



Research Paper

Leading Stock Repurchase Patterns with Implementation of Association Rule Mining Onthe Indonesian Stock Exchange

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Abstract

Many issuing companies offer their shares to the public in various ways with the aim of attracting the public's attention to buy their shares. This research was conducted to describe stock movements from the perspective of the information technology field. All issuers in the research are listed on the BEI (Indonesian Stock Exchange) which have been classified into 9 stock sectors according to industry classification. The aim of this research is to see the best stock movements (dominant positive movements) by looking at the stock relationship between issuers and also the relationship with the Composite Stock Price Index (IHSG), where this relationship can move positively (*p*), negatively (*n*) or equal (*e*). The sample used was by selecting 18 issuer companies from share movements over 3 years (2020 - 2022) which were selected using the sampling method used was the purposive sampling method (judgment sampling), namely 9 companies with the largest share value and 9 issuers with the smallest share value. from each stock sector. The analysis technique uses Association Rule Mining (ARM) with the Apriori algorithm and the WEKA 3.6.10 application program. To see the relationship between issuers and IHSG by looking at support (the level of frequency it appears) and confidence (the level of confidence in the existence of a relationship). The category value shows a relationship that is in the same direction (positive), inverse (negative) or there is no change in the value of other shares (equal). The research results show that there are shares that are dominant and moving positively, so that they can be considered as investments by potential investors. Shares associated with the group of large value shares with a confidence value of more than 95 percent and support of 10% are ASII, BHIT and BNII, and for small value shares with support of 30% are ARTA, RIMO, KICI and KARW.

Keywords — Indonesian Stock Exchange, Association Rule, Apriori algorithm

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I. INTRODUCTION

Many issuing companies offer shares in various attractive ways and methods, which are able to lull potential investors by providing confidence that the shares they offer will grow positively. All of this is packaged attractively using statistical models, graphs and tables that describe past, present and future stock movements, as done by (Putu et al., 2018) through simulation data using an a priori algorithm, whereas (Prayitno, 2015) (Cahyati, 2023) proposed how to predict stock prices using neural network algorithms and also (Fitriyani, 2016) put forward a Fuzzy algorithm with a clustering model in predicting the price of a share. So that investors

can see stock movements from current and future business activities with various application models offered, whether development is rapid, normal or even slow. For public companies (Tbk) which generally have many subsidiary companies, to grow and develop of course requires quite a large amount of capital. One way to get this capital is from the sale of shares, as stated by SuadHusnan regarding share management.(Fitriyani, 2016).

The Jakarta Stock Exchange (BEI) is a means for companies trading their shares that brings together share sellers (issuers) and share buyers (investors). The Indonesian Stock Exchange manages the capital market(Arliman S, 2017)is a means of funding for companies and other institutions (for example the government), and also as a means for investment activities. Fluctuations in the price of traded shares are of course related to the health of the company in managing its finances. If the company grows well, it is usually followed by share prices growing (positive), conversely, if the company being traded is responded negatively by the market, the share price usually decreases (negative). or there are shares that in a certain period have a stagnant / not moving (equal) share price, as stated(Candy & Winardy, 2018). Even though there are many illustrations of the disadvantages of investing in shares, quite a few investors also experience large profits from investing in sharesinvestors need as complete information as possible from the issuers who will become their partners, using various information media, asking questions here and there, attending various seminars or using reliable analysts who are able to describe the technical complexity of doing stock business, making it easy to understand and interesting, so that investors become confident in investing and choosing one or more issuers,(Hamzah et al., 2021).

The capital market is the place of choice for investors, because many offer cooperation in capital participation by buying shares, where issuers provide the hope of quite large profits from ongoing business growth.(Candy & Winardy, 2018). More than 500 issuer companies offer their shares and transact on the Indonesia Stock Exchange (BEI) every day. The various information on stock movements presented is interesting and gives hope of big profits(Cahyati, 2023).

Generally research is formulated using an economics approach, the author will examine stock movements using a management information systems approach. Computer capabilities through certain application systems, are able to carry out data analysis, summarize and extract very large amounts of data into useful knowledge, which would not be possible if handled conventionally,(Cahyati, 2023). Data mining is an example of a scientific discipline that studies methods for extracting knowledge or finding patterns from a collection of databases, which are able to provide important information that is implicit in nature from a collection of databases that are increasing in number over the years.(Putra et al., 2018), and has never previously been discovered by conventional systems. Data mining is also commonly referred to as knowledge discovery in data bases (finding knowledge from databases), in a way that includes collecting, using data, history of data relationship patterns, and relationships in large data sets.(Istianingsih& Defit, 2021). With this rule, an associative relationship can be found between share data from various issuers that transact with the two guidelines used in the association rule,(Science, 2021), namely generating a value for the level of confidence (confidence level) from this relationship and which often appears from data on shares in transactions (support). The support value of an item is obtained using the formula: Meanwhile, the support value of 2 items is obtained from the following formula:

$$\text{Support A} = \frac{\sum \text{Transaction containing A}}{\sum \text{Number of Transactions}} \times 100\%$$

The confidence value of rule $A \rightarrow B$ is obtained from the following formula:

$$\text{Confidence } A \rightarrow B = \frac{\sum A \cap B}{\sum A} \times 100 \%$$

Data is a collection of characters that do not yet have meaning for the user, while knowledge is patterns, rules or models that emerge from data. An example of a data pattern is the up and down movement of stock prices which change all the time. Data mining provides information as a basic guide to potential investors for-

This research is limited to stock price movements over 3 years (2020 - 2022) on the Indonesia Stock Exchange (BEI). Stock price movements are marked with several symbols, if they are up (P), down (N) or equal (E), and these symbols are then referred to as categories. The stocks studied in 9 stock sectors have good and profitable stock investment choices. The method that is able to describe stock price movements and IHSG using data mining is using Association Rule Mining (ARM) and the a priori algorithm.

In general, the algorithm used for stock price movements and to predict future stock prices, namely the neural network algorithm, and the weakness of this algorithm is that in its application it cannot be used as a precise tool for predicting stock prices, so researchers do it from the other side, namely from the relationship

between shares that move together (associate). To see the stock price movements of many issuers that are related and related, use the a priori algorithm, where so far researchers have not found another algorithm that can describe the stock price movements of many issuers in a related way, and the weakness of this a priori algorithm is that it still has to be processed. again by other applications to be used to make decisions in stock selection. Scope of problem

This research is limited to stock price movements over 3 years (2020 - 2022) on the Indonesia Stock Exchange (BEI). Stock price movements are marked with several symbols, if they are up (P), down (N) or equal (E), and these symbols are then referred to as categories. The shares studied in 9 stock sectors totaled 18 issuers, which actually amounts to around 500 issuers. The shares selected are 9 shares with the highest share prices and 9 shares with the lowest prices from each share sector and also look at their relationship with price movements from the Composite Stock Price Index (IHSG).

II. METHOD

In the research carried out, the data used is data sourced from the BEI (Indonesian Stock Exchange or Indonesia Stock Exchange (IDX) which can be accessed via the internet. The shares of listed companies on the BEI (Indonesian Stock Exchange) total around 500 shares which are divided into 9 stock sectors, Based on the number of stock sector divisions on the BEI (Indonesian Stock Exchange), research was conducted on 18 stocks and the value on the IHSG, where the shares were selected from 9 stock sectors, where each stock sector was represented by 2 issuers by selecting from each sector the one the share value is the largest and the smallest, as depicted in the table below.

Table 2. High value stocks

No	Company name	Code	Sector
1	Astra International Tbk.	ASII	Other industries
2	MNC InvestamaTbk	BHIT	Trade, services and investment
3	Bank International Indonesia Tbk	BNII	Finance
4	PP London Sumatra Indonesia Tbk	LSIP	Agriculture
5	Energi Merge PersadaTbk	ENRG	Mining Materials
6	Kalbe FarmaTbk	KLBF	Industrial products for consumption
7	PakuwonJatiTbk	PWON	Property, Real Estate & Building Construction
8	SekawanIntiPratamaTbk	READY	Basic industry and chemicals
9	Telekomunikasi Indonesia Tbk	TELKOM	Transportation, Infrastructure and Utilities

Table 3. Small value shares

No	Company name	Code	Sector
1	Astra Agro Lestari Tbk.	AALI	Finance
2	ArthavestTbk.	ARTA	Finance
3	CTSI Prima Services Tbk.	KARW	Transportation, Infrastructure and Utilities
4	Kedaung Indah Can Tbk	KETCH	Industrial products for consumption
5	LippoCiakrangTbk.	LPCK	Property, Real Estate & Building Construction
6	Multi Prima Sejahtera Tbk.	LPIN	Other industries
7	PerdanaKarya Perkasa Tbk.	PKPKB	Mining Materials
8	RimoCatur Lestari Tbk.	RIMO	Trade, services and investment
9	YanaprimaHastapersadaTbk	YPAS	Basic industry and chemicals

The stages that will be taken are:

1. Preparation.
2. Data collection.
3. Data mining processing. The data collected is processed according to the Knowledge Discovery in Database (KDD) stages.
4. Results and Discussion. The discussion at this stage explains the results of the data mining process which was carried out using an a priori algorithm.
5. Conclusions and recommendations. Make conclusions from research results and provide suggestions for the library so that it can be even better.

III. RESULTS AND DISCUSSION

Data set 1 (first) Testing the value of the largest shares in each sector plus the IHSG value, to produce an optimal confidence value is carried out by changing the vulnerable values of the two variables contained in the a priori algorithm, namely Minimum Support and Minimum Metric (Confidence).

Table 4. Testing Data set 1

Minimum support: 0.2 & Minimum metric (confidence): 0.65 & Rules: 15		
No	Rules	Conf
1	BHIT=E 269 ==> READY=E 192	0.71
2	JKSE=N 327 ==> READY=E 231	0.71
3	LSIP=N 299 ==> READY=E 210	0.7
4	BNII=E 303 ==> READY=E 211	0.7
5	ASII=N 326 ==> READY=E 227	0.7
6	PWON=E 256 ==> READY=E 177	0.7
7	KLBF=P 291 ==> READY=E 200	0.69
8	PWON=N 249 ==> READY=E 171	0.69
9	JKSE=P 402 ==> READY=E 273	0.68
10	PWON=P 261 ==> READY=E 177	0.68
11	PWON=N 249 ==> ENRG=N 168	0.67
12	ENRG=P 283 ==> READY=E 190	0.67
13	BHIT=P 240 ==> READY=E 161	0.67
14	BHIT=N 257 ==> READY=E 172	0.67
15	BNII=N 250 ==> READY=E 167	0.67

In this test, a minimum support of 0.2 or equal to 20% is used, which means that the percentage of itemset appearances in the table that forms the rule is less than or equal to 20% of all the data used in this simulation. In table 4 there are 15 rules that describe the relationship between shares and IHSG. For example, rule number 2 shows that the IHSG value fell 327 times, followed by SIAP shares with the same value 231 times, resulting in a confidence value of 0.71, which means that 71% of SIAP shares appeared with a fixed value (E) from the movement. contains IHSG shares with a decreasing value (N). Another example in rule number 7 shows KLBF shares with an increasing value (P) of 291, followed by SIAP shares with a fixed value (E) of 200, resulting in a confidence value of 0.71, which means that 69% of SIAP shares appear with a fixed value (E) from movements containing KLBF shares with an increasing value (P). The appearance of these stocks is 20% of all existing databases, the higher the confidence and support values that appear, the stronger the data can be said to be used as a basis for investors' consideration in choosing stocks that perform well. Data set 2 (second) Stock value testing is carried out with the smallest stock value in each sector plus the IHSG value, to produce an optimal confidence value, this is done by changing the vulnerable values of the two variables contained in the a priori algorithm, namely the Minimum Support used, 0, 25 and Minimum Metric (Confidence) is 0.65 with a rule of 20 which can be seen in the table below:

Table 5. Testing Data set 2

Minimum support: 0.25 & Minimum metric (confidence): 0.70 & Rules: 20		
No	Rules	Conf
1	ARTA=E KICI=E RIMO=E 286 ==> KARW=E 281	0.98
2	ARTA=E RIMO=E 329 ==> KARW=E 305	0.93
3	ARTA=E KARW=E RIMO=E 305 ==> KICI=E 281	0.92
4	KARW=E RIMO=E 366 ==> KICI=E 332	0.91
5	KICI=E RIMO=E 372 ==> KARW=E 332	0.89
6	ARTA=E KICI=E 392 ==> KARW=E 349	0.89
7	ARTA=E RIMO=E 329 ==> KICI=E 286	0.87
8	ARTA=E RIMO=E 329 ==> KARW=E KICI=E 281	0.85
9	ARTA=E KARW=E 411 ==> KICI=E 349	0.85
10	KARW=E KICI=E RIMO=E 332 ==> ARTA=E 281	0.85
11	RIMO=E 441 ==> KICI=E 372	0.84
12	KARW=E RIMO=E 366 ==> ARTA=E 305	0.83
13	RIMO=E 441 ==> KARW=E 366	0.82
14	KARW=E KICI=E 427 ==> ARTA=E 349	0.82
15	KARW=E 527 ==> KICI=E 427	0.81
16	ARTA=E 510 ==> KARW=E 411	0.81
17	ARTA=E KARW=E KICI=E 349 ==> RIMO=E 281	0.8
18	JKSE=P KARW=E 257 ==> KICI=E 206	0.8
19	KICI=E 535 ==> KARW=E 427	0.8
20	KARW=E 527 ==> ARTA=E 411	0.78

In this test, a minimum support of 0.25 or equal to 25% is used, which means that the percentage of itemset occurrences in the table that forms the rule is less than or equal to 25% of the entire database used in this simulation. In table 4.6 there are 20 rules that describe the relationship between shares and IHSG, where the number of rules states that of all existing rules, the percentage of occurrence of rules like the table above is 25%. For example, rule number 1 shows that the value of ARTA, KICI and RIMO shares remains fixed (E) at 286 times, followed by KARW shares with a fixed value also (E) at 281 times, resulting in a confidence value of 0.98, which means 98%. the emergence of KARW shares with a fixed value (E) from movements containing

ARTA, KICI and RIMO shares which are also equal. For another example that illustrates the rule that contains the value of IHSG shares (share code JKSE) against other shares shown in rule 18, namely if JKSE shares rise as indicated by the P category and KARW shares by 257 times, this will be followed by KICI shares which have the same value. shown in category E 206 times, resulting in a confidence value of 0.8 or 80%. There are 25% occurrences of examples of these two rules from all existing databases. Data set 3 (third) The third test uses stock data which has a combined stock value of the largest and smallest values, with the total of 18 stocks plus the IHSG value movement being 19 stock value movements in the same period (3 years). The minimum support value used is 0.1, and the minimum metric (confidence) used is 0.65 and the number of rules sought is 50 which can be seen in the table below:

Table 6. Testing Data set 3

Minimum support: 0.1 & Minimum metric (confidence): 0.65 & Rules: 20		
No	Rules	Conf
1	ASII=P ARTA=E KICI=E RIMO=E 127 ==> KARW=E 126	0.99
2	ARTA=E KICI=E LPIN=E RIMO=E 122 ==> KARW=E 121	0.99
3	ARTA=E LPIN=E RIMO=E 133 ==> KARW=E 131	0.98
4	ARTA=E KICI=E RIMO=E 286 ==> KARW=E 281	0.98
5	READY=E ARTA=E KICI=E RIMO=E 152 ==> KARW=E 149	0.98
6	BNII=E ARTA=E KICI=E RIMO=E 122 ==> KARW=E 119	0.98
7	ENRG=N ARTA=E KICI=E RIMO=E 121 ==> KARW=E 118	0.98
8	JKSE=P ARTA=E KICI=E RIMO=E 137 ==> KARW=E 132	0.96
9	JKSE=N ARTA=E RIMO=E 131 ==> KARW=E 126	0.96
10	PWON=E ARTA=E KICI=E 132 ==> KARW=E 126	0.95
11	BHIT=E ARTA=E RIMO=E 124 ==> KARW=E 118	0.95
12	BNII=E ARTA=E RIMO=E 135 ==> KARW=E 128	0.95
13	KICI=E LPIN=E RIMO=E 144 ==> KARW=E 136	0.94
14	AALI=P ARTA=E RIMO=E 131 ==> KARW=E 123	0.94
15	ASII=P ARTA=E RIMO=E 147 ==> KARW=E 138	0.94
16	KLBF=E ARTA=E 144 ==> KARW=E 135	0.94
17	BHIT=E ARTA=E KICI=E 142 ==> KARW=E 133	0.94
18	LSIP=P ARTA=E RIMO=E 123 ==> KARW=E 115	0.93
19	ASII=P ARTA=E KICI=E 166 ==> KARW=E 155	0.93
20	PWON=E ARTA=E RIMO=E 131 ==> KARW=E 122	0.93

The number of rules can appear more than 100 rules, this number is in accordance with the desired support and minimum confidence values, the lower we make the more rules will appear. The number of rules displayed in the table above is 20 rules as an illustration of the relationship between each stock in a different category, with its confidence level value. Rule number 1 shows that if ASII shares rise (P), and ARTA, KICI, RIMO shares have equal value (E), it will be followed by equal KARW shares 126 times, resulting in a confidence value of 0.99, which means 99% occurrence KARW shares are equal from the movement of shares containing ASII shares increasing (P), and LSIP, PWON with movement of equal shares (E). For another example that illustrates the rule containing the value of IHSG shares (JKSE share code) against other shares, it is shown in rule number 8, namely if JKSE shares rise (P), and ARTA, KICI, RIMO shares equal (E) which appears 137 times, will be followed by KARW shares in the equal category (E) which appeared 132 times, resulting in a confidence value of 0.96, meaning that 96% of the occurrences of KARW shares were equal from stock movements containing the value of JKSE shares increasing (P) and the value of ARTA shares, KICI, RIMO are equal. This can also be read if the value of the Composite Stock Price Index (IHSG) on a certain day experiences an increase in value (P), while ARTA, KICI, RIMO shares have a fixed value with the event appearing together 137 times in the 3 year period of the entire database and followed by KARW shares in the fixed category (E) appeared 132 times with a confidence level of 96%. Data set 4 (fourth) Still uses combined stock data, but the minimum support used is 0.3, and the minimum metric (confidence) used is 0.65 and the number of rules searched is 35 which can be seen in the table below:

Table 7. Testing Data set 4

Minimum support: 0.1 & Minimum metric (confidence): 0.65 & Rules: 35		
No	Rules	Conf
1	ARTA=E KICI=E RIMO=E 286 ==> KARW=E 281	0.98
2	ARTA=E RIMO=E 329 ==> KARW=E 305	0.93
3	ARTA=E KARW=E RIMO=E 305 ==> KICI=E 281	0.92
4	KARW=E RIMO=E 366 ==> KICI=E 332	0.91
5	KICI=E RIMO=E 372 ==> KARW=E 332	0.89
6	ARTA=E KICI=E 392 ==> KARW=E 349	0.89
7	ARTA=E RIMO=E 329 ==> KICI=E 286	0.87
8	ARTA=E RIMO=E 329 ==> KARW=E KICI=E 281	0.85
9	ARTA=E KARW=E 411 ==> KICI=E 349	0.85

10	KARW=E KICI=E RIMO=E 332 ==> ARTA=E 281	0.85
11	RIMO=E 441 ==> KICI=E 372	0.84
12	KARW=E RIMO=E 366 ==> ARTA=E 305	0.83
13	RIMO=E 441 ==> KARW=E 366	0.83
14	KARW=E KICI=E 427 ==> ARTA=E 349	0.82
15	KARW=E 527 ==> KICI=E 427	0.81
16	ARTA=E 510 ==> KARW=E 411	0.81
17	ARTA=E KARW=E KICI=E 349 ==> RIMO=E 281	0.81
18	KICI=E 535 ==> KARW=E 427	0.8
19	KARW=E 527 ==> ARTA=E 411	0.78
20	READY=E KICI=E 345 ==> KARW=E 269	0.78
21	KARW=E KICI=E 427 ==> RIMO=E 332	0.78
22	READY=E ARTA=E 320 ==> KARW=E 248	0.78
23	READY=E KARW=E 349 ==> KICI=E 269	0.77
24	KICI=E RIMO=E 372 ==> ARTA=E 286	0.77
25	ARTA=E 510 ==> KICI=E 392	0.77
26	KARW=E RIMO=E 366 ==> ARTA=E KICI=E 281	0.77
27	KICI=E RIMO=E 372 ==> ARTA=E KARW=E 281	0.76
28	RIMO=E 441 ==> KARW=E KICI=E 332	0.75
29	RIMO=E 441 ==> ARTA=E 329	0.75
30	ARTA=E KARW=E 411 ==> RIMO=E 305	0.74
31	KICI=E 535 ==> ARTA=E 392	0.73
32	ARTA=E KICI=E 392 ==> RIMO=E 286	0.73
33	ASII=P 331 ==> KARW=E 239	0.72
34	ARTA=E KICI=E 392 ==> KARW=E RIMO=E 281	0.72
35	JKSE=N 327 ==> KARW=E 233	0.71

Rule number 1 shows that the value of ARTA, KICI and RIMO shares remains fixed (E) 286 times, followed by KARW shares with a fixed value (E) also 281 times, resulting in a confidence value of 0.98, which means 98% of shares appear. KARW with a fixed value (E) from movements containing ARTA, KICI and RIMO shares which are also equal. For another example that illustrates the rule containing the value of IHSG shares (share code JKSE) against other shares shown in rule 35, which shows JKSE shares falling as indicated by category N by 327 times, followed by KARW shares which have the same value as indicated by category E 233 times, resulting in a confidence value of 0.71 or 71%. With a support value of 0.3, it means that there is 30% data on the occurrence of this rule from all existing databases in the 3 year period (2020 – 2022).

IV. CONCLUSIONS AND RECOMMENDATIONS

Data mining can be used to find out which stocks often appear in transactions and have a high level of confidence in the relationships between stocks in the 9 stock sectors on the IDX. The use of association rule mining with an a priori algorithm can build basic knowledge (knowledge base) for the relationship between shares that move positively (P), move negatively (N) and remain constant (E), which is shown from the support value from 10% to 30% and confidence levels from 65% to 99%. The results of the discussion show that share movements originating from joint stock (discussion 3 and 4) have a higher confidence level than share movements in the small share value group (2nd data set discussion) and the large share value group (1st data set discussion). The results of the research provide input to investors to choose shares that are associated with large value stock groups with a confidence value of more than 95 percent and 10% support, namely ASII, BHIT and BNII, and for small value shares with 30% support, they are ARTA, RIMO, KICI and KARW. Information on confidence levels and support values that are varied, indicated by each rule of the relationship between shares, can make it easier for investors to choose shares from profitable sectors. Movements in the positive category (P) with a high level of confidence and a high support value can be used as a basis for consideration in determining which shares to invest in. Of course, information from other sources is also needed as additional consideration when making a decision to invest in shares.

In future research, it can be considered to use the association method with other algorithms to process the mining data for comparison. And the data created for the trial can be further reproduced so that it can produce many combination choices.

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