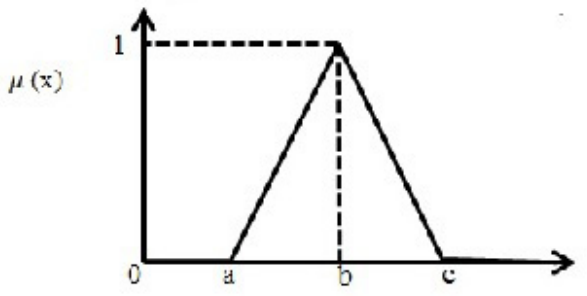

Fig. 2. Triangular Fuzzy Number

Membership function :

$$\mu(x) = \begin{cases} 0;\ x \le a \text{ or } x \ge c \\ \dfrac{x-a}{b-a};\ a \le x \le b \\ \dfrac{b-x}{c-b};\ b \le x \le c \end{cases} \tag{5}$$

2.3. Related Works

Liao et al[12], investigated problems about stock market investments in the Taiwan by using a two-stage data mining approach. The first phase of Apriori algorithm is a methodology of association rule, which is implemented and describes patterns of association to categorize stocks and share investment categories. This study used 19 stock indices in Taiwan engaged in various systems by using SPSS Clementine to see the support and confidence of the stock index in Taiwan. Then the K-means cluster algorithm implemented to explore the stock cluster to categorize stocks as investment information. With the results of the association conducted, there were two clusters with increasing and not increasing movement. The next phase is to investigate the correlation between stock market in Taiwan and the international stock markets. With the support value of 80% on the cluster which increases, it can be seen that the Taiwan stock market has a higher degree of correlation of the three countries.

Liao et al[9], analyzed the movement of stock market in Taiwan by looking at risk. This study used 58 shares which were normalized by using "0" as the down category and "1" as the up category. By using a star schema, mutual funds are classified based on the standard deviation. Apriori algorithm is used to categorize low-risk stocks, medium and high. To conclude, in any given risk level, the performance of at least seven stocks indicates high movement system. This study also showed the influence of the global economy on the correlations between the different funds.

Hoon Na and Sohn[?], analyzed the association rules to predict the changes of Composite Stock Price Index in Korea (KOSPI) based on time series data from around the world interconnected with stock market indices. The data used is the daily close data by looking at the movement of Korean stocks and comparing to 7 international stock indices. Association used can be seen that KOSPI tends to move in the same direction as the stock market indices in

the United States and Europe, while it moves in the opposite direction to those in East Asian countries, such as Hong Kong and Japan, which has a competitive relationship with Korean.

Liao et al[10], examined the movement of both foreign exchange rates and stock index categories in Taiwan stock market. By involving 13 currency exchange rates and 30 stocks based on the its sector, they used a star schema and SPSS Clementine. The role of association rule is to look at the correlation between the foreign exchange and Taiwan stock, so that the result of the study shows that the currency with the same region was correlated each other. Currency rates are categorized as high in developing country that have good stability. This study illustrates that there was no strong correlation between stocks which were categorized within the foreign exchange sector.

Cheng[3], argued that fuzzy time series model combines adaptive expectation models in the prediction process to modify the error prediction. By using actual trading data from Taiwan Stock Index (TAIEX), then evaluated the accuracy of the proposed model by comparing the estimation and the Chen's research (Chen. SM, 1996). The prediction was based on fuzzy time-Series, Fuzzy Sets and Systems. The comparison showed that the model used is better in terms of accuracy suggested by Chen and Yu.

3. Methodology

The data used in this research is data of 10 the best stock companies incorporated in the Jakarta Composite Index (JCI) downloaded from yahoo finance in the form of data for 5 years from on 4st January 2010 to 30st December 2014 which is monitored every day. The data obtained is close data at the history stock price per day. In this study, we explored the correlation among the companies on the stock co-movements in Indonesia by applying the method of association rule, that is Apriori algorithm with fuzzy parameters (Fuzzy Based Apriori). Linguistic variables for stock price increase expressed by high, medium and low. Similarly to stock price decrease. Research framework in this study is shown by figure 3.

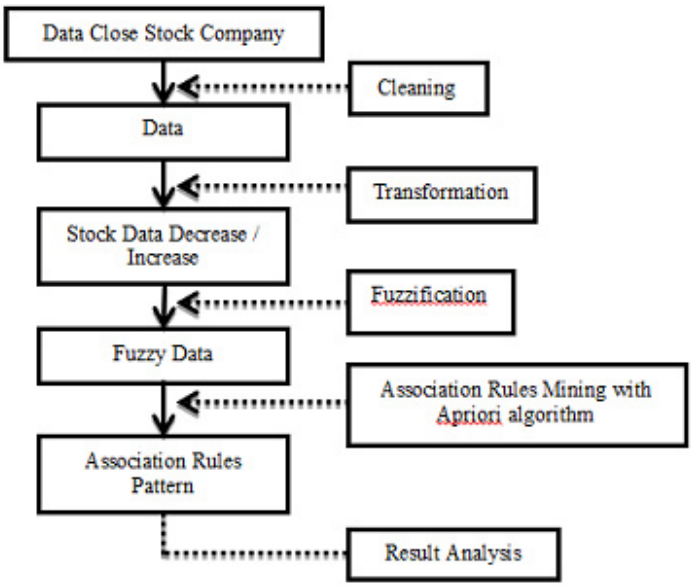

Fig. 3. Framework of Research

4. Result and Discussion

This study uses close price history data for 5 years at 10 companies in Indonesia, as shown in Table 1.

Table 1. Data Close of Stock Price.

Date	A_1	A_2	A_3	A_4	...	A_9	A_10
1	5,050.00	153.00	11,050.00	9,550.00	⋯	2,300.00	23,850.00
2	5,100.00	153.00	11,400.00	9,600.00	⋯	2,300.00	24,200.00
3	4,950.00	150.00	11,300.00	9,500.00	⋯	2,300.00	24,100.00
4	4,975.00	150.00	11,100.00	9,250.00	⋯	2,350.00	25,050.00
5	4,850.00	150.00	11,150.00	9,350.00	⋯	2,350.00	25,250.00
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1283	13,150.00	301.00	31,950.00	2,850.00	⋯	1,095.00	23,750.00
1284	13,125.00	299.00	32,300.00	2,865.00	⋯	1,065.00	24,250.00

The first step is cleaning process by removing the noise data and sorting them by time. Then the data is converted into a percentage (see Table 2). So that the data can be a mining, the data in the form of percentage are transformed by combining the data.

Table 2. Data and Percentage of Exchange Stock.

No	Date	K_1	P_1	K_2	P_2	K_3	P_3	...	K_10	P_10
1	4-Jan-10	increase	5.26	increase	10.34	increase	4.26	...	increase	15.21
2	5-Jan-10	decrease	18.75	decrease	8.57	decrease	1.17	...	decrease	5.00
3	6-Jan-10	increase	2.63	stable	0.00	decrease	2.35	...	increase	41.30
4	7-Jan-10	decrease	15.62	stable	0.00	increase	0.60	...	increase	8.69
5	8-Jan-10	increase	5.26	increase	3.44	increase	1.21	...	decrease	15.00
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	...	⋮	⋮
1283	29-Des-14	decrease	6.25	decrease	8.57	increase	5.18	...	increase	19.56
1284	30-Des-14	decrease	3.12	decrease	5.71	increase	4.26	...	increase	21.73

Before applying the Apriori algorithm, all of the attributes are converted into categorical data using fuzzy approach. The use of fuzzy in this data is to categorize the data in order to facilitate the process of finding association rule in looking at stock movement patterns. Process of fuzzification using triangular curve consisting of three linguistic values i.e. low, medium and high. Further, the determination of membership function based on the likert scale rules as follows:

$$\mu_{Low} = \begin{cases} 1, & x \leq 25 \\ \dfrac{33,3 - x}{33,3 - 25}, & 15 < x < 33,3 \\ 0, & x > 33,3 \end{cases} \tag{6}$$

$$\mu_{Medium} = \begin{cases} 0, & x < 33,3 \\ \dfrac{x - 25}{50 - 25}, & 25 < x < 50 \\ \dfrac{66,6 - x}{50 - 25}, & 50 < x < 66,6 \\ 0, & x > 66,6 \end{cases} \tag{7}$$

$$\mu_{High} = \begin{cases} 0, & x > 66,6 \\ \dfrac{x - 66,6}{75 - 66,6}, & 66,6 < x < 75 \\ 1, & x > 75 \end{cases} \tag{8}$$

Where the variable x is the percentage of stock price changes at the time (k) and (k-1). This formula is applied to stock changes up and down. After the fuzzification process, the result obtained is shown the following table.

Table 3. Fuzzification Result.

Date	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
T1	A1_LI	A2_LI	A3_LI	A4_LI	A5_LI	A6_LI	A7_LI	A8_LI	A9_S	A10_LI
T2	A1_LD	A2_LD	A3_LD	A4_LD	A5_LD	A6_LD	A7_LI	A8_LI	A9_S	A10_LD
T3	A1_LI	A2_S	A3_LD	A4_LD	A5_LD	A6_LD	A7_LD	A8_LD	A9_LI	A10_MI
T4	A1_LD	A2_S	A3_LI	A4_LI	A5_LI	A6_LI	A7_LD	A8_LD	A9_S	A10_LI
T5	A1_LI	A2_LI	A3_LI	A4_LI	A5_LI	A6_LI	A7_LI	A8_LI	A9_LD	A10_LD
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
T1283	A1_LD	A2_LD	A3_LI	A4_LI	A5_LI	A6_LD	A7_LI	A8_MI	A9_LI	A10_LI
T1284	A1_LD	A2_LD	A3_LI	A4_LI	A5_LI	A6_LI	A7_LI	A8_LD	A9_LD	A10_LI

In Table 3, attributes of the 10 company's stocks can be written as $A = \{A_1, A_2, \cdots, A\_10\}$. The movement of stock price in the data fuzzification is divided into 7 categories: Low Decrease (LD), Medium Decrease (MD), High Decrease (HD), Low Increase (LI), Medium Increase (MI), High Increase (HI) and (S) is "Stable". The stock increase or decrease, is categorized as low if the value of x is between 0 and 33.3 percent, medium if the value of x is between 33.3 and 66.6 percent, and high if it is between 66.6 and 100 percent.

Furthermore, Apriori association rule algorithm is applied to the data in Table 3 resulting rules as shown in Figure 4. In this case we do not see the quantitative value of the stock price but qualitative data that illustrate the interconnectedness of the company on the stock movement patterns.

From the result, we find some best rules with minimum support 0.1, 0.07, and 0.06.

1. $A1 = A1\_LD\ A7 = A7\_LD\ A9 = A9\_LD\ 134 \Rightarrow A5 = A5\_LD\ 102$ conf:(0.76)
2. $A5 = A5\_LD\ A7 = A7\_LD\ A8 = A8\_LD\ 123 \Rightarrow A9 = A9\_LD\ 91$ conf:(0.74)
3. $A1 = A1\_LD\ A2 = A2\_LD\ A9 = A9\_LD\ 126 \Rightarrow A5 = A5\_LD\ 92$ conf:(0.73)
4. $A3 = A3\_LI\ A9 = A9\_LI\ A10 = A10\_LI\ 142 \Rightarrow A5 = A5\_LI\ 102$ conf:(0.72)
5. $A1 = A1\_LD\ A4 = A4\_LD\ A5 = A5\_LD\ 138 \Rightarrow A3 = A3\_LD\ 95$ conf:(0.69)
6. $A6 = A6\_LD\ A9 = A9\_LD\ A10 = A10\_LD\ 114 \Rightarrow A5 = A5\_LD\ 87$ conf:(0.76)
7. $A1 = A1\_LD\ A9 = A9\_LD\ A10 = A10\_LD\ 104 \Rightarrow A5 = A5\_LD\ 79$ conf:(0.76)
8. $A1 = A1\_LI\ A4 = A4\_LI\ A9 = A9\_LI\ 105 \Rightarrow A5 = A5\_LI\ 78$ conf:(0.74)
9. $A3 = A3\_LI\ A6 = A6\_LI\ A10 = A10\_LI\ 113 \Rightarrow A5 = A5\_LI\ 83$ conf:(0.73)
10. $A9 = A9\_LI\ A10 = A10\_LI\ 232 \Rightarrow A5 = A5\_LI\ 159$ conf:(0.69)
11. $A1 = A1\_LI\ A10 = A10\_LI\ 238 \Rightarrow A5 = A5\_LI\ 163$ conf:(0.68)
12. $A7 = A7\_LI\ A10 = A10\_LI\ 218 \Rightarrow A5 = A5\_LI\ 149$ conf:(0.68)
13. $A1 = A1\_LI\ A9 = A9\_LI\ 232 \Rightarrow A5 = A5\_LI\ 158$ conf:(0.68)
14. $A4 = A4\_LI\ A10 = A10\_LI\ 203 \Rightarrow A5 = A5\_LI\ 146$ conf:(0.72)
15. $A6 = A6\_LI\ 10 = A10\_LI\ 179 \Rightarrow A5 = A5\_LI\ 127$ conf:(0.71)
16. $A2 = A2\_LI\ A10 = A10\_LI\ 189 \Rightarrow A3 = A3\_LI\ 126$ conf:(0.67)
17. $A1 = A1\_LI\ A6 = A6\_LI\ 172 \Rightarrow A5 = A5\_LI\ 116$ conf:(0.67)
18. $A3 = A3\_LI\ A9 = A9\_LI\ 256 \Rightarrow A5 = A5\_LI\ 170$ conf:(0.66)
19. $A1 = A1\_LI\ A2 = A2\_LI\ 191 \Rightarrow A3 = A3\_LI\ 125$ conf:(0.65)
20. $A2 = A2\_LD\ A8 = A8\_LD\ 211 \Rightarrow A9 = A9\_LD\ 158$ conf:(0.65)

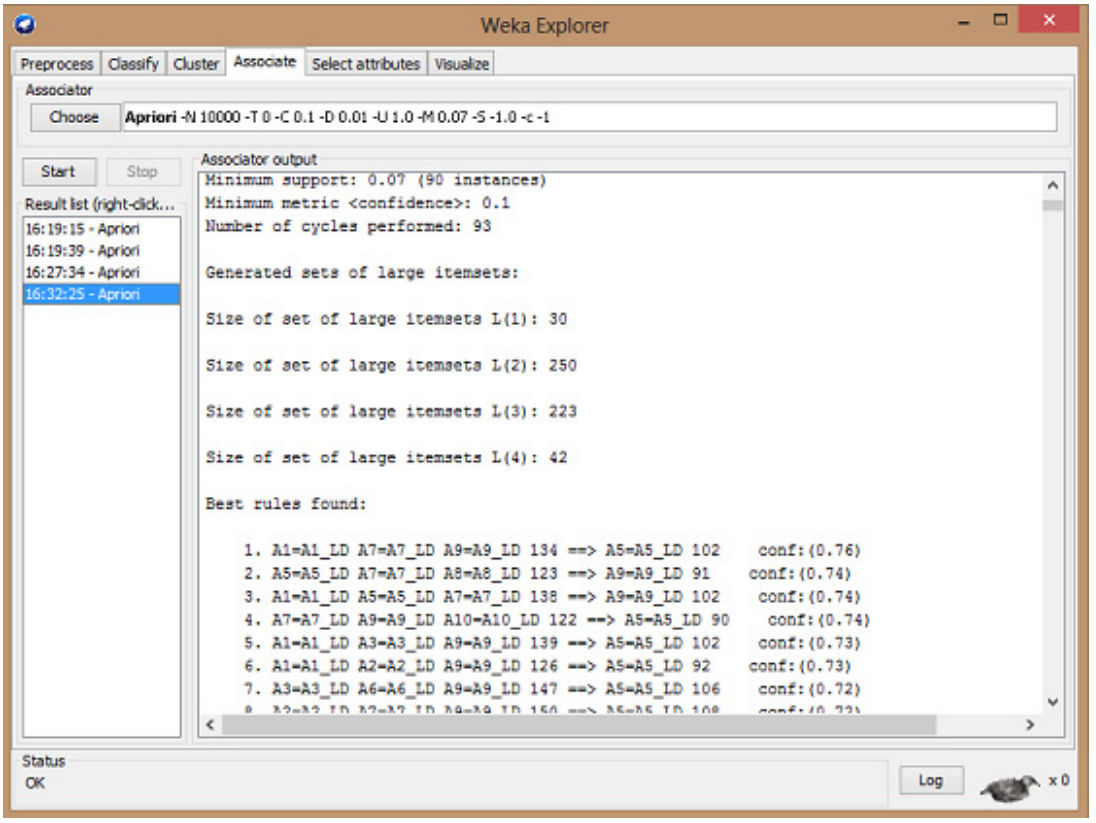

Fig. 4. Rules of Stock Movements min_{sup}= 0.07

21. $A6 = A6\_LI\ 362 \Rightarrow A5 = A5\_LI\ 214$ conf:(0.59)
22. $A10 = A10\_LD\ 462 \Rightarrow A5 = A5\_LD\ 266$ conf:(0.58)
23. $A1 = A1\_LD\ 417 \Rightarrow A3 = A3\_LD\ 239$ conf:(0.57)
24. $A7 = A7\_LD\ 480 \Rightarrow A5 = A5\_LD\ 275$ conf:(0.57)
25. $A2 = A2\_LI\ 393 \Rightarrow A3 = A3\_LI\ 225$ conf:(0.57)
26. $A9 = A9\_LI\ 451 \Rightarrow A5 = A5\_LI\ 279$ conf:(0.62)
27. $A10 = A10\_LI\ 508 \Rightarrow A5 = A5\_LI\ 303$ conf:(0.6)
28. $A1 = A1\_LI\ 502 \Rightarrow A5 = A5\_LI\ 298$ conf:(0.59)
29. $A4 = A4\_LI\ 435 \Rightarrow A5 = A5\_LI\ 258$ conf:(0.59)
30. $A1 = A1\_LI\ 502 \Rightarrow A3 = A3\_LI\ 297$ conf:(0.59)
31. $A1 = A1\_LD\ 417 \Rightarrow A3 = A3\_LD\ 239$ conf:(0.57)
32. $A7 = A7\_LD\ 480 \Rightarrow A5 = A5\_LD\ 275$ conf:(0.57)
33. $A7 = A7\_LD\ 480 \Rightarrow A3 = A3\_LD\ 270$ conf:(0.56)
34. $A4 = A4\_LI\ 435 \Rightarrow A3 = A3\_LI\ 241$ conf:(0.55)

This experiment used the minimum support 0.1, 0.07 and 0.06 obtained some rule that shows the relationship between the movement of stock price of the many companies. Rule 1 with 3-large itemset which can be seen if stock price of company $A10$, $A7$ and $A9$ decreases low then stock price of $A5$ is also decreases low movement with confidence value is 0.76. Rule 2 show that if the company $A5$, $A7$, and $A8$ indicates the decrease low is movement then company $A9$ is also associated with a low increase movement with confidence value is 0.74. Rule 10 with 2-large itemset which can be seen if stock price of company $A9$ and $A10$ increases low then stock price of $A5$ is also increases low movement with confidence value is 0.69. Rule 16 show that if the company $A2$ and $A10$ indicates the increase low

is movement then company $A3$ is also associated with a low increase movement with confidence value is 0.67. Rule 21 with 1-large itemset which can be seen if stock price of company $A6$ increases low then stock price of $A5$ is also increases low movement with confidence value is 0.59. Rule 23 show that if the company $A1$ indicates the decrease low is movement then company $A3$ is also associated with a low increase movement with confidence value is 0.57 etc.

5. Conclusion

This paper has discussed about Apriori algorithm on the association rule to obtain the rules of stock movement between the companies. Rules are obtained by carrying out the categorization process of data attributes with fuzzification. Furthermore, by using the software, data mining is performed by the association rule mining with Apriori algorithm.

Experimental results show with the minimum support parameters of 0.1, 0.07, and 0.06 the association with between the company's stock co-movement. In the unique patterns of interest e.g. a particular company's stock price increases along with the rise and fall of another company's shares. This means that the application of the algorithm to obtain the association rules of stock price movements to see the relationship between the company effective to look at the main linkage of data on a large scale.

The next research, we will be applied method of sequence pattern with a fuzzy approach to determine the sequence pattern of stock price movements in Indonesia.

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