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Financial Performance Evaluation of Companies Using Decision Trees Algorithm and Multi-Criteria Decision-Making Techniques with an Emphasis on Investor's Risk-Taking Behavior

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ABSTRACT

Evaluating the performance of companies using their financial ratios is a challenging task that is expected to become more straightforward by reducing the dimensionality of the data. The purpose of this study is to evaluate the performance of companies using a hybrid model for investment-related decision making through which the mean value of various financial ratios are calculated based on the investor's risk-taking behavior so that the number of all criteria is reduced to one single value for each alternative. To do so, a sample of 172 companies listed in Tehran Stock Exchange was selected from 2008 to -2018. Firstly, the financial ratios were prioritized using decision trees regression analysis (type CART) and TOPSIS Technique. The results showed that Gross Profit Margin and Debt to Equity Ratio are the most and the least important factors, respectively. Then, using OWA (Ordered Weighted Averaging Aggregation) operator, the role of investor's risk-taking behavior was investigated, and the results showed that investor's risk-taking behavior changes the outcome of the decision-making process significantly.

1 Introduction

Several investigations have in the recent past been conducted into the basics and methods of performance evaluation of companies. The values of such studies lie in the sense that the corresponding results may be deployed to comprehend the current status of companies as well as address further challenges on the way of performance evaluation. Nowadays, management experts emphasize the importance of performance evaluation models as one of the most reliable indicators of the development of companies. Therefore, one of the primary concerns of companies has been to explore efficient and feasible approaches to assess all aspects of the company's performance. To address the challenges faced, managers of companies are obliged to exploit suitable models for performance evaluation to obtain a state of perpetual improvement in all subjects and directions. The performance evaluation process facilitates continuous progress towards designated goals, further promoting the identification

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of strengths and weaknesses. Among the most determining criteria for performance, evaluation is the financial criterion, which may be measured in a variety of ways. Generally, performance evaluation and prediction deliver a significant impact on the decisions taken by potential and current investors. This approach To evaluation is also effective in determining a firm's position and perhaps even investigating the possibility of bankruptcy. This, undoubtedly, piques the interest of virtually any decision-maker seeking to distinguish the factors that can properly predict the performance of business units [4, 5, 6]. A performance evaluation model provides the decision-maker with an objective framework through which the comparison of different business units is possible by one single value. Evaluation of the performance of business units is performed according to different criteria. Preliminary searches for the development of performance evaluation criteria led to the use of accounting information. Many performance evaluation criteria are based on accounting models, particularly, the reported net income and the profit per share. Financial ratios stated in financial statements are among the criteria used in accounting models to determine the value and worth of companies [7].

The present study makes the following contributions apropos of the literature for accounting studies: First and foremost, the concept of ration analysis and consequently ratio analysts can be employed to assist stakeholders in assessing the overall fiscal situation and financial soundness of a company. Secondly, the financial ratios thereof can be used to compare various organizations within a defined industry, in both inter- and intra-organizational formats. The mentioned tools may also be applied as a means for crosschecking companies on various scales in terms of their relative performance. Third, the proposed approaches may come to the aid of investors in identifying the most relevant financial ratios affecting a company's performance as well as in utilizing rather straightforward tools of data mining to investigate financial statement data. Ultimately, the proposed approach helps both experts of finance and economics come to realize the relatively long-established and erroneous theories of traditional finance as well as to face the truth that investors may very well be irrational and succumb to fallacies, yet be able to predict their return on investment [13, 15, 18]. To the best of the author's knowledge, no study has thus far been conducted in Iran or other countries alike on the evaluation of financial performance based on the risk-taking behavior of decision-makers, with the simultaneous use of decision tree regression analysis and multi-criteria decision-making methods within an integrated framework. To this aim, machine learning algorithms in general, and decision tree algorithm, in particular, have been used to prioritize financial ratios and subsequently apply decision-making mentality and risk to the decision matrix by optimizing entropy and quantifying verbal indices. This clarifies the difference between the present study as opposed to other related domestic (Iranian) and non-domestic studies in the literature.

The present study attempts to answer two questions:

1. Whether it is possible to prioritize the financial ratios in terms of their predictive power of the future performance of the companies, using regression-based decision trees?
2. Does the involvement of investors' risk-taking behavior in the decision-making process, using OWA Operator potential change the outcomes significantly**?**

2 Literature Review

The significance of performance evaluation models lies in their ability to improve work input quality and thereby further engage staff members, as well as to establish a foundation upon which upgrades towards organizational development and employee succession programs may be implemented. Never-

theless, one must note that performance appraisal systems tend to vary based on the nature of work as well as the intra-organizational designation [16]. "Financial aspects are among the most significant aspects of organizational performance, quite appealing to traditional practices. This is most likely due to the fact that the primary objective of numerous companies is to increase financial performance, which in turn requires proper evaluation. Given the competitive nature of companies, primarily reflected in financial performance indicators, careful proceedings must be taken to identify said indicators within the evaluation process" [21, 23].

This notwithstanding, financial ratios have previously been applied to assess firm performance, and therefore may not be considered as entirely a new-fangled approach. A glance at the relative literature reveals thousands upon thousands of publications on the topic, among which those considered as the infrastructural studies tend to differentiate themselves by distinct independent variables (financial ratios) or different statistical or machine learning-based approaches to data analysis [4]. Using decision trees algorithm and multi-criteria decision-making techniques simultaneously can distinguish one research from another especially OWA operator that can consider investors' risk-taking behavior in the decision making the process. Investors around the globe characterized by different risk-taking behaviors, howbeit, the general division of risk-behaviors includes four basic categories: seeking risk, tolerant towards risk, aversive against risk, and neutral to risk. Evidently, the rate of investment, as well as profits gained by an organization, are heavily influenced by such behaviors [14]. This highlights the significance of classifying investors based on stable characteristics with predictable managerial implications in the selection, placement, and training of personnel. Risk preference is among such determinative characteristics, based on which individuals are placed upon a continuum from risk-averting to risk-seeking. According to common managerial belief and further supported by empirical evidence, risk-taking behavior is followed by both personal and corporate success [9].Wang and Lee [19] proceeded to evaluate the financial performance of Taiwan major container shipping companies utilizing integrating Grey Relation Analysis (GRA) and fuzzy MCDM. They also employed GRA to cluster financial ratios and identify representative indicators, with the ultimate result being the construction of a fuzzy MCDM configured on strengths and weaknesses for the evaluation of financial performance. Bulgurcu [1] employed TOPSIS to analyze the financial performance of technology firms in the Istanbul Stock Exchange, concerning ten financial ratios. The ratios were integrated into a single financial performance score using TOPSIS, seeking to find overlap, if existent, between TOPSIS ranking output and corresponding results of the firms' target market values. Cheng et al. [3] developed an approach combining fuzzy integral with the Order Weight Average (OWA) method for evaluating financial performance in the semiconductor industry of Taiwan.

Delen et. al. [4] attempted to measure company performance using financial ratios in a two-phase approach: exploratory factor analysis for identifying underlying dimensions of the financial ratios thereof followed predictive modeling for revealing potential correlations among company performance and financial ratios. To this aim, they used a total of four popular decision tree algorithms, counting on: CHAID, C5.0, QUEST, and CandRT. Upon the development of prediction models, the authors performed an information fusion-based sensitivity analysis of the obtained results to measure the relative significance of each independent variable. As held by the findings, the CHAID and C5.0 decision tree algorithms were the most optimal models apropos of prediction accuracy. According to sensitivity analysis, Earning Before Tax-to-Equity ratio and Net Profit Margin were the two most relevant variables. Shaout and Yousif [16] performed a comprehensive survey of performance evaluation techniques including both traditional approaches, including ranking and graphic rating scale, as well as more contemporary approaches such as 360-degree appraisal and Management by Objectives. The

review also elaborates various fuzzy hybrid MCDM methods, including Fuzzy Order Preference by Similarity to Ideal Solution (TOPSIS and FTOPSIS), Fuzzy Analytic Hierarchy Process (AHP and FAHP), Multistage and Cascade fuzzy method, Hybrid Neuro-Fuzzy (NF) technique, and Type-2 fuzzy method. Staňková and Hampel [17] studied the prediction of bankruptcy of engineering companies using decision trees classification and support vector machine (SVM). They used both original (financial ratios) and artificial (extracted from raw information) data. Their findings suggest that artificial data are suitable for SVMs, while decision trees are more accurate when the original data is used. However, they argue that the prediction of bankruptcy of companies becomes harder and harder as they are approaching the situation. Caro et al. [2] analyzed the financial ratios of companies in Latin America using decision trees algorithm to detect their financial problems. The results of the study showed that profitability is a determinative factor in all markets. Also, they found out that the relative importance of each financial ratio can vary from country to country.

Patari et al. [11] compared the performance of TOPSIS, AHP, MS, and the DEA in forecasting future values of securities in the US Stock Exchange. As maintained by the findings, MCDM methods and DEA are the superior choices for the management of portfolios. Ptak-Chmielewska [12] studied the failure of micro-enterprises using data mining techniques, including decision trees regression. According to the results of the study, the most important financial ratios in predicting small enterprise failures were: operating profitability of assets, current assets turnover, capital ratio, coverage of short-term liabilities by equity, coverage of fixed assets by equity, and the share of net financial surplus in total liabilities. Omidi et. al [10] researched the potential application of predictive methods in the detection of financial statement frauds. They have used supervised and unsupervised methods to classify financial statements based on financial ratios. Their findings suggest that financial ratios in combination with predictive methods can be applied to real-life situations to detect fraud in financial statements. MacCrimmon and Wehrung [6] scrutinized dependencies between risk-taking propensity and a myriad of socio-economic characteristics, all with the help of linear discriminant analysis (LDA) to determine whether risk-takers can be distinguished from risk averters. According to the findings, the most successful investors were the greater risk-takers.

3 Methodology

The required data were collected from 172 nonfinancial companies listed on the Tehran Stock Exchange from 2006 to 2017. The inclusion criteria for this study were: **a**) companies must have closed their fiscal year in mid-March (end of the Persian calendar year); **b**) Full access to financial data for the entire study period; **c**) Companies had to be registered on the Tehran Stock Exchange list of companies before 2006; and **d**) No signs of interruption of the transaction for a minimum of one month. Evaluation data for assessment of the hypothesis consisted of financial ratios and annual returns for the companies thereof. MATLAB 2018b coding environment was used for procedural and analytic purposes. The variables studied in this study include financial ratios of companies and annual returns within a 12-year long period. Each financial ratio falls within one of these categories: Liquidity ratios, Efficiency ratios, Financial leverage ratios, Growth and Profitability ratios. Financial ratios studied in this paper are presented in Table 1. Also, the annual return of each company has been calculated for the objective and practical evaluation of the proposed model. The research variables are defined and calculated as follows:

Liquidity ratios:

Liquidity ratios are classified as among significant categories of financial metrics used to determine

whether a debtor is capable of paying off their current debt obligations, with no need for external raise in the capital.

Quick ratio=(Total Current assets-Inventory)/ Total current liabilities

Cash ratio= Net cash inflow and outflow/(Long-term liabilities repayment+ Purchase of other assets+ Purchase of fixed assets+ Interest paid on the facility+ Dividends payable)

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Current ratio= Total Current assets/ Total Current liabilities

Current assets ratio= Total Current assets/ Total assets

Liquidity ratio= (short-term investments-cash on hand and in bank)/ Total current liabilities

Profitability ratios:

Profitability ratios are employed as financial metrics for the assessment of a business's capacity to generate earnings concerning its revenue, operating costs, balance sheet assets, and shareholders' equity over time, using data from a given point in time.

Return on equity= profit or loss after tax/ owners' equity

Return on fixed assets=Total revenues/net fixed assets

Return on working capital= profit or loss after tax/ Total Current assets- Total current liabilities

Net working -capital= Total Current assets- Total current liabilities

ROE/ROA ratio= Return on equity/ return on fixed assets

Return on capital ratio= profit or loss after tax/ capital

Profit to gross profit ratio= profit or loss after tax/gross profit

Gross profit margin= profit or loss before tax/sales

Net profit margin= net income/ sales

P/E Ratio= [net income-dividend of preferred stocks]/ number of common stocks

Operating profit margin= Operating profit/sales

Gross margin= profit or loss after tax/ sale

Growth ratios:

Growth ratios may be used as indicators of a business's speed of growth and progress.

Sales growth ratio= (Sales of last year- This year's sale)/ Sales of last year

Profit growth= (Profit of last year- This year's Profit)/ Profit of last year

Leverage ratios:

A leverage ratio refers to virtually any financial measurement which takes into account exactly how much capital comes in the form of debt (loans) or assesses a company's ability to meet its financial obligations.

Fixed assets to equity=net fixed assets/ equity

Debt to equity ratio=Total liabilities/ equity

Interest coverage ratio= [Interest paid on the facilities +net income +tax]/ Interest paid on the facilities

Current liability to equity=Total Current liabilities/ equity

Liquidity coverage ratio=net fixed assets/long-term liabilities

Long-term liability to equity= long-term liabilities / equity

Working interest ratio= equity/Total assets

Interest payment ratio== [Interest paid on the facilities +net income +tax]/ [Interest paid on the facilities +facilities payment]

Debt ratio=Total liabilities/Total assets

Financial expenses to net profit= Financial expenses/ net profit

Financial expense to operating profit= Financial expenses/ operating profit
Efficiency ratios:
Inventory to working capital= Inventory/ Total Current assets- Total current liabilities
Working capital turnover=Total revenue/ Total Current assets- Total current liabilities
Fixed assets turnover= Total revenue/ Total Fixed assets
Asset turnover= Total revenue/ Total assets
Inventory turnover= Inventory/cost of goods sold
Accounts receivable turnover= [(Accounts and notes receivables +other Accounts and notes receivables)/ Total Fixed assets revenue] 365
Other variables:
ROA= Net Income /Average Total Assets
Tobin's Q= Total Market Value of Firm/ Total Market Value of Firm
Annual returns= [(DPS+ Profit or loss on the sale of shares+ Stock day value)/average of investment]
First of all, the importance of each financial ratio for predicting the performance of the companies in the future was estimated using a decision tree algorithm of type CART (Classification and Regression Trees). The input and output data for the decision tree regression analysis were financial ratios and two measures of performance (Tobin's Qand ROA) respectively.
To examine the role of investors' risk-taking behavior in the results of the decision-making process, the OWA operator has been used for calculating the ordered weights based on the value of ORNESS which represents the risk-taking behavior of the decision-maker. ORNESS of value 0 means the decision-maker accepts no risk, while ORNESS of value 1 represents the highest degree of risk-taking behavior. The tool used for calculating the ordered weights based on ORNESS is called "OWA operator with maximal entropy".
Yager [20] proposed two characterizing measures for the weighting vector W in an OWA operator. The first measure, ORNESS of aggregation, is defined as follows:

$$orness(W) = \frac{1}{n-1}\sum_{i=1}^{n}(n-1)w_i \tag{1}$$

This measure characterizes the extent to which aggregation resembles the functionality of an OR operation. ORNESS (W) ∈ [0, 1] holds for any weighting vector.
The second measure refers to the dispersion of aggregation, which is also formulated as:

$$disp(W) = -\sum_{i=1}^{n} w_i \ln w_i \tag{2}$$

This measure shows the extent to which W considers the entire information in aggregation. However, the actual type of aggregation performed by an OWA operator varies based on the form of the weighting vector. Several approaches have thus far been put forth for calculating the associated weights including quantifier guided aggregation, exponential smoothing, and learning. Another possible approach, proposed by O'Hagan, applies a special class of OWA operators, with maximal entropy of OWA weights for a specific ORNESS level. The proposed approach can be formulated as the solution of following mathematical programming problem:

$$maximize \ -\sum_{i=1}^{n} w_i \ln w_i$$

$$subject\ to\ \frac{1}{n-1}\sum_{i=1}^{n}(n-1)w_i = \alpha, 0 \le \alpha \le 1 \quad (3)$$
$$\sum_{i=1}^{n} w_i = 1, 0 \le w_i \le 1, i = 1, \dots, n$$

The Lagrange multipliers method can then be used to map problem (1) to a polynomial equation, the solution to which determines the optimal weighting vector.

4 Analytics and Findings

In this section, the research questions have been answered using the results of different analyses.

1. Is it possible to prioritize the financial ratios in terms of their predictive power concerning the future performance of the companies, using regression-based decision trees?

Table 1: Financial ratios and their corresponding weights based on the results of a regression-based decision tree

Financial Ratios	Abr	Weights	Financial Ratios	Abr	Weights
Gross profit margin	C1	0.44289	Quick ratio	C20	0.00039
Net profit margin	C2	0.21612	Sales growth ratio	C21	0.00037
Return on equity	C3	0.16869	Interest payment ratio	C22	0.00034
Working interest ratio	C4	0.09191	Liquidity ratio	C23	0.00025
Asset turnover	C5	0.03139	Net working capital	C24	0.00025
ROE/ROA ratio	C6	0.01298	Cash flow ratio	C25	0.00015
Current liability to equity	C7	0.00898	Operating profit margin	C26	0.00014
P/E Ratio	C8	0.00485	Cash ratio	C27	0.00009
Long-term debt to equity	C9	0.00393	Liquidity coverage ratio	C28	0.00009
Return on fixed assets	C10	0.00316	Debt ratio	C29	0.00007
Current ratio	C11	0.00298	Profit growth	C30	0.00005
Profit to gross profit ratio	C12	0.00292	Inventory to working capital	C31	0.00004
Return on working capital	C13	0.00153	Financial expenses to net profit	C32	0.00002
Working capital ratio	C14	0.00150	Fixed assets to equity	C33	0.00001
The financial expense to operating profit	C15	0.00105	Inventory turnover	C34	0.00001
Gross margin	C16	0.00090	Current liabilities ratio	C35	0.00001
Interest coverage ratio	C17	0.00069	Working capital turnover	C36	0.00001
Accounts receivable turnover	C18	0.00055	Debt to equity ratio	C37	0.00000
Fixed assets turnover	C19	0.00051			

First of all, a decision matrix has been set up which includes the financial ratios (columns) of each correspondent company (rows) with size M*N. The matrix serves as a set of input variables for further analysis. Then, two vectors of size M*1 have been prepared as the output variables, which include Tobin's Q and ROA. Two separate regression analysis has been carried out on the data using decision trees algorithm. In each analysis, a weight vector has been made as a by-product of the analysis which represents the relative importance of each input variable. The weight vectors have been normalized so that the sum of the elements in each vector is equal to 1. The mean value of each element has been calculated by adding the corresponding elements of the two vectors and dividing the value by 2. The resultant weight vectors are expected to represent the predictive power of each variable (financial ratio) for explaining the performance measures for each company. The results of this

analysis are presented in Table 1. Also, Table 2 shows the descriptive statistics of the research variables. The results of decision trees regression analysis show that Gross Profit Margin and Debt to Equity Ratio are the most and the least important factors, respectively.

Table 2: Descriptive statistics of research variables

Financial Ratios	Maximum	Minimum	Mean	STDDEV
Net profit margin	336.5692	-18598.8325	-98.5697	1422.1707
Gross profit margin	338.0508	-18598.4308	-96.3355	1422.3403
Operating profit margin	363.0592	-57770.3742	-316.5808	4406.6119
Gross margin	100.0000	-92.2625	26.7334	19.8522
Profit to gross profit ratio	11933.3150	-860.5392	119.1673	972.1644
Return on working capital	454.5792	-299.3225	59.8800	81.2800
Return on equity	245.7500	-619.1217	21.9152	70.4573
Working capital ratio	929.0567	-33680.2442	-190.6076	2610.9820
Return on fixed assets	40538.7408	-488.8725	351.5202	3118.0402
ROE/ROA ratio	49.0417	-47.7645	2.8268	6.9545
Current ratio	13.2100	0.4317	1.4639	1.1612
Quick ratio	13.1767	0.1842	0.9612	1.0920
Liquidity ratio	1.3308	0.0092	0.1460	0.1588
Current liabilities ratio	0.9350	0.1833	0.6320	0.1749
Cash ratio	5.6692	-19.6425	-0.4507	1.6657
Cash flow ratio	5.7908	-0.0867	0.3580	0.5441
Net working capital	9930634.1667	-22301805.5833	-87757.5773	2585185.7072
Inventory turnover	6866.9867	0.0000	220.1536	541.5951
Accounts receivable turnover	68197.8500	12.3225	579.5120	5191.3660
Inventory to working capital	24.4775	-147.3658	-0.5559	15.1609
Working capital turnover	145.2458	-705.7625	-2.7158	64.4738
Fixed assets turnover	409.7542	0.5108	8.3212	31.3098
Asset turnover	3.3267	0.1392	0.8454	0.4388
Debt ratio	1.6992	0.1475	0.6327	0.2244
Debt to equity ratio	48.0417	-48.7645	1.8305	6.9546
Fixed assets to equity	14.0975	-21.5464	0.5806	2.2139
Long-term debt to equity	17.9900	-12.7473	0.1944	1.9293
Current liability to equity	30.0525	-36.0164	1.6359	5.3488
Working interest ratio	85.1675	-69.9575	36.6351	22.4527
Liquidity coverage ratio	357.4975	0.4733	11.3544	33.0950
Interest coverage ratio	122.3283	-5093.6475	-58.3039	404.0043
Interest payment ratio	32.7383	-761.0817	-8.4251	60.9902
Financial expenses to net profit	13388.9600	-9002.3417	187.3644	1282.0498
The financial expense to operating profit	1180.1950	-508.1758	46.0151	137.5513
Sales growth ratio	4.8182	-0.2585	0.2322	0.3858
Profit growth	16.7218	-13.9636	0.4877	2.0234
P/E Ratio	167.4590	-32.5978	18.8263	30.8102

To evaluate the efficiency of the weight vector, a matrix has been prepared for the companies and their financial ratios in 2011. The weights have been applied to the columns of the matrix, and then the weighted matrix has been sorted using the TOPSIS technique. The first top ten companies have

been selected and their 5-year return has been calculated by adding the annual returns. Results showed that the application of this weight vector increases the return of the decision-making process.

Table 3: A set of 10 companies selected based on the results of the TOPSIS technique and their (future) 5-year return value

No.	Firms	5-year Return
1	Firm #1	246.02
2	Firm #2	1111.59
3	Firm #3	142.39
4	Firm #4	123.91
5	Firm #5	165.93
6	Firm #6	340.38
7	Firm #7	378.58
8	Firm #8	413.01
9	Firm #9	106.61
10	Firm #10	85.24
-	Average	311.366

Considering the average return presented in Table 3, the answer to the first research question is that one can prioritize financial ratios in terms of their predictive power concerning the future performance of companies using regression-based decision trees. Does the involvement of investors' risk-taking behavior in the decision making process using OWA Operator potentially change the outcomes significantly? People, in general, tend to follow routines that allow them to flow through life steadily, except in the case of unexpected situations. The assessment of rational and conscious, subconscious reasoning and cognitive biases, and emotions influence on individuals and groups in different ways. When decisions must be made under conditions of uncertainty and each of these effects is important because they pay perception of risk. Risk attitude is a response selected from an individual or group to the uncertainty that matters, driven by perception.

Table 4: Different ORNESS levels and the outcome of applying them as the degree of risk-taking behavior to the decision-making process in the form of (future) 5-year return of potential investments

No.	ORNESS Levels	5-year return
1	0.0	436.45
2	0.1	444.59
3	0.2	433.78
4	0.3	440.24
5	0.4	246.26
6	0.5	235.61
7	0.6	235.61
8	0.7	204.69
9	0.8	204.69
10	0.9	299.46
11	1.0	228.90

Therefore, being able to ascertain the position of risk in investment is of utmost importance in effective decision-making scenarios involving risk, particularly in hazardous situations. It should be noted that the absence of this understanding, however, does not correspond to a neutral state, but represents a crucial case of failure, causing decreased effectiveness Rizvi and Ali [14]. To investigate the role of investors' risk-taking behavior in the final results, the optimal weight vector has been obtained for 11 different values of ORNESS, stepping 0.0 to 1.0. Then, the 5-year return for each value has been calculated by sorting the companies based on each weight vector. The results showed that a certain amount of risk-taking behavior changes the results of the decision-making process significantly. The following table represents the average values of 5-year returns for each ORNESS level. As held by the figures in Table 4, the incorporation of different degrees of risk-taking behavior into decision-making processes can significantly alter the overall efficiency and outcome, posing as a positive answer to the second research question. This is further confirmed by the results of Rizvi and Ali [14] which showed that Subjective Financial Risk Attitude is strongly and positively correlated with Mean Risk-Taking (Stocks). Therefore, subjects with a higher Subjective Financial Risk Attitude tend, on average, to invest in more risky portfolios.

5 Conclusions and Discussion

Evaluating the performance of business entities using their financial ratios is a challenging task that is expected to become more straightforward by reducing the dimensionality of the data. Identifying the factors affecting the performance of business entities is not trivial for many decision-makers and investors. In this research, methods of decision making have been proposed which do not require specialized knowledge and expertise in finance and accounting. The purpose of this research is to evaluate the performance of companies to reduce and prioritize the data required for evaluation (financial ratio), so decision tree algorithm of type CART and multi-criteria decision-making techniques were used. At first, we attempted to prioritize the financial ratios in terms of their predictive power concerning the future performance of the companies, using regression-based decision trees. According to the results, Gross Profit Margin and Debt to Equity Ratio were the most and least relevant factors, respectively. From a theoretical standpoint, Gross profit margin is used to assess a company's fiscal standing, while Debt to equity ratio is used to evaluate a company's financial leverage, defined as a measure of the degree to which a company finances its operations through debt versus entirely-owned funds. Therefore, one can conclude that Gross profit margin and Debt to equity ratio are the most and the least relevant factors, respectively.

These findings indicated that the application of the weights obtained by decision trees algorithm leads to higher values of returns; hence, that one can prioritize financial ratios in terms of their predictive power concerning the future performance of companies using regression-based decision trees. Prioritizing financial ratios is based on the research of the Delen et. al, which sought to determine which financial ratios have the greatest impact on a company's performance and thus prioritize financial ratios. According to their findings, earning before tax to equity ratio and net profit margin, impact company performance the most [4]. Also, Yu and Wenjuan using the decision tree examined which financial ratios have a strong influence on the profit growth of companies [22]. Second, using the OWA operator investigated whether investors' risk-taking behavior in the decision-making process can change the outcomes significantly? The results showed investors' risk-taking behavior can increase the efficiency of the decision-making process at certain levels, which is in line with the results of

Rizvi and Ali [14].

According to the results of the current study, it is recommended for investors to:

1. …examine the financial statements using the simplest data mining methods (linear regression) at first to provide an objective basis for future decisions;
2. …use multi-criteria decision-making methods to prevent the possible omission of the important factors;
3. …utilize models that have the flexibility needed for embedding the investors' behavior as an additional factor.

And, it is recommended for researchers to:

1. …address the challenge of time limitations so that younger companies will be taken into account. This way, there will be many more possible opportunities to investigate.
2. …use alternative statistical approaches, such as the Bayesian approach versus the frequentist approach. Statistical approaches other than the classic approach can be useful for developing new techniques and also for covering more theoretical background in applied studies, which in turn supports the robustness of the proposed methods and techniques.

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