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Dominance-based Rough Set Approach in Selection of Feasible Stock Investment in Malaysia

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There is no absolute formula for evaluating a potential company to invest in. Traditionally, investors will use one type of analysis; either fundamental analysis (an attempt to measure the intrinsic value of a stock) or technical analysis (method used to identify the pattern and forecast the stock's trend) as basis of judgment. However, there are some other investors that chose to leverage a combination of both analyses. In this project, not assuming any of these two types of analysis superior than the other, we rely on both aspects of analysis and highlighted the suggested stocks evaluation criteria. On this account, the aspect of risk, return, intrinsic value, the price earnings ratio, market price and movement share price will be used in classifying the chosen stocks into two distinct classes; the feasible and infeasible investment. Despite of having to classify these stocks to the predefined classes over the evaluated criteria, the fact that human is not accurate and have the tendency to make an inconsistent judgment especially when having to process large volumes of information simultaneously is unavoidable. In order to reduce such problem, we used Dominance Based Rough Set Approach (DRSA). In the beginning, the decision maker needs to point out some potential stocks in a current sample of non-dominated stocks. A set of decision rules is then, induced from such indirect preference information to allow a progressive search that focus on the part of non-dominated stocks. From 20 randomly chosen companies, 10 companies are identified to be a feasible investment. This approach has successfully revealed that 1 company have been wrongly classified and the results gradually improved with 11 feasible companies to be invested.

Keywords: stock investment; fundamental analysis; technical analysis; criteria; dominance based rough set approach

I. INTRODUCTION

It has always been difficult to decide to buy or sell a stock for the stock market has a chaotic nature (Abidin and Jaafar, 2012; Omar and Halim, 2015). Lacking in both investment knowledge and not familiar with the market and trend can be so devastating to especially new investors. Besides, decisions must be as certain as possible in order to maximise profits and minimise losses.

In practice, an investor will use either fundamental analysis (Beneish, Lee and Tarpley, 2001) or technical analysis (Pring, 2002). However, there are investors that chose to leverage a combination of both analyses (Bettman, Sault and Schultz, 2009). Despite everything, it remains unclear for those who are new in stock investment for choosing the most important factor to look at when deciding to buy or sell a stock. The factors to consider are also different from one investor to another depending on one's full knowledge of financial and training experience and qualification in finance (Glaser, Langer and Weber, 2005).

This project thus put the focuses on building a set of

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standard criteria in stock selection for analysing and selecting potential stocks that can be comprehended easily, especially by those who does not have financial background knowledge. Hence, this project is done in two stages. In the first stage, the standard stock investment criteria are developed by blending the two approaches of fundamental and technical analysis, recognising their potential as complements (Bettman, Sault and Schultz, 2009). As a means of categorising the evaluated stocks for its feasibility in investment in the second stage, Dominance-based Rough Set Approach (DRSA) is utilised in consideration of how inaccurate and inconsistent human's judgment can be.

This paper is organised as follows. The indicators (or attributes) of a feasible investment of fundamental analysis and technical analysis to be highlighted is discussed in Section II. Following, using these highlighted indicators, an approach for classifying selected stocks into distinct classes is introduced in Section III. Discussion on the experimental result are presented in Section IV. Conclusions and possible future improvement are in Section V.

II. METHOD OF STOCK ANALYSIS

A. The Theories

Studying the background of a company through fundamental analysis helps an investor to understand what one is intending to invest in (Durmusoglu, 2018). It was developed by (Markowitz, 1952). Three statements of importance to be used while undertaking a fundamental analysis are the balance sheet, income statement and cash flow statement.

Technical analysis on the other hand, guides an investor to determine when one can buy or sell a stock. It has been used since the late 1860s. This approach relies on chart patterns or technical application or can be a combination of both to analyse the visual patterns of stock price (Fanning, 1979).

Combining these approaches to some extent has been done with success Bettman, Sault and Schultz, 2009). Obviously, when both are used to support in decision making, then the chance for a profitable investment will be higher. Therefore, the need for highlighting important indicators of both analyses. This in turns will benefit the investors in term of processing time which leads to a cost-effective approach.

B. The Methods

1. Fundamental Analysis

There are numerous fundamental factors can be used to examine a stock. Fundamental factors that can be measured numerically are called quantitative fundamentals and is often indicated by information in financial statements. Qualitative fundamentals on the other hand are related to or based on the business surrounding such as the brand-name, company's board members, patents - to name a few (Khan *et al.*, 2017).

To discuss in this section, is the aspect of quantitative fundamentals which often describes by the ratios. The following suggested key ratios are distinguished according to three (3) areas of a company evaluation.

1. Evaluating a company's management. Two valuable tools for measuring a company's operational efficiency and the value of its potential future growth are return on equity (ROE) and return on capital employed (ROCE). Both are often used together to produce a complete evaluation of its financial performance.
    - Return on Equity (ROE): ROE is the amount of net income returned as percentage of shareholders equity. The higher the percentage is better because it shows that the company can earned higher profit by common shareholders from their investment in the company.
    - Return on Capital Employed (ROCE): Unlike ROE that considers profits generated on shareholders' equity, ROCE measure a company's efficiency based on its capability in utilising all available capital in generating additional profits.
2. Evaluating a company's financial health. Return on the investment is the basis for making stock investment. Nevertheless, an investor must accept some amount of risk in order to obtain that return on the investment. Accordingly, Time Interest Earned (TIE) and Debt Equity Ratio (DER) is suitable to check how much risk a certain company have, and the new investor can

decide to what extend that he/she is willing to take the risk in investment.

- Debt/Equity Ratio (DER): DER is used to measure which company is using debt financing and what degrees of safety that the company provides to creditors. The lower percentage is the better. Sometimes, instead of using total liabilities, the company also used interest-bearing and long-term debt in the calculation.
- Times Interest Earned (TIE): TIE is used in this research to quote how many times the company covered by its earnings before interest and tax. The higher times that a company can recovered is better because it shows that the company able to pay its interest expenses. A company could fall into bankruptcy if its fail to meet these obligations.

3. Evaluating a company's stock valuation.
   - Price Earnings Ratio (PER): PER depicts the market's opinion on a company's earning capacity as well as the future business prospect. Usually, company with high PER en- joys the confidence of investors and have a higher market standing. A valuation ratio of a company's current share price will be compared its earnings per share.
   - Intrinsic Value Through Net Book Value and Earnings Per Share (EPS), these methods are employed to see whether the intrinsic value of a security is higher or lower than its current market price. Resulting, the categorisation of overvalued or undervalued. By determining an appropriate margin of safety, where the market price is below than the estimated intrinsic value, buying securities in the present of this differences allows an investment to be made with minimal downside risk.
   - Market price: Market price is listed price that is evaluated by the company.

2. Technical Analysis

Three assumptions of technical analysis are the market discounts everything, price moves in trends and history tends to repeat.

Famous techniques used are simple moving averages, support and resistance, trend lines and momentum-based indicators (Edwards, Magee and Bassetti, 2007). However, the focus here is on price and volume by using charts in representing the market movement over time. The trend line is studied in order to identify the stock's pattern. Variations can be effectively traced by an indicator, which compare different averages to point to either an uptrend or downtrend.

To implement the above, we forecasted price quarterly for the last three years from each company to designate pattern and trends of stock. The patterns are then categorised either as increasing or fluctuating.

III. DOMINANCE-BASED ROUGH SET APPROACH

Despite of having to classify these stocks to the predefined classes over the evaluated criteria, the fact that human is not accurate and have the tendency to make an inconsistent judgment especially when having to process large volumes of information simultaneously is unavoidable (Mishan *et al.*, 2017). Hence, the used of Dominance-based Rough Set Approach (DRSA).

DRSA is an extended method of the rough set theory to classify a set of alternatives based on exemplary decisions (past decisions or simulated decisions) given by the decision maker(s) (DM) (Greco and Slowinski, 2002). A set of easily understandable" IF… THEN…" decision rules is then, induced from such indirect preference information to represent DM's preferences. The basic concepts are described as follows (Blaszcyński *et al.*, 2013):

STEP 1: Construct the decision table with dominance relations.

A decision table of a finite universe of objects, U= (solutions, alternatives, actions) that are evaluated on a finite set of condition attributes, $F = \{f_1, f_2, \ldots, f_n\}$ and

on a single decision attribute, *d* is considered.

Table 1. Example of decision table

object, U (company)	f_1 *ROE*	...	f_9 *market price*	d *(decision)*
x_1 (Felda)				
x_2 (IOI)				

While decision attribute *d* makes a partition of *U* into numbers of decision classes, $Cl = \{Cl_1, Cl_2, ..., Cl_t\}$ such that $x \in U$, it can only be in one and only one class of Cl_t where $t = 1, 2, ..., m$.

Now, as the classes are preference-ordered, the sets are evaluated as "at most" class or "at least" class, defined respectively as follows:

$$Cl_t^{\geq} = \bigcup_{s \geq t} Cl_s \text{ and } Cl_t^{\leq} = \bigcup_{s \leq t} Cl_s, \text{ for each } t \in T.$$

STEP 2: To identify inconsistency cases.

The P–lower $\left(\underline{P}\right)$, P–upper $\left(\overline{P}\right)$ and boundaries approximation of $Cl_t^{\geq}$ and $Cl_t^{\leq}$ are defined as follows to identify inconsistency cases.

1. For approximation of $Cl_t^{\leq}$:
   - $\underline{P}\left(Cl_t^{\leq}\right) = \left\{x \in U : D_P^-(x) \subseteq Cl_t^{\leq}\right\}$
   - $\overline{P}\left(Cl_t^{\leq}\right) = \left\{x \in U : D_P^-(x) \subseteq Cl_t^{\leq}\right\}$
   - $Bn_P\left(Cl_t^{\leq}\right) = \overline{P}\left(Cl_t^{\leq}\right) - \underline{P}\left(Cl_t^{\leq}\right)$
2. For approximation of $Cl_t^{\geq}$:
   - $\underline{P}\left(Cl_t^{\geq}\right) = \left\{x \in U : D_P^+(x) \subseteq Cl_t^{\geq}\right\}$
   - $\overline{P}\left(Cl_t^{\geq}\right) = \left\{x \in U : D_P^+(x) \subseteq Cl_t^{\geq}\right\}$
   - $Bn_P\left(Cl_t^{\geq}\right) = \overline{P}\left(Cl_t^{\geq}\right) - \underline{P}\left(Cl_t^{\geq}\right)$

STEP 3: Reduce the surplus condition attribute to find condition attributes that related to decision attribute.

The quality of approximation by a set of attributes*P* can be written as

$$g_P(Cl) = \frac{\left|U - \left(\bigcup_{t=2,..,m} Bn_P\left(Cl_t^{\geq}\right)\right)\right|}{|U|} = \frac{\left|U - \left(\bigcup_{t=1,2,..,m-1} Bn_P\left(Cl_t^{\leq}\right)\right)\right|}{|U|}.$$

Hence, *Cl*-reduct and *Cl*-core of $P \subseteq C$ is defined as $CORE_{Cl}(P) = \bigcap RED_{Cl}(P)$.

STEP 4: Induction of decision rules.

Generalisation description of objects in terms of" IF..., THEN..." decision rules are induced from the preferential information which is obtained from the decision table. The decision rules can be considered to be one of the following five types:

1. certain D_3 -decision rules:

   If $f(x, f_1) \geq r_{f_1}$ and $f(x, f_2) \geq r_{f_2}$ and ... $f(x, f_n) \geq r_{f_n}$, then $x \in Cl_t^{\geq}$.

2. possible D_3 - decision rules:

   If $f(x, f_1) \geq r_{f_1}$ and $f(x, f_2) \geq r_{f_2}$ and ... $f(x, f_n) \geq r_{f_n}$, then x possibly belongs to $Cl_t^{\geq}$.

3. certain $D_{\leq}$- decision rules:

   If $f(x, f_1) \leq r_{f_1}$ and $f(x, f_2) \leq r_{f_2}$ and ... $f(x, f_n) \leq r_{f_n}$, then $x \in Cl_t^{\leq}$.

4. possible $D_{\leq}$- decision rules:

   If $f(x, f_1) \leq r_{f_1}$ and $f(x, f_2) \leq r_{f_2}$ and ... $f(x, f_n) \leq r_{f_n}$, then x possibly belongs to $Cl_t^{\leq}$.

5. Approximate $D_{\leq}$ - rules:

If $f(x,f_1) \geq r_{f_1}$ and $f(x,f_2) \geq r_{f_2}$ and ... $f(x,f_n) \geq r_{f_n}$ and $f(x,f_{n+1}) \leq r_{f_{n+1}}$ and $f(x,f_n) \leq r_{f_n}$, then $x \in Cl_s \cup Cl_{s+1} \cup ... \cup Cl_t$.

IV. EXPERIMENTAL RESULT

Consider 20 randomly chosen companies from plantation sector registered under Bursa Malaysia. The data are collected from company's 2016 financial statement.

In the first stage, 20 companies are evaluated over nine criteria; ROE, ROCE, DER, TIE, PER, Net Book, EPS, market price and the share price movement (as highlighted in Section II) to be pre assigned to two disjunctive classes; either feasible or infeasible investment. These data were then analysed using the jMAF software (Blaszczyński *et al.*, 2013).

As a result, nine decision rules were obtained andthe application of these rules to the 20 companies resulted in one company being reclassified to classes of feasible (see Table 2).

Table 2. The classification of DRSA

Company	Original Decision	Classification Results
Sime Darby	Infeasible	Feasible
KL Kepong	Feasible	Feasible
BatuKawan	Infeasible	Infeasible
Genting	Feasible	Feasible
Felda	Feasible	Feasible
United Plantations	Infeasible	Infeasible
Boustead	Infeasible	Infeasible
Sarawak Oil Palm	Infeasible	Infeasible
Jaya Tiasa	Feasible	Feasible
TH Plantation	Feasible	Feasible
Hap Seng	Infeasible	Infeasible
IJM	Infeasible	Infeasible
Kretam	Feasible	Feasible
United Malacca	Infeasible	Infeasible
TSH	Feasible	Feasible
Far East	Feasible	Feasible
Kim Loong	Feasible	Feasible
BLD	Infeasible	Infeasible
TDM	Feasible	Feasible

V. CONCLUSIONS AND POSSIBLE FUTURE IMPROVEMENT

In the effort of maximising profits and minimising losses in stock investment, we proposed an approach that is to be done in two stages:

1. Evaluate the stocks over a set of criteria developed and pre assigned these stocks to either class of feasible or infeasible investment.
2. Classificationresultofthesestocksis improved by using DRSA.

Upon execution of the stages above, it helps one to a better understanding of stocks performance through a thorough data exploration and evaluation. However, with the fact that postulate making possible contradict decision, the generation of certain decision rules that support the decisionprocess justified the used of DRSA to this end.

However, since the calculation above is done manually, it is suggested that the work is to be written in one of the programming languages available. This interface will reduce the error in calculating. The existence of user interface program will help the decision maker in handling decision-making or selection problems effectively.

This research can also be extended by ranking the stocks, grouped under class of feasible investment so that priority can be given to the most profitable investment over less profitable investment. Moreover, the amount of distribution can be identified accordance to the preference using a mathematical approach.

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