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Original Research

Forecasting Influential Factors in Preventing Tax Evasion Through a Lemur Optimization Approach Utilizing a Perceptron Neural Network

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ABSTRACT
Taxes serve as a vital source of funding for governments and significantly influence economic growth and income distribution, which varies based on a country's level of development and economic framework. Recently, researchers have introduced methods to identify effective factors in preventing tax evasion. Most of these methods rely on basic techniques such as regression, structural equations, and non-intelligent methods that cannot effectively analyze the relationship between the values of the variables involved in this field. Therefore, in this study, we introduce a method that leverages artificial intelligence techniques, specifically a meta-heuristic optimization approach and a perceptron neural network. This method effectively analyzes the nonlinear relationships within the data while addressing both the intrinsic and extrinsic aspects of the data dimensions simultaneously. The research sample consists of 25 experts from the Tax Affairs Organization, and the study was conducted in the year 2022. The results indicate a high prediction accuracy of approximately 98%. Additionally, it highlights the significant role of various factors contributing to tax evasion, including income concealment, money laundering, economic crises, political trust, the weaknesses, and complexities of tax laws and regulations, inadequate clarification of tax laws, contradictions in legal tax articles, administrative bureaucracy, and an inefficient tax structure.

1 Introduction

Today, businesses are looking for ways to reduce their taxes while the government is making laws and policies to prevent tax evasion [1]. These conflicting goals and strategies have increased the interest of researchers in investigating and determining the factors that affect the level of corporate tax evasion [2]. Tax evasion, which is also called tax planning, is considered one of the essential work plans of managers during corporate strategic decision-making and is useful for providing cash savings for companies and taxpayers [1]. Tax collection serves as a primary source of revenue for governments. When

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individuals and businesses evade taxes, it hampers the funds that governments depend on for the economic and social development of their nations. As a result, governments, policymakers, and various stakeholders are keen to implement strategies to analyze the factors contributing to tax evasion. Some companies have effectively leveraged tax planning strategies to minimize their tax liabilities, while others resort to residual tax payments and tax evasion. This evasion not only decreases the flow of tax income from businesses to governments but also elevates the after-tax returns. While this increase can enhance company valuations and boost taxpayer income, it simultaneously undermines government revenue[3]. While prior research provides valuable insights into the factors influencing tax evasion, there remains a lack of consensus among these studies. Additionally, they offer limited understanding of why certain firms in specific developing countries engage in extra-tax activities more frequently than others. Conversely, most of the methodologies explored in the literature have utilized basic statistical techniques, such as regression analysis and its more advanced forms, as well as structural equation modeling, to examine the relationships among the data related to the factors under investigation. In other words, they rely on these basic methods to conduct tests that identify the effective factors in preventing tax evasion. Considering that identifying these factors with high accuracy can lead to the development of a preventive model that assists government revenue authorities in finding solutions to the problem of tax planning, it is necessary to provide intelligent solutions to predict and identify the impact of each factor. This process of addressing tax avoidance is crucial, as it helps to reduce rent-seeking behavior that benefits managers at the expense of taxpayers.

2 Theoretical Fundamentals and Research Background

Economic activists in any society, equipped with resources and assets like human and physical capital, or those benefiting from inherent advantages such as preparedness, intelligence, and the capability for initiative, innovation, and job creation, typically contribute to the economy in various ways and earn income[4]. By allocating a portion of their earnings to the government in the form of taxes, individuals assist in funding public expenses, a responsibility of the government. However, experiences have shown that income earners sometimes lack the motivation and interest to fulfill their tax obligations. They may turn to official methods, such as tax consulting services, or informal strategies to seek alternatives to tax payments. When they either fail to pay taxes or pay lower amounts, these economic activists are effectively engaging in tax evasion or avoidance[5]. Tax evasion, in basic terms, refers to any illegal action taken to avoid paying taxes properly. This can include actions like creating false accounts, failing to submit required documentation, or engaging in economic activities without adhering to legal requirements[6]. Additionally, any unauthorized situation that causes individuals or businesses to stray from their tax and legal obligations is also classified as tax evasion[7].Various methods have been introduced to prevent tax evasion by considering its influencing factors. Recently, studies such as those by [8] and [9] have explored these factors using hierarchical AHP and regression techniques, highlighting the significance of each factor in the prevention of tax evasion. An analysis of these studies, along with other recent research in this field, categorizes the influencing factors into six main categories: economic, social, legal, intra-organizational, cultural, and political. This article examines and analyzes the relationships among the factors in each of these categories using the intelligent method, which employs a meta-heuristic algorithm and perceptron neural network. Subsequently, a review of related studies will be presented.Tax collection has historically posed a significant challenge for governments, as many companies worldwide implement strategies to evade taxes and mislead authorities.[10] identified the factors influencing tax evasion, categorizing them into five main dimensions: economic factors, social factors, legal factors, internal organizational factors, and cultural and political factors, along with 20 sub-criteria. The factors were gathered from twenty tax experts through a questionnaire and the fuzzy delphi method. The findings indicated several key contributors to tax evasion, which include ambiguities in tax law, inconsistencies in legal articles related to taxes, insufficient promotion of a tax culture, a lack of political trust, government corruption, bureaucratic inefficiencies, an ineffective tax structure, and issues of fairness within the tax system for taxpayers. Moreover, there is a significant distrust among the public and taxpayers towards the government, compounded by economic crises, inadequate monitoring and follow-up in tax recognition and collection, the existence of fake jobs and underground activities, the inefficacy of tax incentive and punishment mechanisms, and the complexities of tax laws and regulations [10]. In a research, researcher utilized qualitative and quantitative methods, including content analysis, the delphi survey method, and AHP hierarchical analysis, to draw decision trees. This approach allowed us to prioritize the key factors that help prevent tax evasion, based on insights from a statistical population of 25 experts from the tax affairs organization in year 2022. The results revealed the significance of five primary factors influencing tax evasion: managerial, economic, political, social, and legal regulations [8]. A study employing the typology model developed by Friedman and Rosenman explored the influence of four personality types A, B, C, and D among tax officials on tax identification and collection in 2019. To this end, data were collected from five categories of completed questionnaires distributed to all 250 tax officers in the general department of tax affairs of Chaharmahal and Bakhtiari province. The findings revealed a significant correlation between the personality types of tax agents and their effectiveness in detecting and collecting taxes. Moreover, to comprehend the diverse facets of human existence and to support mental well-being, it is essential to consider personality types. This aspect warrants particular attention from managers to optimally achieve organizational [9]. Some researchers explored the influence of various factors namely institutional, economic, socio-psychological, political, and legal—in combating tax evasion. Their study involved a questionnaire distributed to 436 medium-sized entrepreneurs in the Colombo region to identify the key determinants influencing tax evasion. Utilizing regression analysis, they examined the collected data. The results indicated that socio-psychological and economic factors significantly and negatively affect the tax evasion behavior of average taxpayers, whereas institutional, political, and legal factors displayed only a weak correlation with tax evasion. Additionally, social-psychological elements such as perceived fairness of the tax system, moral responsibility, and social impact, along with economic variables including tax rates, penalties, audits, and taxpayer benefits, also influence tax evasion[11]. A study examined how a country's institutional and socio-cultural factors influence tax evasion prevention. The research focused on a statistical sample of 173 publicly listed companies from eight sub-Saharan African nations, employing multiple regression analysis to evaluate the tests and outcomes. The results indicated that a country's institutional framework and its distinct socio-cultural practices significantly impact the tax evasion behaviors of its businesses. Furthermore, the extent of tax evasion activities among companies is shaped by the quality of management, supervision, auditing, as well as the cultural and ethical standards of the nation[12].A survey was conducted involving the distribution of 100 questionnaires which were subsequently analyzed using partial least squares. This analysis aimed to assess the impact of coercive power and the legitimacy of the tax organization on taxpayer morale in relation to preventing tax evasion. The results indicate that taxpayer morale serves as a crucial deterrent against tax evasion, and it has been demonstrated that tax ethics can mitigate the influence of government coercion on this issue. Furthermore, tax morale enhances the effectiveness of legitimate power in curbing tax evasion, even though coercive government power does not have a direct impact on tax evasion. The study also suggests that taxpayer fraud can be anticipated through the application of government power in the form of sanctions and audits, along with moral power[5]. A qualitative analysis was conducted to examine the factors influencing tax evasion, focusing on individual, social, economic, legal, and administrative aspects. Individual factors encompass demographic characteristics and the moral behavior of taxpayers. Social factors involve social conduct, discrimination, corruption, and political instability. Economic factors contributing to tax evasion include unemployment rates and consumer spending, as limited financial resources lead taxpayers to conceal their actual income. While fear of punishment has a negative correlation with tax evasion, this relationship is influenced by the strength of the rule of law and legal enforcement. Additionally, poor governance and subpar service quality are identified as administrative factors contributing to tax evasion. The findings highlight an urgent need for tax awareness campaigns, increased transparency regarding tax obligations, reduced corruption, a simplified tax system, enhanced economic conditions, effective rule of law enforcement, good governance, and improved service quality [13].In another article, the authors examined various factors influencing tax non-compliance, including gender, age, income, education, trust in government, political orientation, and religiosity. They employed correlation and regression models for variable analysis, revealing a significant difference between the global perspective and the attitudes of male and female groups regarding the acceptance of tax fraud. Additionally, the findings indicate that political factors also play a significant role in tax evasion, alongside individual characteristics [14]. The researchers presented evidence in this study that shows that production costs do not decrease as income decreases. This phenomenon is called cost stickiness and indirectly affects tax evasion [19]. Other findings suggest that cost stickiness has a positive impact on the relationship between institutional investors and passive institutional investors with conservatism [20]. Using the Huang and Salmon model, researchers examined the impact of herding behavior of institutional investors on the stock returns of companies listed on the Tehran Stock Exchange, and their research results showed that there is a relationship between these two variables. Other findings of this study showed that the relationship between herding behavior and stock returns is greater in larger companies than in smaller companies, and also in companies with higher financial leverage; it is greater than in companies with lower financial leverage [21].

3 Methodology

This section discusses the statistical population description and the method used to predict the factors influencing the prevention of tax evasion, as well as the prioritization of the importance of each factor involved in this prevention.

3.1 Statistical Population

The research's statistical population consisted of twenty financial and tax experts, selected from the senior staff and management of the tax organization. The criteria for selection included a minimum of a master's degree in economics or related fields and over ten years of professional experience. The rationale behind choosing these individuals lies in their expertise and extensive experience. Within the central organization of tax affairs, there were approximately 40 candidates who met these criteria, and ultimately, 20 agreed to participate by responding to the questions in a consecutive manner, facilitated by their willingness and availability. It is evident that these experts' continuous interaction with business owners has fostered their expertise, enabling them to provide accurate, relevant, and comprehensive information. The purposeful sampling method was also used for sampling. The indicators extracted for this research were derived from an examination and review of recent scientific studies focused on measuring the effective factors influencing tax evasion prevention. This process involved identifying frequently utilized indicators from these studies and conducting analyses such as variance analysis. After compiling the commonly used indicators, statistical techniques, including variance analysis, were employed to assess the impact of the variables [15].The independent variables examined in the section on factors influencing the prevention of tax evasion are presented in Table 1.

Table 1: Variables examined in the research for effective measurements on the prevention of tax evasion

	Factors	Independent variables
1	Economic factors	Accounting
2		Concealing the income of some taxpayers
3		Money laundering
4		The rise of counterfeit employment and illicit activities
5		economic crisis
6	Social factors	Modeling and learning from the actions and performances of other taxpayers
7		Rule of law
8		media
9		Education level of taxpayers
10		Trust in political institutions
11		Level of social engagement among individuals
12	Legal factors	Presence of various exemptions in tax legislation
13		Fragility and complexity of tax laws and regulations
14		Ambiguity in tax law and contradictions in tax provisions
15	Domestic factors	Administrative red tape and ineffective tax structure
16		Inefficiency of the system and mechanisms for tax incentives and penalties
17		Lack of effective oversight and follow-up in the tax assessment and collection processes
18	Cultural and political factors	Inadequate promotion of tax culture
19		Absence of trust in the government among taxpayers and a belief in the fairness of the tax system
20		Education for taxpayers
21		Unawareness of the equity of the tax system among taxpayers
22		Corruption among government officials

3.2 Prediction of Key Factors in Prevention of Tax Evasion Using Optimization Through Perceptron Neural Networks

The analysis of tax information data has recently gained popularity for identifying the factors that influence tax evasion prevention. Given the non-linear characteristics of this data, relying on simple and rudimentary tools that cannot effectively address both the internal and external aspects of the data and its non-linear dimensions is inadequate. Thus, employing advanced tools that can comprehensively address the internal and external nature of data values and adeptly manage non-linear characteristics while analyzing their interrelationships can be advantageous [16]. In this study, we employed intelligent methods from the machine learning subcategory, which have gained popularity in diagnostic applications across various fields. The combination of meta-heuristic optimization methods and neural networks two intelligent techniques within the machine learning domain can enhance the accuracy of predictions and diagnoses by introducing dynamics and diversity into problem solving approaches. So far, hundreds of meta-heuristic optimization methods have become popular, according to the theory of no free lunch, so far there is a claim that the successful use of a meta-heuristic optimization method in a specific problem leads to the successful use of that optimization algorithm in another problem, not proven. Hence, it is essential to explore alternative criteria for selecting a meta-optimization method to address a problem. One such criterion is the capability to strike a balance between productivity and exploration within the optimization algorithm. The Lemur Optimization Algorithm, introduced by Abbasi in 2019, is inspired by the lemur's behavior of locating prey and evading traps to tackle a variety of challenges. The authors assert that this algorithm effectively balances discovery and productivity capabilities while being straightforward, swift, and accurate for applications in engineering, finance, economics, and more[17].

To adapt meta-heuristic optimization techniques, including the Lemur algorithm, for any given problem, two critical steps must first be established: identifying each solution's position and defining the objective. For the current problem, that is, the analysis of tax data with the aim of identifying factors effective in preventing tax evasion and prioritizing factors with the Lemur optimization algorithm, two steps are needed, which are described below:

3.2.1 The Position of Each Solution

The position of each solution in the search space of the Lemur algorithm is considered equivalent to the database introduced in Table 1, with the difference that for each solution (each database), a setting for the number of neurons in the layer the hidden neural network is considered.

3.2.2 Objective Function

The perceptron neural network is considered as the objective function in Lemur optimization and the resulting error rate is considered as the fitness of the position of each solution. That is, by referring the position of each solution to the perceptron neural network, the error rate resulting from the neural network is recorded as the fitness of the position of each solution. The position of each solution is the same as the database introduced in Table 1 and the difference between each solution is the number of specific neurons in the hidden layer for each solution. In this way, for each solution whose position is equivalent to the database of the problem, a specific and unique state of the number of neurons in the hidden layer is considered, and the neural network with that unique setting of neurons in the hidden layer on the database. It is implemented and the error rate resulting from the prediction of factors affecting the prevention of tax fraud is recorded as the appropriateness of that solution.

3.2.2.1 Prediction with Perceptron Neural Network

Given that the objective function is a neural network, then the method of predicting perceptron with a neural network for each solution to the problem is mentioned in order to calculate the error rate, which is recorded as the fitness of each solution. Multilayer perceptron's cover a large group of feedforward neural networks with one or more neuron layers. In most applications, multilayer perceptron networks with three layers in addition to the input and output layers have been used. The neurons in the input layer have a pure linear activation function, but some nonlinear activation functions such as logarithmic and tangent sigmoid functions are used in the neurons in the hidden and output layers. An architectural design for a multilayer perceptron network with only one hidden layer is shown in Fig.1[18].

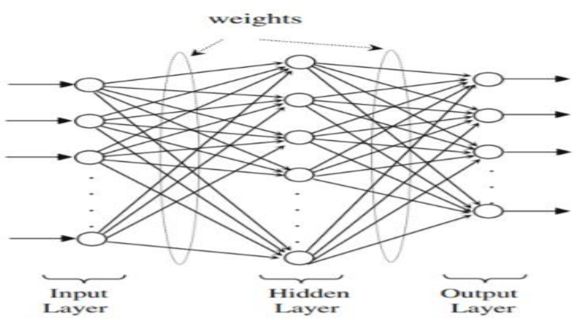

Fig. 1: Simple perceptron neural network [18]

To predict and solve any problem using neural network, first of all, it is necessary to determine some important factors, including the number of input layers, output layer, and hidden layers, and then the number of neurons in each of the mentioned layers and determine some parameters. One of the settings of the learning rate is the type of learning. Fig. 2 shows the overview of prediction with neural network.

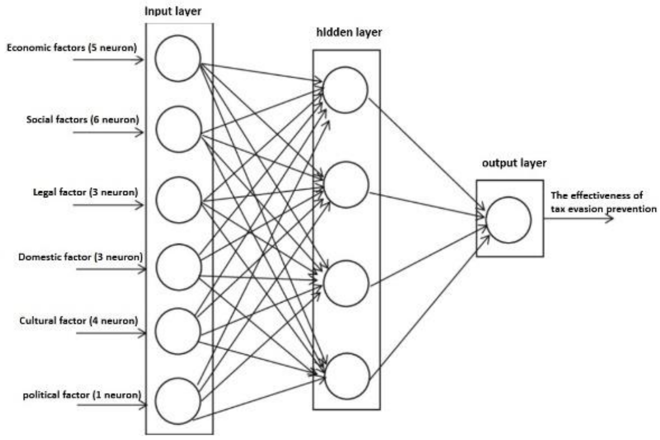

Fig. 2: Overall framework for predicting tax evasion using a perceptron neural network.

As depicted in Fig. 2, the current problem consists of an input layer, a hidden layer, and an output layer. The number of neurons in the input layer and the output layer is determined by the specifics of the problem, as outlined in the research database presented in Table 1. The neurons in the input layer correspond to the independent variables (input variables) of the problem, while the neurons in the output layer relate to the dependent variables (output variables).

In this context, our problem utilizes the database introduced in Table 1, which includes independent variables that are indicators related to the prevention of tax evasion, as well as a dependent variable representing the impact on preventing tax evasion. So, the number of neurons in the input layer is equal to 22 neurons that represent the database inputs and the number of neurons in the output layer is equal to 1 number of neurons that represents the output of the database in Table 1. But regarding the choice of the number of neurons in the hidden layer, it should be mentioned that until now there is no theory that for a specific problem, choosing how many neurons in the hidden layer can be suitable, therefore, in the process of meta-heuristic method for each way solution i in the algorithm, a specific number is considered to determine the neurons in the hidden layer, and in this way, a specific number of neurons is used for each solution, so that each of the solutions in the meta-heuristic algorithm of Lemur with a specific state of the number of neuron in the hidden layer should be tested and the possibility of dynamizing the neural network by diversifying the choice of the number of neurons in the hidden layer would be provided. For this purpose, a certain ceiling is chosen for the number of neurons in the hidden layer, for example 30, and for each solution, a random and non-repetitive state in the range of 1 to 30 is chosen as the number of neurons in the hidden layer, so that each of the ways The solutions should be examined with a special mode of choosing the number of neurons in the hidden layer and the diversity in solving the problem of predicting factors affecting the prevention of tax evasion with a perceptron neural network by means of Lemur's meta-heuristic algorithm should occur. The process of training and calculations in neurons and layers is done using the input-output equation presented in equation (1).

$$y_p^k = logit_p^k\left[\sum_{i=1}^{N_{k-1}} W_{ip}^{k-1}.y_i^{k-1} - \beta_i^k\right].\ \ p = 1.2\ldots N_k;\ \ k = 1.2.\ldots M \tag{1}$$

so that W_{ip}^{k-1}, the connection weights between the ith neuron in the $k-1^{ip}$ layer and the pth neuron in the kth layer, y_p^k, the output of the pth neuron in the kth layer, sgm_p^k, the activity function logit of the pth neuron in the kth layer and β_i^k is the threshold of the pth neuron in the kth layer.

The logit activity function is assumed according to the equation (2):

$$logit(a) = \exp\left(-\frac{\|x-y\|^2}{2\sigma^2}\right) \tag{2}$$

The training process of the back propagation algorithm was used for the perceptron neural network, which is implemented according to the following steps.

1. Initialize all weights randomly
2. Calculate the output vector
3. Calculation of propagation error
4. Update weights using equation (3-4)
5. Calculation of total error (ε) using equation (5)
6. Repeating the algorithm from step 2 onwards until the convergence condition is met. The condition of cooperation is to reach 0 or close to zero error.

$$W_{ip}^{k-1}(t+1) = W_{ip}^{k-1}(t) + \alpha\sum_{n=1}^{l}\delta_{np}^k y_{ni}^{k-1} \tag{3}$$

where t is the iteration of the algorithm and α is the learning rate.

$$\delta_{np}^k = exp_{np}^k\left[\sum_{t=1}^{N_{k+1}}\delta_{nl}^{k+1}W_{pt}^k\,(t)\right] \tag{4}$$

$$\varepsilon = \frac{1}{n}\sum_{n=1}^{l}\sum_{j=1}^{N_M}\left(y_{nj}^M - \hat{y}_{nj}^M\right)^2 \tag{5}$$

3.2.3 The process of predicting the factors influencing the tax evasion and prioritizing the importance of each factor

In this section, the steps of the proposed method for predicting factors affecting the prevention of tax evasion and how to calculate the importance of each of the factors involved using Lemur's meta-heuristic optimization algorithm based on perceptron neural network have been discussed.

1. Initialize tuning parameters such as the maximum iteration of the algorithm ($Maxiter$), population size, dimension size of the problem, lower limit (LB) and upper limit (UB) of the problem search space, low and high-risk rate and repetition which indicates the current iteration of the algorithm with 0 Set value (t=0).
2. Generating the initial population of random solutions based on formula (6) and according to section (3-2-1)

$$l_j^i = rand * \left(\left(ub_j - lb_j\right) + lb\right)\quad \forall i \in (1.2\ \ldots.n)\ \wedge\ \forall j \in (1.2\ \ldots.d) \tag{6}$$

so that rand is a random number in the interval [1,.., Max_int] so that Max_int is the largest integer determined based on the population size, lb_j and ub_j are respectively the lower and upper limit of the problem search space for the decision variable j is the solution with lower fitness changes its position towards the solution with higher fitness, meaning that the overall fitness value of each solution improves with iteration.

3. One unit is added to repetition t ($t = t + 1$) and until the current repetition value of t has not reached the maximum repetition ($Maxiter$), continue steps 4 to 13, otherwise, refer to step 14.
4. By referring the position of each i solution i.e. ($l(i.j)$ to the objective function, calculate the fitness of each i solution according to section (3-2-2).
5. Calculate the FRR rate based on formula (7).

$$FRR = (High\_Risk\_Rate) - CurrIter * ([High\_Risk\_Rate - Low\_Risk\_Rate]/Maxiter) \quad (7)$$

As Low_Risk_Rate and $High\_Risk\_Rate$ are predefined constants respectively, $Maxiter$ is the maximum iteration of the algorithm and $CurrIter$ is the current iteration of the algorithm.

6. For each solution, do the following.
7. Update the position of each solution i based on the closest position with the best fit.
8. For each dimension j of solution i, do the following.
9. Choose a random number (rand) in the interval [0,1].
10. If the generated random number is less than the FRR rate (rand<FRR), go to step 11, otherwise, go to step 12.
11. Update the position of each solution based on the first state in equation (8).

$$L_j^i = l(i.j) + abs\left(l(i.j) - l(bn.j)\right) * (rand - 0.5) * 2 \qquad rand < FRR \quad (8)$$

so that $l(i.j)$, solution i with the current (current) position in dimension j, $l(bn.j)$, the position of the closest solution with the best fitness (best position) to the current solution $l(i.j)$ for dimension j be $l(gb.j)$ is the solution with the best position among all solutions of the problem, FRR is the safety (risk-free) rate of lemurs in their collective group, and rand is a random number in the interval [0,1].

12. The position of each solution i should be updated based on the second state in equation (10).

$$L_j^i = l(i.j) + abs\ (l(i.j) - l(gb.j)) * (rand - 0.5) * 2 \qquad rand > FRR \quad (9)$$

So that all the terms of this equation are the same as equation (9) with the difference that $l(gb.j)$ is the solution with the best position among all the solutions of the problem.

13. Sort the solutions in ascending order and the solution with the best position among all the solutions (solution gb) is selected as the answer and the algorithm is terminated.
14.

Fig. 3 shows the proposed method for predicting factors affecting the prevention of tax evasion.

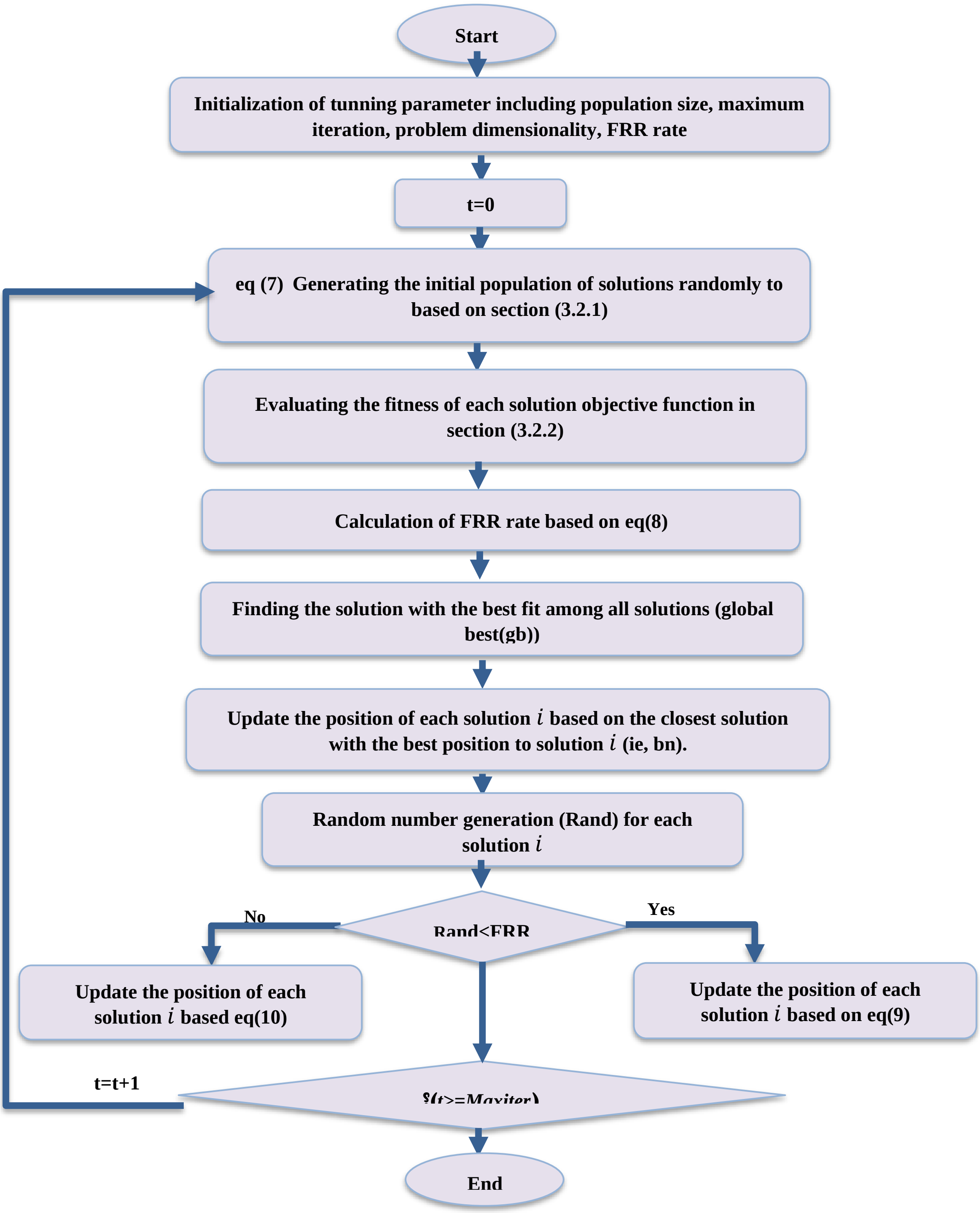

Fig. 3: Lemur optimization process based on neural network objective in the proposed method

The flowchart of the proposed method for predicting effective factors on tax evasion prevention based on the identification of effective factors with Lemur optimization method based on perceptron neural network is shown in Fig. 3 Since the Lemur optimization algorithm method is considered a meta-heuristic method, first of all, it is necessary to determine the position of each solution and evaluate the position and the degree of fitness is any solution. Therefore, the method of Lemur optimization algorithm in the first phase requires determining the solutions in the problem space, after determining the number of solutions in the problem, it is necessary to determine the position of each solution, the position of each solution according to section 3.2.1. equivalent to a matrix with M rows and N columns, that is, M*N, where M represents the rows of the database (samples of tax information data) and N represents the total number of input and output variables in Table1, it is considered, in other words, the position of each solution is equivalent to the database of the problem, where each database is considered with a specific and individual setting of the number of neurons in the hidden layer. After determining the position of each solution, the initial position of each solution should be evaluated, the evaluation of the initial solutions by referring to the objective function in section 3.1.2 and placing it in the calculation of the update of the position of each solution in lemur optimization That is, it is determined in the formula. Up to this stage, the value of the initial position and the assessment of the suitability of each solution in the problem space are calculated, after that it is time to update each solution in each iteration, so that when the solutions pass to the iteration space of the algorithm, the solution are updated in each iteration until the termination condition is reached. How to update each solution in each iteration is done by approaching the global best and the closest solution with the best position for each solution. After updating each solution, the fitness function is referred to again and the fitness level of each solution is selected to decide on the best solution. The objective function is the accuracy of the evaluation of two functions, minimization and maximization. By dynamizing the process of predicting factors affecting prevention of tax evasion with neural network, it is expected that the neural network method will work with higher accuracy to achieve more accurate prediction.

4 Findings

In this section, the research data is analyzed. First, the main factors to prevent tax evasion from the perspective of the employees of the country's tax affairs organization, which are extracted from the review of available literature and sources, are confirmed by the meta-heuristic optimization method based on perceptron neural network. Table 2 shows the descriptive statistics of the respondents. As can be seen in the Table, 30% of the respondents were female and 70% of them were male. In terms of age, 50% were 30 to 40 years old, 20% were 41 to 50 years old, and 30% were over 50 years old. In terms of education, 40% have a master's degree and 60% have a doctorate.

Table 2: Descriptive statistics of the respondents

	Properties	Percentage	Frequency
Gender	Female	30	6
	Man	70	14
Age	30 to 40 years old	50	10
	41 to 50 years old	20	4
	over 50 years old	30	6
Level of Education	Masters	40	8
	P.H.D	60	12

Since the combination of Lemur's meta-heuristic algorithm and neural network has been used, these two methods are among the machine learning methods. We know that machine learning methods are data-based methods. In order to apply data-based methods in any problem, including the problem of predicting the factors affecting the prevention of tax evasion, it is necessary to divide the data into two parts: training (data containing input and output) and test (data containing only input and no output) .In the data-driven method, first, the data of the training department is used to train the proposed method, including the method of predicting the impact of each factor, and after the method becomes a trained method and aware of the values of the used characteristics, by referencing the data of the department The test is based on the trained method (neural network-based meta-heuristics), which has been transformed into an informed and trained method with training data, to predict the factors in the test data for validation and efficiency testing.) method is discussed. One of the ways to divide the tax data into two parts, training and test, is to use the percentage random selection method, and in this problem, numerous reviews and tests indicated that the percentage method of 70% to 30% is suitable. and leads to high efficiency in detecting the impact level by relying on the measurement of the coefficients of the used characteristics. Therefore, in this thesis, 70% of the data are randomly used as training data and the remaining 30% as test data. MATLAB software was used to simulate the meta-heuristic method equipped with neural network proposed in this research. Using the MATLAB programming environment, the implementation and testing of the proposed method and the compared method for predicting the factors affecting the prevention of tax evasion and calculating the importance coefficients of each of the factors were discussed, and the tax information data was processed. In the following, the tests performed and the performance evaluation criteria and the findings have been discussed. Different numbers of neurons in the hidden layer (1-20 number of neurons) have been tested. Fig. 4 shows the average relative error resulting from considering each arrangement of neurons in the hidden layer (1-20 neurons). so that the x-axis indicates the number of neurons in the hidden layer and the y-axis indicates the prediction error of preventing tax evasion and the factors affecting it. Also, the color problem line indicates the error of the neural network method with each setting of the hidden layer neurons on the test data and the red line indicates the error of each setting of the hidden layer neurons on the training data. The mse criterion was used to calculate the error value. The mean square error formula is defined according to the equation.

$$mse = \frac{1}{n}\sum_{i=1}^{n}\left(Y_i - \hat{Y}_i\right)^2 \tag{10}$$

So that in the formula (10) where Y_i is the observed value (actual output), $\hat{Y}_i$ is the corresponding predicted output value for Y_i and n is the number of observations. Sigma represents the summation over all i values for differences between actual and predicted output values.

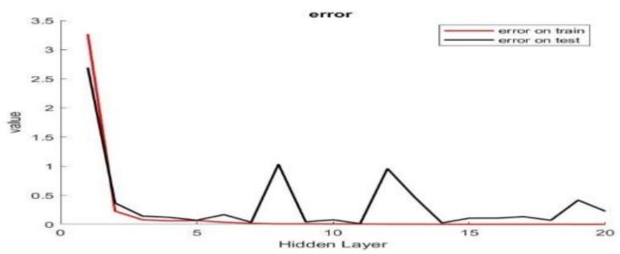

Fig. 4: Prediction error in the proposed intelligent tax evasion prevention system

Fig. 4 shows the prediction error. Here too, for the majority of the number of neurons in the hidden layer, we are faced with an error of less than 1% (or more than 99% accuracy), but for 8 of the number of neurons in the hidden layer, with 100% prediction in all three parts, respectively, training, test and All tax data has been exposed. The Table 3 shows the corresponding relationships of forecast error and tuning of neurons in the hidden layer.

Table 3: Corresponding table of errors and neurons

		Errors	
		Error on train	**Error on test**
Number of neurons	1	3.269537683	2.693925688
	2	0.230231067	0.369868381
	3	0.08347561	0.146277734
	4	0.063307882	0.123338452
	5	0.069723783	0.074268259
	6	0.039529831	0.169424047
	7	0.021735036	0.040384458
	8	0.011513447	1.036230705
	9	0.012096051	0.046500317
	10	0.00985717	0.081291763
	11	0.009376082	0.015475374
	12	0.007182841	0.96075765
	13	0.006816475	0.468707455
	14	0.005687306	0.027508417
	15	0.005567576	0.109508139
	16	0.005531112	0.10981304
	17	0.005333146	0.135017181
	18	0.005682177	0.073317214
	19	0.00470482	0.418811611
	20	0.004995833	0.229154852

One of the ways to ensure the results obtained from the proposed method is to check the confusion analysis matrix, this matrix is from comparing correct estimates against incorrect estimates (wrong), to estimating measurement criteria such as accuracy, precision, specificity and sensitivity. The view of the disturbance matrix is shown in Fig. 5. If the output (dependent) variable has two positive and negative values, then the disturbance matrix is expressed as Fig. 5.

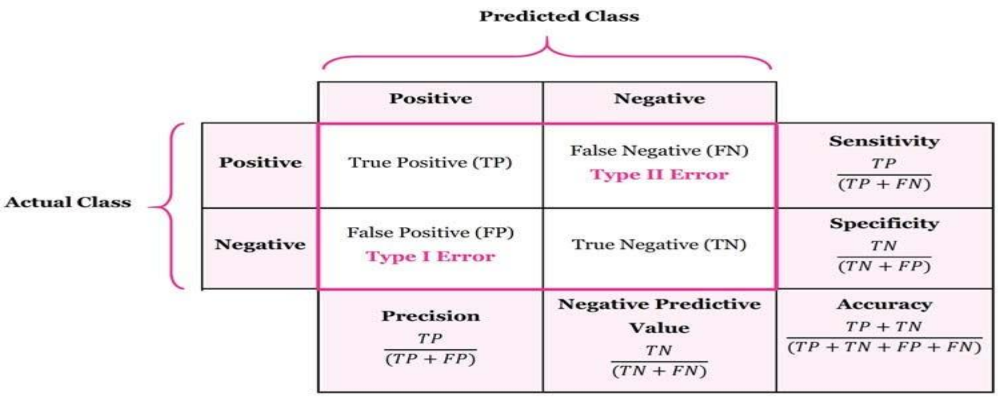

Fig. 5: Confusion Matrix

Considering that in the current research, the amount of impact is an output (dependent) variable and has a variable value, so it is not possible to define a specific output value for it, therefore, to break down the range of impact into positive and negative classes, The solution is to calculate half of the maximum amount of impact (calculate the maximum amount of impact and then divide it by 2) and consider the impact amount to be less than half of the impact amount equivalent to negative class and more than half of the impact amount equivalent to positive class. In other words, it is assumed here that the class of those data whose impact is less than half of the maximum impact is equivalent to class 0 (negative) and the class (model) of those data whose impact is greater than Half the maximum effect is taken as equal to 1 (positive). Next, the disturbance analysis for the best setting of the number of neurons in the hidden layer is shown in Fig. 6.

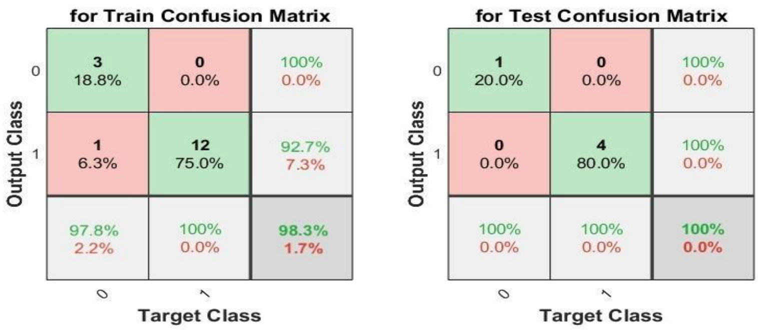

Fig. 6: The importance of effective factors

As it is clear from Fig. 6, the rows represent the expected output and the columns represent the actual outputs. The diagonal cells represent those samples that are correctly predicted. Off-diagonal cells also represent observations (samples) that are incorrectly predicted. The number of samples and the percentage of total data samples are shown in each cell. As can be seen from Fig. 6 high percentages of predicted data have been obtained in the section of test samples, about 98.3% for the training section and 100% for the test section. Fig. 7 shows the findings of the percentage of influence of each of the factors involved in tax evasion on the estimation of the influence of the factors in each of the investigated data, so that the x-axis is the research variables (22 variables in Table 1) and the y-axis is the percentage of importance of each of It shows the variables in the normalized interval [0-1], by multiplying each of the y-axis values by 100, the percentage value of each variable is obtained based on the percentage based on 100.

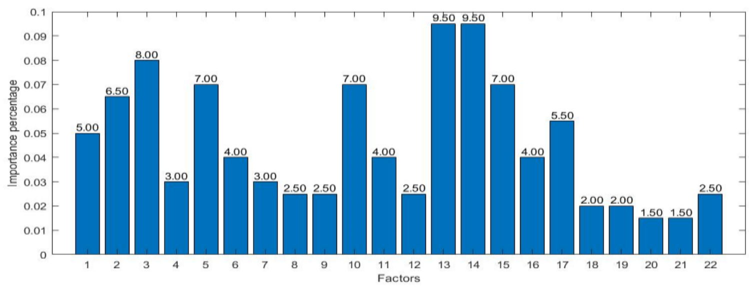

Fig. 7: The importance of effective factors

It should be noted that the importance coefficient of each index is distributed in such a way that the sum of the importance coefficients is equal to 100%. In this regard, if we want to categorize the indicators in three categories of importance including high, medium and low importance in predicting the prevention of tax evasion, the indicators of variables number 2, 3, 5, 10, 13, 14, 15 can be which respectively indicate the factors of concealment of income, money laundering, economic crisis, political trust, weakness and complexity of laws and regulations related to taxes, weakness in clarifying the tax law and contradictions in legal articles of taxes and administrative bureaucracy and inefficient tax structure, except Variables are placed in the category of high importance.
Variables No. 1, 6, 16, 17, 22, which respectively indicate accounting, modelling and learning from the actions and performances of other taxpayers, Inefficiency of the system and mechanisms for tax incentives and penalties, Lack of effective oversight and follow-up in the tax assessment and collection processes and Corruption among government officials except for the variables in the category of medium importance. Variables No. 4, 6, 7, 8, 9, 11, 12, 18, 19, 20, 21, which respectively represent the rise of counterfeit employment and illicit activities, rule of law, media, education level of taxpayers, level of social engagement among individuals, presence of various exemptions in tax legislation, inadequate promotion of tax culture, absence of trust in the government among taxpayers and a belief in the fairness of the tax system, education for taxpayers and unawareness of the equity of the tax system among taxpayer, they are placed in the low importance category.
Therefore, according to the results, it seems that more accurate diagnoses can be made to prevent tax evasion by relying and focusing more on technical indicators that are in a high importance category.
In the perceptron neural network, there are connection weights.
Connecting weights are in two categories. The first category is the connection weights between the neurons of the input layer and the neurons of the hidden layer, whose number is equal to the product of the number of neurons of the input layer and the neurons of the hidden layer.
The second category includes the connection weights between the neurons of the hidden layer and the neurons of the output layer, whose number is equal to the product of the number of neurons of the hidden layer and the neurons of the output layer. According to the article, the number of neurons in the first layer is equivalent to the number of research variables introduced in Table 1, that is, it is equivalent to 22 variables.
The number of neurons in the output layer, 1 neuron is equivalent to tax evasion or non-evasion. The best tuning obtained from Lemur optimization for the neural network also shows 8 neurons in the hidden layer.
So, in the best setting obtained from the proposed algorithm, the number of connecting weights between the neurons of the input layer and the neurons of the hidden layer is equal to 8*22, the details of which are given in Table 4.
Also, regarding the number of connecting weights between the neurons of the hidden layer and the neurons of the output layer, the number is equal to 1*8, the details of which are given in Table 5.

Neurons in the input layer (22 Neuron)		Neurons in the hidden layer (8 Neuron): Neuron 1	Neuron 2	Neuron 3	Neuron 4	Neuron 5	Neuron 6	Neuron 7	Neuron 8
Economic factors	factor1	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor2	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor3	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor4	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor5	0.000989	0.002763	-	-0.006242	-	0.000185	-	-0.001948
Social factors	factor6	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor7	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor8	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor9	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor10	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor11	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
Legal factors	factor12	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor13	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor14	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
Domestic factors	factor15	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor16	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor17	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
Cultural and political factors	factor18	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor19	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor20	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor21	0.000989	0.002764	-0.00348	-0.00624	-0.00068	0.000186	-0.00791	-0.00195
	factor22	-1.17115	-1.30004	-1.12317	1.00005	1.166378	-0.9482	-0.96361	0.943143

Table 4: The values of the connecting weights between the input layer and the hidden layer

Table 5: The values of the connecting weights between the hidden layer and the output layer

		Neurons in the hidden layer (8 Neurons)							
		Neuron 1	**Neuron 2**	**Neuron 3**	**Neuron 4**	**Neuron 5**	**Neuron 6**	**Neuron 7**	**Neuron 8**
Neurons in the output layer (1 Neuron)	**Neuron 1**	-1.39245	-1.33269	-1.41349	1.464032	1.394714	-1.48125	-1.4731	1.482464

5 Discussion and Conclusions

Nowadays, the use of techniques based on artificial intelligence to analyze tax data, recognize the process of tax payment and prevent tax evasion has become common, in this article we will study the recently presented smart techniques in this field and promote one of the common and important smart techniques in This field has been addressed. A review of forecasting studies shows that in the field of using intelligent techniques, the technique based on the regression of the simple neural network method, although it is not very new, and the peak of studies in this direction belongs to the past few years, but until now, studies in the field of improving these methods continue. had. Therefore, providing a technique that leads to a more accurate analysis of neural network techniques can provide an accurate decision-making system with the least error for making decisions in the direction of tax data analysis. One of the effective versions of the neural network is the perceptron neural network. In this article, from the technique based on the use of Lemur's meta-heuristic algorithm with the objective function based on the perceptron neural network to analyze the relationships between the variables involved in the prevention of tax evasion, to analyze tax data in order to provide an effective method to prevent tax evasion by determining the impact of each of the variables involved were used. The results of the experiment show that the average accuracy of the associated network method is better than using the classical neural network method without meta-heuristic algorithm. In addition, it can detect multiple values at the same time, and the average accuracy of each detected value is more than 98%. Using the neural network as the objective function in the optimization algorithm allows for proper adjustment and estimation of the initial outputs in the neural network, and therefore the values of the indices extracted from the tax data (independent variables) with optimal and conscious weights in order to estimate the output of preventing Tax evasion and then estimate the percentage of involvement (importance) of each of the independent variables of the statistical population. The implementation method discussed in this article is a robust approach that utilizes detailed analysis of independent variables to effectively address the decision-making challenges associated with tax data. This technique is specifically designed to identify tax evasion and its contributing factors. By employing a multiscaling technique on time series data, it optimizes the dataset by removing irrelevant information. The method calculates coefficients for each independent variable, allowing for a precise assessment of the similarity between the primary tax data time series, which is processed using the sigmoid activation function in the neural network throughout different iterations of the Lemur optimization algorithm. This process enhances data reconfiguration and accurately highlights the significance of each independent variable (factors that contribute to the prevention of tax evasion) within the tax data and subsequently, it leads to an increase in accuracy in the decision-making process in the process of predicting the percentage of tax evasion with the proposed method and at the same time reducing the execution time of this algorithm. Therefore, according to the mentioned explanations, the analysis of the findings indicates the correctness of the technique, including equipping the proposed technique. It can also be concluded that government managers' more attention to variables of high and medium importance can cover part of the problems of tax evasion. The variables of the high importance category include the variables of income concealment, money laundering, economic crisis, political trust, weakness and complexity of the laws and regulations related to taxes, weakness in clarifying the tax law and contradictions in the legal articles of taxes and administrative bureaucracy and inefficient tax structure, and the variables The category of medium importance includes the variables of the spread of fake jobs and underground activities, modelling, learning and taking from the actions and performance of other taxpayers, legalism, media, the level of education of taxpayers, the level of social participation of individuals, the existence of various and numerous exemptions in the tax law. , lack of efficient promotion of tax culture, lack of tax belief among people and taxpayers' lack of trust in the government, taxpayers' education and not knowing the fairness of the tax system are facing the taxpayers. The findings of the studied research are compatible with the findings of the researcher [11] and [12] in the direction of predicting the prevention of tax evasion and the difference of the proposed method is the use of more indicators as well as the use of optimal Sazi Lemur is a meta-heuristic algorithm in line with the development of solutions found in the neural network, which has led to higher accuracy than the compared method. According to the results and analysis carried out in the findings section, the following suggestions are presented:

1. Based on the research findings, several significant factors have been identified that serve as effective indicators for preventing tax evasion. Consequently, government officials should closely examine the indicators categorized as high and medium importance in this study to develop policies aimed at predicting and preventing tax evasion. Even a slight reduction in tax evasion could result in billions of dollars in revenue, which is urgently needed for Iran's economy.
2. Future researchers may consider exploring the topic of deep neural networks. Utilizing deep neural networks to analyze tax data for predicting tax evasion and its influencing factors necessitates robust hardware, including a powerful processor and graphics processor. When such resources are accessible, deep neural networks can effectively predict the significance of each factor involved in mitigating tax evasion with an accuracy exceeding 99% and approaching 100%.
3. Also, in the future work, an attempt will be made to use the LSTM neural network and its optimization with the Lemur optimization algorithm. In other words, the number of appropriate layers in LSTM can be determined with the Lemur optimization algorithm.

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