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Original Research

Predicting Social Responsibility Reporting using Financial Ratios

Mohammad Javad Zare Bahnamiri [a,] *, Mahsa Golkar [b], Niloofar Beyki [a]

[a] *Department of Accounting, University of Qom, Qom, Iran*
[b] *Department of Accounting, Toloue Mehr Qom Higher Education Institute, Qom, Iran*

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ABSTRACT

The purpose of this research is to investigate the prediction of corporate social responsibility reporting using financial ratios. To answer the research question, four prediction models of linear regression, K. Nearest Neighbor, decision tree, and deep learning were investigated. Also, 61 financial ratios were used according to previous research using data related to listed and non-listed companies of Iran from the years 2012 to 2018. According to the results obtained from the estimation of each of the proposed prediction models, it can be stated that the k-nearest neighbor model has the lowest RMSE value, and in fact, this model predicts the amount of social responsibility with less error than other models. The linear regression model with the highest RMSE value has a weaker performance than other models. LSTM model and decision tree respectively had the lowest RMSE value after the k-nearest neighbor model. As a result, since the LSTM model requires a large number of test samples for deeper learning, it could not achieve high performance in the evaluated data set. Based on the investigations, it can be stated that the current research does not have a similar example inside or outside of Iran.

1 Introduction

Corporate social responsibility has been on the agenda of companies for years. Moving in the direction of social responsibilities is a necessary factor that leads to the continuation of the company and organization in the long term. The meaning of social responsibility is that the company should always consider itself a part of the society, feel responsible towards the society and try to improve the public welfare independently of the direct interests of the company. The means of informing society about the social responsibilities of the company and organization are disclosure and social reporting [1]. Disclosure and social reporting are the process of transmitting information related to the social, environmental, and economic performance of the company in society [2]. Social responsibility reporting is done in three ways, which are: 1) Qualitative reporting: In qualitative reporting, reporting is done descriptively and if possible through charts and tables. The advantage of this reporting system is the simplicity of information expression. But one of its main disadvantages is the lack of a scale to quantitatively measure these effects. Such a reporting method takes a tasteful form due to the lack of a single standard for providing information. As a result, according to the opinion of the information provider, part of it may

* Corresponding author. Tel.: *09111179607*
E-mail address: *Mj.zare@qom.ac.ir*

be deleted and even some information may be presented misleadingly. Also, the lack of providing environmental and social information quantitatively makes the social strata unable to determine their net benefit from the company's activities; 2) Quantitative and descriptive reporting: This reporting system is divided into two parts. A part of the social effects of social transactions that cannot be converted into money, and another part that includes the effects of social and environmental transactions of companies that can be measured in money and has a cost aspect. The second part is divided into two parts, including the costs incurred by the company and the costs and losses imposed on society and the environment; 3) Quantitative reporting: In this reporting model, the social benefit is obtained by comparing social benefits with social costs [3]. In general, the disclosure of environmental and social information is part of the organization's responsibility toward its stakeholders and responding to their expectations. The greater the possibility of incompatibility of the company's activities with society's expectations, the more effort is needed to influence the processes through the disclosure of the company's social information [4]. In addition, with the increase in social expectations from organizations, societies have become more sensitive to issues such as the environment, the rights of women, children, minorities, the disabled, employment equity, and the reduction of human resources. Negligence of organizations to these rights and non-compliance with ethical principles in dealing with external stakeholders can create problems for the organization and challenge the legitimacy of the organization and its actions, thus affecting the profit and success of the organization [5]. As a result, providing useful information for external users of financial statements to make decisions is one of the important goals of corporate reporting. To be useful for decision-making, information must be understandable, relevant, reliable, and comparable. Timely reporting is one of the main tools to reduce the misuse of the company's first-hand information by people inside the company. In other words, providing timely information can be a way to reduce information asymmetry and reduce the spread of rumors about the health and performance of the company [6]. Also, the complexity of the competitive business environment and the increase in customer expectations have revealed the need to be aware of the strengths and weaknesses of the organization and continuous improvement of the processes. Therefore, today's managers have been searching for a comprehensive, reliable, and flexible solution to evaluate their organization's performance, so that while ensuring the implementation of their strategies, they can obtain accurate and sufficient information, and obtain their current position among competitors and with Looking to the future, provide the means to upgrade and improve your organization. As a result, an evaluation method should be able to present the overall situation of the organization about the organizational goals at any moment. Also, determine the position of the organization in relation to the surrounding environment. In addition to these, it also indicates the effectiveness of all activities carried out in the organization [3]. Financial ratio analysis can help stakeholders analyze the financial health of a company. Using these financial ratios, comparisons are made within companies within an industry, between industries, or within companies. Also, such a tool can be used to compare the relative performance of companies of different sizes and create a competitive advantage [7]. For example, the current ratio is one of the financial ratios used to evaluate the company's performance. Current ratio measures the company's liquidity status and power. Also, this ratio shows how much current assets are able to cover current liabilities. The mentioned ratio is known as the short-term liquidity scale. The higher the ratio, the better the company's liquidity. Therefore, in evaluating the overall financial condition of a company, the profit and loss statement and the balance sheet are important reports, because the profit and loss statement shows the company's operational performance and the balance sheet shows its net worth [8]. For this purpose, real and legal managers and investors prefer to have a mechanism that can help and advise them in their decision

making due to the existence of many influential variables. For this purpose, they turn to forecast methods through which their estimates are close to reality and their errors are very small [9]. Forecasting is a key element in decision making; because the final part of every decision depends on the consequences of the events after the decision. Being able to predict the uncontrollable aspects of these events before making a decision can lead to better choices. For this reason, management systems for planning and managing operations have prediction models in different dimensions. The purpose of forecasting is to reduce risk in decision-making. Although predictions are usually not accurate, the amount of prediction error depends on the method used. By allocating more resources for forecasting, its accuracy can be increased and as a result, some of the losses caused by uncertainty in the decision-making process can be eliminated or reduced [10]. Making rational decisions has a direct relationship with evaluating the performance of an economic enterprise, and evaluating the performance of economic enterprises also requires knowing the criteria and indicators that are classified into two sets of financial and non-financial indicators. Financial performance measurement criteria are preferable to non-financial criteria due to their quantitative, practical, objective and tangible characteristics [11]. Financial metrics are still common among most companies, as non-financial metrics such as customer satisfaction, quality, market share, and human resources are usually subordinated to financial figures [8]. On the other hand, environmental and social reporting is a tool for companies to respond and account for their performance [12]. As a result, business units are expected not only to think about increasing their profits, but also to be responsive to society and useful for the society they interact with. Therefore, social responsibility reporting is a method to measure, disclose and answer to internal and external stakeholders for organizational, environmental, social and economic performance [13]. According to the material raised, the main question of the research is, among the forecasting methods using financial ratios that have been evaluated in the current research, which one has the ability to predict social responsibility reporting more accurately?

2 Literature Review

Theories related to social responsibility seek to explain why companies choose to engage in social responsibility activities. Based on the theory of legitimacy, a company has a social contract with the society, which means that the business unit is required to operate within the framework and norms of the society. The criterion of legitimacy is conformity with the norms, values, beliefs and definitions of the desirable and appropriate social system. Also, based on the ethical domain, all stakeholders are considered fairly by the organization. Therefore, companies are accountable for activities that affect stakeholders through social responsibility reporting [14]. According to the legitimacy theory, providing information about the social and environmental performance of an organization leads to an increase in society's trust in that organization [15]. Chan et al showed that companies that report on social responsibility have stronger financial health and economic stability and less business risk because companies with financial risk are unlikely to invest in social responsibility activities. In other words, companies that engage in social responsibility activities increase customer satisfaction and can create a way to increase the overall credibility of the company by providing signals to stakeholders about the positive characteristics of the company and various other benefits such as maintaining the license to operate, reducing risk, increasing bring productivity and tax benefits to the company [16]. Matsumoto et al. during a survey of analysts regarding their understanding of financial ratios, found that growth rates were the most important, followed by valuation and then profitability ratios. Also, they ranked earnings per share and leverage ratio slightly lower than the above three. Charles Merwin showed in research

that among the financial ratios, the ratio of working capital to total assets is the best indicator for predicting the bankruptcy of companies [17]. Also, considering the nature and relationship between the financial crisis or economic recession and the risk of bankruptcy of companies, it can be expected that the higher the probability of financial crisis, the more deviant the companies will be in reporting their profit. As a result, social responsibility as one of the most obvious items of social performance evaluation will also be affected when facing the financial crisis [18]. Badertscher et al stated that there is a positive and almost weak relationship between corporate social responsibility and financial performance. They claimed that corporate social responsibility reporting improves financial performance. However, Delen et al showed that the ratio of pre-tax profit to equity and net profit margin are two basic variables in predicting the performance of companies. As a result, these financial ratios are expected to be effective in predicting social responsibility reporting. Hashemi et al. showed in their research that cash ratios in predicting the financial performance of strong companies and accrual ratios in predicting the performance of weak companies have higher information content. On the other hand, the willingness and insistence of the business unit to commit to social responsibility in all dimensions have a significant effect on financial performance. The trend towards social responsibility encourages the business unit to try to improve the environment, use less energy and materials, manage waste, etc. As a result, the business unit can optionally maximize its long-term returns by reducing its negative effects on society [19]. Brown and Zamora investigated the role of guaranteeing corporate social responsibility. Because companies may report a high level of investment in CSR to demonstrate their commitment to CSR, if management's explicit attention to CSR-based performance raises investors' suspicions about the reported information. Such explicit attention to CSR-based performance creates more managerial motivation to invest in CSR, and as a result, more appropriate performance is reported in relation to CSR. On the other hand, investors will seek to ensure corporate social responsibility as a sign of the credibility of the disclosure [15]. Delen et al in a research estimated the performance of the company using financial ratios in the decision tree method and the results showed that the most important financial ratios are the ratio of pre-tax income to net assets, net profit margin, debt to net assets ratio and sales growth ratio have the highest impact on the company's performance. On the other hand, companies that perform better and commit to social responsibility activities, according to the concept that companies consider increased disclosure as a form of social responsibility behaviour in the overall implementation of corporate social responsibility practices, also provide more financial disclosure [20]. Hahn and Cohen found numerous potential business benefits for companies that disclose their social, environmental, and sustainability information, including increased transparency, improved company reputation and brand value, employee motivation, and support for the company's control process. Also, the positive relationship with financial performance for companies that have performed well in the field of social and environmental responsibility reporting and have met the requirements of the stakeholders can be another motivation for reporting in this field [21]. Qiu et al found that profitable companies are more inclined to disclose social and environmental information. Hafer and Searcy also expect a positive relationship between the disclosure of sustainability information and financial performance and company value based on the theory of resource-based perspective and stakeholder theory; Because, the resource-based view theory states, that a company has unique capabilities and if it is exploited strategically, it can gain a competitive advantage that will lead to better financial performance. In the stakeholder theory, meeting the requirements of the stakeholders (environmental and social) improves the financial performance and value of the company [21]. Stany and Eli showed that companies with high debt or high financial leverage are likely to be less able to bear the costs of disclosing such information. Hess and Dunphy found that companies that have obsolete assets and use old technologies cause pollution; Therefore,

these companies are less inclined to disclose social responsibility, and environmental and sustainability performance information [22]. Brooks and Oikonomo stated that companies with poor financial performance are less inclined to comply with corporate social responsibility reporting than companies with good financial performance; Because, less profitable companies, compared to more profitable companies, have fewer resources to allocate for activities related to social responsibility, environment, and sustainability [21]. On the other hand, equity-oriented companies have better performance in terms of maintaining liquidity during economic recession due to lower financial costs than the industry average [23]. Piri and Zarei showed that the decision tree algorithm is more suitable for performance evaluation; because it is free from the unrealistic assumptions of traditional techniques and managers can use this technique to evaluate their performance compared to previous years and correct their performance if necessary. Hall and Lee proved that high financial performance leads to increased company reputation, and companies with a high reputation have many benefits such as more loyal customers, better employees, continuous income, better future growth, and lower cost of capital [24]. As a result, investors place companies that perform better in terms of social responsibility and social responsibility reporting in a higher position [25].

Based on the investigations and research presented, it can be concluded that the current research has no similar example in Iran or outside Iran. Also, considering the importance of social responsibility reporting in recent years and the willingness of investors to invest in companies that carry out social responsibility reporting, it can be said that the results of this research can provide useful information to reduce the gap between the company and the expectations of stakeholders, and make the right decisions. At the time of investment and providing a suitable solution for predicting social responsibility reporting for companies.

3 Methodology

The current research is practical in terms of the objective because the results obtained from it can be used in the decisions of managers and investors. Also, from the aspect of the method of inference, it is included in the group of correlational descriptive research, because regression techniques have been used to discover the relationships between research variables.

The selected companies in the research include Tehran Stock Exchange and Iran OTC companies. Also, to calculate financial ratios, data from 2013 to 2017 and data from 2012 to 2018 were used to calculate social responsibility. Then, using the (systematic) screening method, 98 companies were selected as the research sample. Finally, in order to test the research hypothesis and analyze the data, Excel and MATLAB software were used.

Table 1: How to Screen Data

Description	Number
Active companies in Tehran Stock Exchange in 2018	541
Companies in the financial intermediary industry	(45)
Companies that were not part of the stock market during the research period	(60)
Companies in the banking industry	(31)
Trading stop	(27)
Insurance Companies	(21)
Companies in the investment industry	(90)
Companies with incomplete data	(78)
Companies with a fiscal year other than March 29	(89)
The number of companies under research	**98**

3.1. Research Methodology

In this research, to evaluate the predictive power of social responsibility reporting using financial ratios, linear regression models, k nearest neighbor, decision tree, and deep learning were evaluated, which are briefly described below.

3.1.1 Linear Regression Model

Regression analysis is a statistical method that explains and predicts changes in the dependent variable through the independent variable or variables. Although the classic linear regression model has many applications, sometimes the model construction faces problems such as: The small or inappropriate number of observations, the problems of defining the appropriate distribution function, ambiguity in the relationship between dependent and independent variables, ambiguity in the occurrence or degree of occurrence of events, carelessness, and error. To solve this problem, other methods such as robust regression and fuzzy linear regression can be used [26].

3.1.2 K Nearest Neighbor (KNN) Model

The k-nearest neighbor algorithm is a type of example-based learning or lazy learning. This algorithm is one of the simplest machine learning algorithms whose purpose is to classify a new example based on the characteristics of the training examples. The k-nearest neighbor method, unlike the traditional transfer function, does not use any predefined mathematical function to estimate different variables. In this approach, a reference data set, such as the data set used in the training and development of traditional transfer functions, is searched to find the closest (most similar) sample to the target sample. The first step in this field is to determine the distance between the target sample and each of the set data. In this method, the input contains the k closest training examples in the feature space, and the output depends on using KNN for classification or regression. Weighting the neighbors is useful in the application of this algorithm so that the neighbors closer to the target have a greater share than the neighbors farther from the target [27]. The advantages of using this algorithm in predictions include simple implementation, no need for parameter estimation, non-linear modeling capability, effectiveness, and high-efficiency performance in dealing with a large number of categories of data [28].

3.1.3 Decision Tree Model

In the decision tree, its class or category is determined by following a set of questions related to the characteristics of the data and looking at the current data to make a decision. In each middle node of the tree, there is a question and when the answer to each question is determined, we go to the node related to that answer and another question is asked there. The goal of decision tree algorithms is to correctly select these queries in such a way that they generate a short sequence of queries to predict the new record category. Each internal node corresponds to a variable and each edge represents a possible value for that variable. A leaf node represents the predicted value of the target variable (the variable we intend to predict); That is, the leaves represent the final classification and the path traveled to that leaf shows the process of reaching that node [29]. The main advantage of the decision tree approach is to show the solutions. A decision tree shows three things: 1) Each internal node that tests an attribute; 2) every branch that corresponds to the value of the attribute; 3) Each leaf node representing a class. Also, one of the disadvantages of the decision tree is its instability. The decision tree acts like an unstable classifier with little disturbance in the training data. The decision tree structure may be completely transformed by a slight change in the data set, and in cases where numerical decisions are required, this type of decision tree becomes unusable. To overcome this problem, some scholars suggest a fuzzy decision tree [30].

3.1.4 LSTM Deep Learning Model

Deep learning is a branch of machine learning and artificial intelligence and is a set of algorithms that try to model high-level abstract concepts using learning at different levels and layers. In other words, the algorithms of this method use several layers of information processing and especially non-linear information to extract the best suitable features from the raw inputs [31]. In a recurrent neural network, a feedback loop makes it possible for the information obtained (last state) by the network at the end of each computation to be used for future computations. Now, if the number of intermediate layers in a recurrent neural network increases, along with the increase in complexity, this network will be able to discover hidden patterns in the data for problems that are complex and non-linear with high efficiency and accuracy. The word "deep" in the phrase "deep learning" refers to the number of intermediate layers, the more there are, the deeper the network will be. One of the problems of recurrent neural networks is their inability to learn long-term dependence. To solve this problem, Hockreiter et al proposed architecture for recurrent neural networks, which became known as the long-short-term memory architecture and was able to compensate for the aforementioned short-term memory loss. The most common architecture is LSTM. The structure of an LSTM block includes three gates: input, output, and forgetting. The output of the LSTM block is recursively connected to the input of the block and the input of the three named gates. Activation functions in input and output gates are usually hyperbolic tangent functions and the activation function in the forgetting gate is the sigmoid function [32]. One of the disadvantages of LSTM networks is that their performance on time series prediction data is still not satisfactory, and shallow architectures do not represent the characteristics of time series data efficiently. Especially when the time series data is processed with long time intervals and is highly non-linear. Also, as the architecture of deep networks becomes more complex, a question arises as to how to tune a network. Of course, a limited number of hyper-parameters can be optimized by experiment. But deep networks have a complex structure and hundreds of hyper-parameters. Often, success in solving a problem depends on choosing the right architecture for that problem [33].

3.2 Research Variables

In the current research, the predicted variable, social responsibility, and predictive variables are 61 financial ratios, including liquidity ratios, profitability ratios, leverage ratios, and activity ratios, and the method of calculating each one is mentioned below.

3.2.1 The Predicted Variable

We will use corporate social responsibility disclosure to measure social responsibility. Disclosure of corporate social responsibility has four dimensions, disclosure of information related to employee relations, disclosure of information related to social participation, disclosure of information related to production, and disclosure of information related to the environment. Finally, using equation (1), the overall value of social responsibility was estimated [34].

$$CSR=EMPD+COMD+PROD+ENVD \quad (1)$$

In relation (1), CSR is social responsibility, EMPD is the amount of information disclosure related to employee relations, COMD is the amount of information disclosure related to social participation or society, PROD is the amount of information disclosure related to production or product, and ENVD is the amount of information disclosure related to the environment [35]. How to calculate each of the factors is described below.

The total score of corporate social responsibility disclosure was obtained from relation (2):

$$CSR_j = \frac{\sum_{t=1}^{nj} X_{ij}}{n_j} \quad (2)$$

In relation (2), CSR_j is the CSR disclosure score in company j, n_j is the number of estimated cases for company j, and X_ij if the cases of the disclosure are quantitative and its details are in the form of numbers, a detailed description of the activity and, if possible, pictures, diagrams, In the case of tables, the disclosure score is 3, if the information is non-quantitative and its details are in the form of paragraphs, the disclosure score is 2, and if the disclosures are qualitative and the details are in the form of sentences with paragraphs, the disclosure score is 1. If an item is not disclosed, the disclosure score is zero.Six criteria for estimating the disclosure of information related to employee relations (EMPD) include, 1) the health of the employees' environment, 2) the training of employees, 3) the benefits of employees, 4) the characteristics of employees, 5) ownership of shares, and 6) the safety and health of employees. Finally, this criterion was added together and divided by 6.

Also, six criteria to estimate the disclosure of information related to social or community participation (COMD) include, 1) cash donation program 2) charity program 3) scholarship program 4) financial sponsors for sports activities 5) national pride sponsors 6) project General issues are raised. Finally, this criterion was added together and divided by 6.

To estimate the amount of information disclosure related to employee relations (EMPD), four criteria including 1) product safety, 2) product quality, 3) product development and 4) after-sales service are proposed. Finally, this criterion was added together and divided by 4.

To estimate the amount of environmental information disclosure (ENVD), four criteria including, 1) air pollution control, 2) damage prevention and compensation plan, 3) protection and use of recycled products, and 4) environmental award are proposed. Finally, this criterion was added together and divided by 4.

3.2.2 Predictor Variable

With the investigations carried out in the field of forecasting CSR, the predictive ratios were extracted from different studies. The list of financial ratios used in this research is shown in Table (2).

Table 2: Predictive Financial Ratios

Return on assets	debt ratio
Cash flow to sales ratio	Proprietary ratio
The ratio of net profit to financial expenses	Asset turnover
Fixed asset return ratio	Ratio of inventory to total assets
current ratio	current capital turnover
instantaneous ratio	Cash flow to asset ratio
Interest coverage ratio	Accounts receivable to total assets
Gross profit on sales	Gross profit to total assets
Percentage of sales changes	Net profit on sale
Percentage of changes in accounts receivable	Ratio of accounts receivable to sales *365
Current assets to total assets	Operating profit on sales
Cash to total assets	Net profit to equity
The ratio of accruals to assets	The ratio of operating profit minus operating cash flow to assets
Percentage changes in inventory	Cash to current liabilities
Cash to current assets	Gross profit to operating profit and loss

Table 2: continue

Operating cash flow to assets	Inventory to current assets
Interest cost on total debt	The ratio of total inventory and accounts receivable to total assets
Profit before tax to total assets	Profit before tax on fixed assets
Profit before tax on current liabilities	Current liabilities to total assets
Sale to equity	Sale to total debt
Changes in accounts receivable to assets	Interest expense to total assets
Operating profit to assets	Ratio of operating profit minus operating cash flow to sales
Changes in the ratio of accounts receivable to sales compared to the previous year	Accounts receivable to inventory
Accounts receivable to operating profit	Operating profit to equity
Operating profit to fixed assets	Net profit to fixed assets
Percentage changes in operating profit	Percentage changes in net profit
Changes in the ratio of inventory to sales	Profit before sales tax
Net profit to gross profit	Profit before tax to equity
Cash to debt	Sale of fixed assets
Working capital to sell	Fixed asset change percentage
The ratio of changes in inventory to changes in sales	

4 Research Findings

4.1 The First Test: Linear Regression Model

The purpose of using the linear regression model is to find the line that has the least difference between the available data and the estimated data. In this model, a straight line is drawn that best minimizes the root sum of squares between the responses observed in the data set and the responses predicted by the linear approximation. The results of estimating the linear regression model are shown in Figure (1).

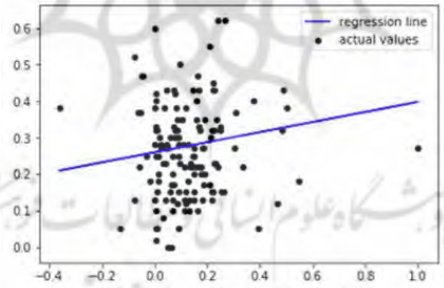

Fig. 1: Linear Regression Model

Figure (1) shows the relationship between corporate social responsibility and the financial information of companies. The black circles represent the actual values from the test and evaluation data. The regression line is also obtained from the predicted values. This line is drawn in such a way as to produce the least amount of error. The results show that the values of MSE and RMSE in this experiment are estimated as 0.069 and 0.263, respectively.

4.2 The Second Test: K-Nearest Neighbor (KNN) Model

In this test, to achieve the appropriate value of k, the data set is divided into two parts, training, and experimental data with a ratio of 80 to 20, and by running the algorithm several times and changing the value of k, the error rate of the model is measured. Is. Figure (2) shows the relationship between RMSE and the k value.

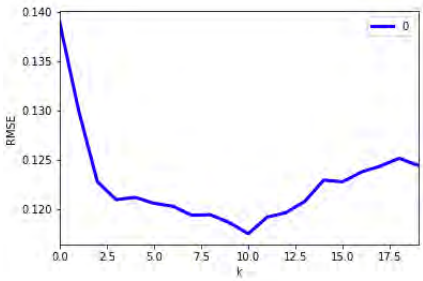

Fig. 2: K-Nearest Neighbor Model

According to figure (2), the results of model estimation show that when k=1, RMSE receives a very high value. This value decreases with the increase of k. In such a way that at k=10, the value of RMSE reaches the lowest value in this experiment, and finally, the value of RMSE increases again by increasing the value of k to more than 10. In this experiment, the value of k=10 has obtained the best performance and as a result the least error. For k=10, the final values of MSE and RMSE are 0.0138 and 0.117, respectively.

4.3 The Third Test: Decision Tree Model

In this test, a tree with recursive partitioning is built on 80% of the data set as training data. In the stages of tree training, by increasing the depth of the tree up to the value of 5, the performance of the model increases gradually, and after that, the performance of the model decreases at values greater than 5 for the depth of the tree. To visualize this test, one-dimensional training data with a depth equal to 5 was used and a decision tree was tried to be fitted on it. Each node represents a test on the attribute value and each branch of its output. The leaves of the tree also represent the classes. Finally, the resulting tree contains 29 nodes, 30 leaves and 5 levels. In figure (3), the final results of decision tree model estimation are shown.

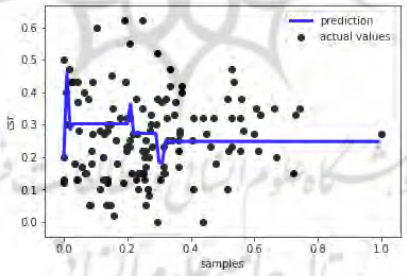

Fig. 3: Decision Tree Model

Based on the results obtained in this experiment, the values of MSE and RMSE were obtained as 0.0205 and 0.143, respectively.

4.4 The Fourth Test: LSTM Deep Learning Model

To implement the LSTM network, Cross libraries with two layers of LSTM and Adam have been used as optimizers. The experiment was analyzed for 20 periods and amount of 50 batches. In Figure (4), the results of the relationship between social responsibility and financial information of companies are shown by comparing the actual values and the predicted values.

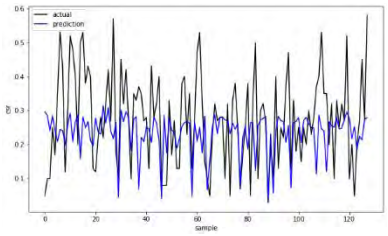

Fig.4: LSTM Deep Learning Model

According to Figure (4), the value of MSE and RMSE in the LSTM model is estimated as 0.0169 and 0.13, respectively.

4.5 Comparison of Proposed Methods

The comparison of RMSE values of each of the linear regression, decision tree, KNN, and LSTM methods is presented in Table (3) and Figure (5).

Table (3): Results of the RMSE

Models	RMSE
Linear Regression	0.263
KNN	0.117
Decision Tree	0.143
LSTM	0.130

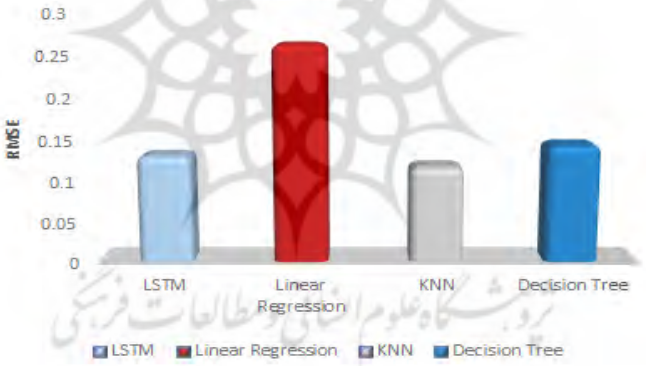

Fig. 5: Results of the RMSE

According to the results obtained from the estimation of each of the proposed prediction models, it can be stated that the k-nearest neighbor model has the lowest RMSE value, and in fact, this model predicts the amount of social responsibility with less error than other models. The linear regression model with the highest RMSE value has a weaker performance than other models. LSTM model and decision tree respectively had the lowest RMSE value after the k-nearest neighbor model. As a result, since the LSTM model requires a large number of test samples for deeper learning, it could not achieve high performance in the evaluated data set.

5 Results and Discussion

The purpose of this research is to investigate the prediction of social responsibility reporting using

financial ratios. For this purpose, 61 financial ratios including liquidity, profitability, leverage, and activity ratios were used. Then, four prediction models including linear regression, k nearest neighbor, decision tree, and deep learning were examined to evaluate the predictive power. Finally, by comparing the RMSE values of each of the proposed models, it can be acknowledged that financial ratios are an effective factor for predicting social responsibility reporting. The results obtained from the estimation of the mentioned models indicate that companies with appropriate and good financial ratios act desirably in disclosing their social responsibility. This result is in agreement with the results of Hafer and Sirsi (2017), Estani and Eli (2008), and Q et al. (2016) that profitable companies have a greater tendency to disclose social and environmental information, and companies with high debt or high financial leverage. They likely have less ability to bear the costs of disclosing such information. Also, the results show that the past financial ratios can predict the social responsibility of the company. Among the aforementioned forecasting methods, the K-nearest neighbor algorithm with the least error has a better performance and the linear regression model with the highest error has a weaker performance for predicting social responsibility. The result is in line with the research of Menamizadeh and Hamidzadeh (2016) with the error rate of prediction using the K-nearest neighbor algorithm, 0.112, and the research of Dezhaloud and Soleimian Qarachepag (2019) with the error rate of 0.174. In the aforementioned studies, the K-nearest neighbor method among the proposed methods has been recognized as the best method for prediction.

In advanced societies, accountability is an integral part of the government's decisions and planning, and after the completion of the program period with audit, the performance results of each device are concretely, completely real, and comprehensively provided to the decision-makers. Also, during the last few years, many companies around the world have started discussing considering three aspects of reporting (economic, social, and environmental). As a result, it is suggested that business units, government organizations, and companies use the model proposed in the present study to predict social responsibility reporting to gain legitimacy and acceptance in society and from the perspective of their stakeholders.

It is suggested that researchers address the following topics in further research:

Examining the effects of macroeconomic, social, cultural and political variables on social responsibility.

Investigating other artificial intelligence techniques and fuzzy models. Instead of the usual statistical methods such as regression and models done in this research.

≠ Examining the comparison of the desired model with the probit model and other statistical models. He ranked the financial ratios according to the opinion of experts and according to their priority, he selected the financial ratios to be studied.

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