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A Comparative Study of the Prediction Stock Crash Risk by using Meta- Heuristic & Regression

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ABSTRACT

One of the most important methods of opacity accounting information by management is to accelerate the identification of good news versus delaying the identification of bad news on profits, but there is always a final level of accumulation of bad news in the company, and by reaching that its final level, these bad news will be released, which will lead to a Stock Price Crash Risk. In fact, stock price collapse is a phenomenon in which stock prices are subject to severe negative and sudden adjustments. Accordingly, the first purpose of this research is to model the Stock Price Crash Risk of the listed companies at the Tehran Stock Exchange by using an optimal algorithm The cumulative particles and comparison with the results of logistic regression model. To this, a hypothesis was developed for the study of this issue and the data of 101 listed companies of Tehran Stock Exchange for the period between 2010 and 2014 were analyzed. First, 14 independent variables were introduced as inputs of the combined genetic algorithm and artificial neural network, which was considered as a feature selection method, and 7 optimal variables were selected. Then, using particle cumulative algorithm and logistic regression, predicted The Crashs. To calculate the Stock Price Crash Risk, a Stock Price Crash Period criterion has been used. In The Second Stage, the particle algorithm was used as a feature selection, and this time, to calculate the Crash risk, the NCSKEW criterion was used. Finally, the optimal variables were entered into the Ant Colony algorithm and the results were compared with the multivariable regression. In the second step, MSE and MAE were used to compare the results. The results of the research show that the particle Swarm Optimization and Ant colony are more able than traditional regression (lojestic and multivariable) to predict the Crashs. Therefore, the research hypothesises are confirmed.

Keywords: Cumulative motion algorithm of particles, genetic algorithm, artificial neural network, stock price risk.

1. Introduction

Many researchers, such as Chen et al. (2001), believe that the stock price changes of a company result from its internal information management. In the event that the information is randomly introduced into the market and the process of disseminating information, regardless of its good or bad, is systematically performed, that is, if managers disclose all information quickly, this will result in stock returns Has a symmetric distribution (Kotari et al., 2009), but managers are always motivated to hide information and negative news from investors and accumulate them within the company. The result of this operation is that the image of the business unit looks better than the real situation and the motivation of the outsourcing people to increase in the business unit (Ball, 2009). If managers are able to hide bad news for a long time, it appears that negative information will be stored within a company. This restriction is due to the fact that if, at a certain time, the amount of bad news collected has reached a certain threshold or a certain limit, then it will either be very costly to continue hiding or it will be completely impossible to continue to hide them. . When the collection of bad news reaches the last point, all of them are suddenly published, resulting in high negative returns for the stock, which the market has adapted to, and this is the fall of prices (Hatton et al. , 2009; Jane and Myers, 2006 Knowing the causes of this phenomenon, the ways in which this phenomenon can be prevented in capital markets, and models that can predict this phenomenon are of great importance to capital market operators. The other side, with the growing issues and the importance of speeding up the response, are other classic methods It is not a solution to many problems, since the search space increases exponentially with the next dimension of the problem, and classical ones are not cost-effective due to cost constraints. Studies also show that the use of statistical models. The reason for relying on restrictive assumptions has been reduced and encouraged by artificial intelligence techniques, because these techniques are often nonparametric, and their use does not require much initial assumptions. In the meantime, ultra-high-tech algorithms pay more attention. They have been attracted because of the financial optimization issues with a massive and incomplete set of data Who are facing change over time. The main advantage of using Meta - heuristic methods is the existence of limited assumptions in formulating the model, while this does not apply to mathematical programming. Studies have shown that the analysis of financial ratios using statistical methods, such as Logistic regression or methods such as probability, bay, and multivariate regression have been widely used. Artificial intelligence and more neural networks have also been used and have better results than completely statistical methods. Therefore, according to the materials mentioned in this research, it has been tried to study the literature of the subject and the relevant background, a complete set of independent variables that are compatible with the economic conditions of Iran and are available, and by calculating the dependent variable (Stock Price Crash Risk) and placing the results in a relatively comprehensive research forecasting model. Thus, it can be argued that this research is based on a reason, such as the use of a more complete set of variables than previous research, the use of new methods for predicting which are used in other financial and non-financial issues, and the more favorable outcomes Statistical methods have been used to compare the results with logistic regression, which is one of the most widely used statistical methods used in this field, as well as calculating the Crash of research based on weekly returns that is more accurate in comparison with seasonal and monthly calculations. Some kind of innovation can be achieved.

2. Literature Review

If managers are able to hide bad news for a long time, it appears that negative information will be stored within a company. However, there is a limit to managers in terms of the amount of bad news that they can attract and successfully hide. This limitation is due to the fact that if, at a certain time, the amount of bad news gathered reached a certain threshold or a certain limit, then they would either continue to hide them or they would be very costly or, The whole thing will be impossible. When the bad news collection arrives, all of them are suddenly released, resulting in high negative returns for stocks, which the market has adapted to, and this is the price collapse. (Hatton, 2009; Jane and Myers, 2006). The definition of Stock Price Crash Risk has three distinct features: A stock price collapse is a very large and unusual change in stock prices that occurs without a major economic incident. B. These huge changes are negative. Falling stock price is a contagious

phenomenon at the market level. This means that the decline in stock prices is not limited to a single stock, but includes all types of stocks available in the market (Chen et al., 2001). Despite the fact that the phenomenon of negative asymmetry or negative skewness in the stock market return is generally agreed upon by all owners, the economic mechanism that led to this phenomenon is still not explicitly stated (Hatton et al. 2009). In the literature, several theories and perspectives on the explanation of the phenomenon of falling stock prices have been presented (Tonani et al., 2015). Black and Christy (2007) presented a theory of leverage effects in explaining how the stock price collapses. This theory states that the decrease (increase) in the stock price of a company increases (decreases) its financial and operational leverage, and, in turn, leads to a fluctuation in stock returns and this asymmetric response, the negative skewness of return on equity Has a companion. Blanchard & Watson (1982) in explaining the phenomenon of negative stocking of stock returns, the bubble model Random stock prices. According to new financial theories, the value of a share is equal to the sum of the present value of its future cash flows. Also, based on the efficient market hypothesis, stock prices fluctuate in an efficient market or within its inherent value range. But at times, due to a shock (the publication of new information, etc.), prices rise without any fundamental justification and, in other words, stock prices are rising dramatically.

Chen et al. (2001) investigated the determinants of stock returns in a study entitled "Crash Forecast Using Trading Volume, Previous Returns, and Contingent Skidding in Stock Price" and a series of cross-sectional regression techniques for The prediction of skewedness was used in daily stock returns of individuals, and concluded that the more negative skewness in stocks that had first increased turnover in the first six months, and secondarily, in the thirty-six months, had a positive return , More visible. Hung and Stein (2003) talked about falling stock prices that behavioral heterogeneity of their investors was a reason to speed up the fall in stock prices. Their model shows that if the difference between investors in the beginning is high, the hard-line investor, by hearing the smallest bad news badly, is selling his stock quickly, and trying to get out of the market as quickly as possible, which this The move will ultimately lead to a fall in stock prices. The two researchers, on the other hand, have also pointed out the asymmetric information between investors as well. Houghton et al. (2009) investigated the relationship between the lack of transparency of financial reporting and the Crashs in a study entitled "Transparent Financial Reporting, R2 and Risk of Price Fall". Using earnings management as a criterion for the lack of transparency of financial information, they concluded that the lack of transparency of financial information is associated with less disclosure of information. In addition, companies with non-transparent financial statements are more exposed to the Crashs.

Kim et al. (2015) in a study entitled "Understanding complex financial reports and the Crashs" concluded that less understanding of the K-10 reports predicted a higher risk of falling prices. The results showed that the reporting effect A complex financial risk to the Crashs for companies with good news or good news, transient profits, companies with incentives to buy senior executives and companies with lower risk appeals. They also found that the Sarbanes law - Axel does not reduce the relationship between complex financial reporting and risk of collapse.Cullen & Fang (2015) in a research entitled "Religion and the Crashs" are investigating whether religiosity is at stake with the Crashs in the future. Findings of this study show that religion as a set of social norms helps reduce managers' activities in hiding bad news from shareholders. The results also show that the negative relationship between religion and the risk of future stock price collapse is likely to be stronger for high-risk companies and for companies with weak corporate governance.

Worst (2016) explores the impact of capital market competition on the risk of stock price collapse in a study entitled "Capital Market Competition and Risk of Stock Price Risk." He concluded that capital market competition reduced the impact of bad news kept, and was linked to a reduction in the likelihood of a fall.

In Iran, Dyanty et al. (2012) in a study entitled "The Impact of Cash Flow Turnover Working Capital Management (Gutman) on Reducing the Crash" examines the impact of working capital management on reducing the Crashs. To pay. In this study, strong evidence is provided that the management of capital in circulation reduces the risk of stock price risk significantly. Ahmadi et al. (2014), "Investigating the Impact of the Auditor's Size and Auditor's Opinion on

the Future Risk of Future Stock Price", examined the impact of the size of the audit firm and the auditor's opinion on the risk of future stock price collapse in companies admitted to the Tehran Stock Exchange The results of the research show that modified commentary variables and lack of transparency of financial information have a positive and significant effect on the size of the audit firm and have a negative and significant effect on the risk of future stock price collapse in companies admitted to the Tehran Stock Exchange.

Taleb Nia et al. (2013) in a study entitled "The Impact of Financial Flexibility on Risk Factors". Flexible Financial Impact on Falling Risk (Fall) (Stock of 58 Companies Admitted to the Stock Exchange over the Period from 2001 to 2010) The results show that financial flexibility reduces the risk of stock price collapse, as well as control variables of profitability, conservatism and negative coefficient of skewness have a reverse relationship with stock returns and the relationship between heterogeneous variables of investor beliefs and non-existence Transparency of financial information is direct and significant with the fall in stock prices. Ahmadpour et al. (2013) investigated the effects of some of the company's characteristics, such as return on assets, return on equity, firm size, corporate finance leverage, market value to equity, and the ratio of the company's quotation to the risk of falling prices. The shares of companies admitted to the Tehran Stock Exchange have been paid for a seven-year financial period (from fiscal year 2007 to 2011). The results of this research indicate that there is a negative relationship between asset returns, company size, market value to book value of equity and the ratio of QT to Crashs in companies admitted to the Tehran Stock Exchange. But there are two variables of return on equity and Financial leverage does not have a significant relationship with the risk of stock price collapse in companies admitted to Tehran Stock Exchange .

Wadeyy and Rostami (2013) in a study entitled "Investigation of the Effect of Institutional Ownership on the Future Stock Price Risk in the Companies Acquired in the Tehran Stock Exchange" The Impact of Institutional Ownership on the Future Stock Price Risk in Accepted Companies. In the Tehran Stock Exchange, according to data from 80 companies during the years 2014 to 2012. The results showed that institutional ownership has a significant positive effect on the risk of future stock price collapse. By dividing institutional ownership into both active and inactive, the results show that the positive effect of institutional ownership on the risk of a future stock price fall is due to inactive institutional ownership and active institutional owners have a supervisory role in reducing the risk of future stock collapse. In other words, active institutional ownership, negative impact and inactive institutional ownership have a positive impact on the risk of future stock collapse. Jafari (2015), in a study entitled "The Effect of Real Profit and Competitiveness in the Product Market on the Risk of Future Price Fall on the Stock Exchange of Tehran's Tobacco Stock Exchange", examines the true management of profits and competition in the product market on the basis of the fall of the future price The shares of 122 companies listed on the Tehran Stock Exchange during the period from 2009 to 2013. The statistical method used to test the research hypothesis is the panel data method. The results indicate a significant relationship between the risk of future stock price collapse and the level of competition in the product market and the actual management of profits.

Tannyani et al. (2015) in a study entitled "Investigating the Role of Corporate Governance Mechanisms in Reducing Stock Price Risk in Tehran Stock Exchange" examines the role of some corporate governance mechanisms in reducing the stock price risk of accepted companies in Tehran Stock Exchange. The findings of the research indicate that there is a negative and significant relationship between institutional investors and the Crashs, and a positive and significant relationship between the ratio of non-executive board members and the Crashs. In general, the results show that the mechanisms of the governance system A company is a factor in the Crashs. Ahmadi (2015) examines the impact of the short and long term perspectives of the auditor's selection on the risk of future stock price collapse in companies admitted in the "Review of short and long term short-term and long-term selection of auditor on the risk of future stock price crash" Tehran Stock Exchange paid. The results of the research show that the short-run variable of auditor selection and long-term persistence of auditor selection have a significant negative impact on the risk of future stock price collapse. In summary, the findings of the study indicate that the continuation of the auditor's selection will increase the quality of the audit and thus reduce

the risk of future stock price collapse in the Tehran Stock Exchange. Badeni (2016) explores the relationship between managerial talent and investment efficiency, as well as the interaction of managerial capability and financial reporting quality with the risk of stock price collapse in a research entitled "The relationship between managerial talent, the efficiency of investment and the Crashs" . The research results confirm the rendering search theory and suggests that companies with more talented managers adopt inappropriate investment decisions. Also, in these companies, doing opportunistic actions and manipulating financial reports to hide and accumulate bad news will increase the Crashs. Hyderpur (2016), in a study entitled "The relationship between company life cycle and Crashs", examined the relationship between the company's life cycle and the Crashs. To quantify the Crashs, four of the four criteria of skewness were negative stock returns, maximum sigma, fluctuations, and fluctuations of stock prices. The findings showed that after controlling the financial leverage, the size of the company, the ratio of market value to the book value of equity between the stages of growth and decline and the Crashs, a positive and significant relationship between the stage of maturity and the Crashs have a negative and significant relationship has it. Vaez (2016) in a study entitled "The Impact of the Auditor's Expertise on the Relationship Between the Avoidance of Taxes and the Risk of Future Collapse in the Stock Prices of Pharmaceutical and Non-Pharmaceuticals Accepted by the Tehran Stock Exchange" examines the influence of the auditor's specialty on the relationship between the industry Between avoidance of taxes and the Crashs, it has been concluded that tax avoidance has a significant positive effect on the industry and the auditor's expertise in the industry has a negative and significant effect on the risk of future stock price collapse. Also, the expertise of the auditor in the industry has a negative and significant impact on the relationship between tax avoidance and the risk of future stock price collapse. In addition, the effect of the auditor's specialization on the industry of the relationship between tax avoidance and the risk of future stock price collapse in pharmaceutical companies is more than non-pharmaceutical companies. Ahmadi (1395), in a study entitled "Investigating the Impact of Corporate Governance Measures on the Future Risk of Futures in Stock Exercise Companies in Tehran Stock Exchange", investigated the impact of corporate governance criteria on the risk of falling future stock prices. The results showed that among the selected criteria for corporate governance, only the concentration of ownership has a positive and constructive relationship and institutional ownership, management ownership, independence Board members and duplication of duty The chairman of the board of directors and CEO has a significant and negative impact on the Crashs.

3. Methodology

In the descriptive statistics section, data analysis was performed using central indices such as mean and median and standard deviation indexes. Because the results of this research can be used in the decision making process, this research is in terms of the purpose of the application. Also, this research is in terms of the descriptive-correlation nature, because in this type of research, the researcher seeks to assess the relationship between two or more Varies. The research is conducted within the framework of deductive-deductive reasoning. This means that the theoretical foundations and the history of the research have been carried out through librarian studies and articles, and in an analogous way, and gathering information for confirmation or rejection of the hypothesis, in an inductive form. In this research, Excel, SPSS and MATLAB software were used to analyze the data and extract the results of the research. Also, the confidence level used to test the hypothesis and to examine the classic assumption of regression is 95%. In order to estimate the parameters of the regression models, the classical assumption test is of great importance. One of the most important of these assumptions is assumptions about self-correlation, non-coherence and non-heterogeneity of variance among model residuals. Durbin-Watson test was used to determine the correlation between residuals. The value of this statistic for research models indicates a lack of self-correlation between the remainders. In this research, library method or organizational documents are used to collect required information. Preliminary studies, research background and research framework have been collected using library resources including books, journals, dissertations, research articles and internet sites. In this research, the combination of genetic algorithm and artificial neural network has been used as a feature selection method. Of the 14 technical

indicators that are given as independent variables to the system input, variables that increase the accuracy of the prediction of the Crashs Take away Generally, feature selection methods are divided into three groups of filtering, coating and mixing methods. In the filtering techniques, according to the general characteristics of the data, the operation of selecting the optimal features is performed and does not use the classification operation. This method is suitable for high volumes of data and has a high rate of process execution. However, in coating methods, using an optimization function, each attribute adds a feature to the initial constructed subgroup and, if it improves its prediction accuracy, holds it. This method has a higher accuracy than filtering methods but is more time consuming and has a higher computing volume than filtering. Combined methods include both methods. In this technique, the primary subgroup is formed using a filtering method and then it is carried out with a classification method covering the method. Genetic algorithm is one of the covering techniques that, according to the learning process, classifies the properties and chooses an optimal subset of all the features presented (Orsky et al.), Including the benefits of the feature selection process It is possible to increase the accuracy and speed of the implementation of prediction techniques, eliminate unrelated and unnecessary data, and increase the comprehensibility of the models used. The entire computation of this section by MATLAB software using the data mining module and associated operators It has been done with it.

3.1. Research hypothesizes

1) The particle motion-based algorithm is more capable of predicting the Crashs than logistic regression.
2) The Ant Colony Algorithm has more ability to predict the Stock Price Crash risk versus multivariate regression.

3.2. Statistical population and sampling method

The statistical population of this research includes companies admitted to Tehran Stock Exchange in the period of 2010 to 2014. In this research, a targeted sampling (cytological removal) has been used for sampling. For this purpose, all the companies of the society that have the following conditions are selected as the sample and the rest are eliminated;

1) Research is conducted for non-financial companies, so banks and all investment companies, leasing companies and financial institutions are excluded from the sample.
2) According to Hatan and Tehranian (2009), only companies can be selected as models for implementing the stock price model of a negative skewning model that has at least six months of monthly yield.
3) In order to compare the information, the fiscal year of these companies will be March 29th each year.
4) The financial statements of the fiscal year 2010 to 2014 are available

3.3. Cumulative particle motion algorithm

The algorithm was first introduced by Kennedy and Eberhart in 1991. The basis of cumulative particle motion is the simulation of a collective behavior used to represent the movement of the group of birds and fish, and is one of the most commonly used techniques for optimizing the body. The particle cumulative movement of the population factor, which includes potential solutions to the problem under consideration, uses exploration in search space. In the cumulative motion of particles, each member of the population has an adaptive velocity (displacement), which moves accordingly in the search space, in addition, each of them has memory, that is, the best position in the space The search for it is remembered, so the movement of each member takes place in two directions: the best position they have met and the best position that the best member has met in their neighborhood. One of the key aspects And the attractive approach of the PSO method is its simplicity, so that it contains only two equations of velocity and location, in which the coordinates of each particle represent a possible answer associated with two vectors. The position vectors (Xi) and the velocity (Vi) are two dependent vectors and are related to each particle in the N-dimensional space, respectively, as xi1; xi2; ... ..; xiN]] Xi = And [vi1; vi2; ..... viN] Vi = expression. A community of birds consists of a few particles (possible responses) that fly in an appropriate response space to search for optimal solutions. The position of each particle in accordance with its best search

particle, the best overall flight experience of the group, and the vector of its previous particle velocity, are consistent with the following relationships

$$v_i^{k+1} = wv_i^k + c_1 r_1 \left(pbest_i^k - x_i^k \right) + c_2 r_2 \left(gbest^k - x_i^k \right)$$
$$x_i^{k+1} = x_i^k + v_i^{k+1}$$

Where C1 and C2 are two positive factors. r1 and r2 are two random numbers with uniform distribution between zero and one. w is the weighted weight. i pbestk is the best position of the particle i, which is achieved with the experience of this particle

$$pbest_i^k = \left[x_{t_1}^{pbest}, x_{t_2}^{pbest}, ..., x_{t_N}^{pbest} \right]$$

gbestk is the best position of the particle with respect to the overall group experience

$$gbest_i^k = \left[x_1^{gbest}, x_2^{gbest}, ..., x_N^{gbest} \right]$$

And finally K is the repeat index. The process of the PSO algorithm is, in general, such that for each position and velocity magnifier, randomly identical to the dimensions of the initialized problem. The fitness for each pbest particle is measured and the particle has the best gbest fitness. The velocity and position vectors are matched in accordance with the above relations for each particle. In spite of the simple concept and easy implementation of the proposed method, its superiority has been proven in comparison to other methods in many different applications (Danberg, 2001).
If the speed change relation that came up in the global algorithm is written as follows:

$$v_i^{k+1} - v_i^k = c_1 r_1 \left(pbest_i^k - x_i^k \right) + c_2 r_2 \left(gbest^k - x_i^k \right)$$

It is clear that the left side of the relationship actually represents the acceleration of the i-th particle at time t

$$\alpha_i^k = v_i^{k+1} - v_i^k$$

As a result, c1 and c2 are positive integers, acceleration coefficients are known, and in some studies are known as social identification and social coefficients, respectively, and determine the relative elasticity of pbest and gbest. The coefficient c1 is a coefficient that determines how much the particle affects its best memory status, and c2 determines how much the particle affects the best of the rest of the population. Increasing the value of the parameter c1 increases the search space of the response, so that each particle moves to its best position, the pbest. Similarly, an increase in the value of the parameter c2 will increase the utilization rate of the hypothetical global hypothesis. Recent work done in the context of the PSO suggests C1 = C2 = 2 as an appropriate value for this algorithm.

The coefficients $r1$ and $r2$ are for generating random numbers between zero and one, which are usually two random numbers, which are quite different from each other, and in most implementations, the two random numbers are random and random, with a uniform distribution that is for change. Giving the tensile strength $pbest$ and gbest are used. The use of random numbers in the optimization algorithm is to simulate a small part of the unpredictable behavior of the particle community. In this research, data for the first four years (1399-2010) were considered for education (80%), and data for 2014 were considered as test data (20%). The training data is used to calculate weights.

3-4. Ant Colony Algorythm

An ant colony optimization algorithm was first introduced by Marco Dorigo in 1992 in his doctoral dissertation. The original algorithm sought to find an optimal path in a graph based on the ant colony behavior in the search for a path between the nest and the source of food. An initial idea was developed to solve many categories of numerical issues (Durigo, 2005). To use the ant colony algorithm in solving problems, the first must be a graph, in which the probability of movement in the next path is determined by the following qualitative function, and then the amount of pheromone or the weight of each edge is updated as follows

$$P_{ij}(t) = \frac{\tau_{ij}(t)^{\alpha} \left(\frac{1}{d_{ij}} \right)^{\beta}}{\Sigma k \varepsilon allallowedvertices \tau_{ik}(t)^{\alpha} \left(\frac{1}{d_{ij}} \right)^{\beta}}$$

$$\tau_{ij}(t+1)=(1-p)\tau_{ij}(t)+\sum_{k\varepsilon ant,thatchoseedge(i,j)}\frac{Q}{L_k}$$

Pij (t) The probability of passing ants along the edge i and j, the pheromone value associated with the edges i and j, dij the distance between the node i and the node j, and α and β parameters for controlling the effect and dij, p the vaporization coefficient of pheromone, Lk the cost of k route Ant and Q are fixed (Mirfakhredini, 2013).

3.6. Research models

Regarding to the fact that at first 14 entrants were selected as inputs for the selection of features and derivatives of artificial neural network combination and finally 7 variables were chosen as optimal, the logistic regression model related to the prediction of the Crashs is as follows:

$CRASH_{j,t+1}$=b0+b1(audqualit)+b_2(duality)+b_3(roe)+b_4(

mtb)+b_5(lev)+b_6(ind_ratio)+b_7(Work-Capital)+ $\varepsilon_{j,t}$
Wherein:

CRASHj, t + 1: The Crashs at the end of the fiscal year t + 1 is measured using the Stock Price Crash Period criterion
Leverage: Equal to the financial facilities divided by the sum of the assets of the end of the period , Audit quality: audqualify is equal to one if the audit report is of a modified type (conditional)and otherwise zero, ROE: Return on equity, MTB: Ratio of market value to equity, Ind-ratio: The ratio of non-executive directors to board members, DUALITY: Separation of manager duties Agent from the Chairman of the Board, WORK-CAPITAL: Working Capital Management
- The multivariate networked neural network model trained with the particle motion optimization algorithm that includes direct variables (MPSO) is as follows:
MPSO: E (Yt) = αilogsig (β0j + β1j roe + β2jlev + β3jaudquality + β4j mtb + β5j duality + β6j w-capital + β7j ind-ratio)

3.7. Variables

In this research, for the selection of independent variables, empirical evidence has been used in this regard. For this purpose, previous studies of the Crashs have been carefully considered. In previous studies, financial, nonfinancial, market or investor variables have been used as independent or controlling variables.

dependent variable

In this research, the Crashs is considered as a dependent variable. To measure this variable, the Stock Price Crash Period criterion is used to measure the risk of stock price collapse. First, we use the relationship (1) to calculate the company's weekly returns:
Relation 1)

$$W_{j,\theta}=Ln(1+\varepsilon_{j,\theta})$$

In the above relationship:
θ Wj: Weekly returns of the company j in the week θ, j, θ ε: The residual return of the company j in the week θ is the residual or residual of the model in relation (2):

$$R_{i,t}=\beta_0+\beta_1 r_{m,t-2}+\beta_2 r_{m,t-1}+\beta_3 r_{m,t}+\beta_4 r_{m,t+1}+\beta_5 r_{m,t+2}+\varepsilon_{i,t}$$

relation(2)
in this regard:
Rit Return on company, rm Market return, t: time. Then, using the company's weekly yield, the Stock Price Crash Period criterion is calculated asfollows:

Stock Price Crash Period

According to Hatton & Collins (2009), Bradshaw & Collar (2010), and Colin & Fang (2013), the fall of a certain fiscal year is a period in which the company's monthly yields are 3.09 times lower than the average monthly return Be it special. The basis of this definition is the statistical concept that, with the assumption of the normal distribution of the specific monthly returns of the company, the fluctuations that fall within the mean distance plus 3.09 of the standard deviation and the average minus 3.09 of the standard deviation, including the normal fluctuations and outflows This is a minor part of the abnormalities. Given that stock price collapse is an unusual fluctuation, the number 3.09 is considered to be the

boundary between normal and unusual fluctuations. In Iran, the stock price collapse is a virtual variable if the company experienced at least one fallback period by the end of the fiscal year. Its value will be one and otherwise it will be zero

- NCSKEW

Equation 3 is used to calculate the negative skewness of stock returns:

Relation(3):

$$NCSKEW_{j,t} = -\left[N(N-1)^{3/2} \sum_{\theta=1}^{\theta=12} W^{3}_{j,\theta} \right] / \left[(N-1)(N-2) \left(\sum_{\theta=1}^{\theta=12} W^{2}_{j,\theta} \right)^{3/2} \right]$$

In the above relationship:

NCSKEWj, t: Negative skewness of the stock return of the company j during the fiscal year t

Wj, θ: Specific weekly yield of j in month θ

N: The number of weeks that their returns are calculated.

Independent variables

- Leverage: Equal to financial assets divided by the sum of assets at the end of the period.
- Audit quality: (audqualify is equal to one if the audit report is of a modified type (conditional)and otherwise zero.
- Return on Equity (ROE): The ratio of net profit to total equity of the company at the end of the fiscal year
- Ratio of market value to book value of equity (MTB): Equal to the ratio of the market value to the book value of ownership of the owners of the company.
- The ratio of non-executive directors to members of the board of directors (IND-RATIO): represents the independence of the board, which represents the percentage of non-executive directorships to the total number of members of the board of directors.
- Separation of the duties of the CEO from the chairman of the board of directors (DUALITY): This variable, if the chairman of the board of directors apart from the director, is equal to 1 and otherwise equal to zero.
- Working Capital Management (ML): This variable is calculated using the cash flow cycle model (Lazaridis, 2006), which is as follows: Cash Flow Cycle = Inventory Conversion Period + Conversion Period Conversion - Deferred Creditors Period Convertible accounts receivable = Average accounts receivable / sales * 365 Inventory conversion period = Average inventory / finished product sales price * 365 Deferred Creditors Period = Average Payables / Cost of Sales * 365

In the second step, the following optimal variables were obtained using the cumulative particle algorithm: ROA: Is the ratio of net profit to total assets of the company at the end of the fiscal year,TAX: Tax expense divided by profit before tax ,Lev,Auditsize: Is equal to one if the audit firm is an audit firm and otherwise zero. ,Mtb,ML,Ind-ratio: Represents the independence of the board of directors, which represents the percentage of non-executive directorships to the total number of board members. ,Past-return: Stock returns for the past financialperiod,V: Monthly shares traded in millions of shares.

4. Results

4.1. Descriptive statistics

The results of the descriptive statistics of the research variables are shown in Table (1).

Table (1) shows the descriptive statistics of the research variables, which represent the descriptive parameters for each variable individually. These parameters mainly include information on central indicators, such as maximum, minimum, average and median, as well as information on dispersion indicators such as standard deviation. The most important central indicator is the mean, which represents the equilibrium point and distribution center, and is a good indicator of the centrality of the data. For example, the average financial leverage variable is equal to 0.61, which indicates that most data related to this variable are centered around this point. In general, scattering parameters are the standard deviation for determining the amount of dispersion of data with each other or their dispersion relative to the mean, including the most important dispersion parameters. The value of this parameter for the equity return variable is 86/16 and for the working capital management variable equal to 0,018, which shows that among the variables of research, return on equity and working capital management, the largest and most The least amount of dispersion.

Table 1. Descriptive statistics of research variables

Deviation	Minimum	Maximum	Average	variable
.50	0	1	.51	crash
.50	0	1	.49	AUDQUALITY
.12	0	1	.98	DUALITY
.18	0	1	.67	IND_RATIO
.47	0.7	6.51	.61	LEV
1.5	-1.15	9.73	1.80	MTB
4.16	-7.56	7.32	1.40	ROE
.018	0.12	.21	0.17	WORK_CAPITAL
1.8	-6.52	6.81	-.23	NCSKEW
1.58	-2.44	38.94	.17	ROA
2.04	0	75.43	2.04	V
.201	-.54	8.59	.67	Past-return
6.72	-.54	8.59	.66	Ind-ratio
.15	.01	2.1	.17	TAX
1.58	-2.44	38.94	.17	ROA

4.2. Inferential statistics

For estimating the parameters of regression models, classical false test is of great importance. Therefore, these assumptions (including zero mean of residues, constant variance of residuals, non-dependence of the order of one residue, and normal distribution with derivatives) are examined through inferential descriptive methods in regression models, necessary It should be noted that the presumption of the presumption of the presumption variables in the logistic regression is not necessary (Sarmad, 2005).

4.2.1. Correlation matrix of research variables

As shown in Table (2), the results of correlation between the research variables have been shown to be used for this test by Spearman coefficient (Platonism, 2013). According to Table (2), as can be seen, the correlation coefficient of logical research variables indicates that there is a lack of correlation among the research variables.

4.2.2. Independence of errors

One of the assumptions made in the regression is the independence of errors, which is used to examine the camera-Watson test. If this statistic is in the range of 1.5 or 2.5, the assumption of the lack of correlation between the errors is accepted. Given the camera-Watson-1, 558, that can be claimed, there is no first-degree correlation among the model's remnants.

Table 2. Correlation between research variables

IND_RATIO	WORK_CAPITAL	DUALITY	MTB	AUDQUALITY	LEV	ROE	crash	variable
							1	crash
						1	-.052	ROE
					1	-.239	.006	LEV
				1	-.02	-.103	.001	AUDQUALITY
			1	-.16	-.19	.45	-.17	MTB
		1	-.03	-.12	-.11	-.008	.003	DUALITY
	1	.025	.45	-.06	-.08	-.13	-.03	WORK_CAPITAL
1	.020	-.05	-.8	.07	-.6	.104	-.02	IND_RATIO

Table 3. Results of Durbin-Watson statistics

Model	R	R Square	Adiusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.177	.031	.018	.49565	1.558
2	.13	.018	-.003	1.81	2.03

4-2-3-Variants inflation (VIF statistics)

states that independent variables do not have a coherent problem, which can be seen in Table(4).

In The first step, the data were divided into two groups of education and experiment. For this purpose, the data related to the first four years (2010-2013), with the data of education and data related to the fifth year (2014), were used as statistical data. . After entering 7 optimal variables, the results of the particle accumulation algorithm were as follows: the results of the training data and test data are presented in Table (5). Also, the results of two-state logistic regression for training data and test data are presented in Table (6) .

In the Second Step, In Table (8), the results of MSE and MAE errors are presented in two methods of multivariate regression and ant colony algorithm with a negative skewness criterion The results of the MSE error in the two methods in 90, 91 and 92 are not significantly different, while the difference is higher for 89, 93 years. In the case of the MAE error, the difference between the two methods is low in 89, 90, 91, 92, and 93

Table 4. The results of the research model estimation

VIF statistics	error rate	statistic t	variable coefficient	variable
	.003	2.998	.716	α
1.048	.361	.915	0	ROE
1.020	.080	-1.75	-.090	LEV
1.045	.739	-.334	-.016	AUDQUALITY
1.061	.037	-2.089	-.034	MTB
1.019	.905	-.19	-.025	DUALITY
1.011	.050	1.968	2.57	WORK_CAPITAL
1.028	.426	-.797	-.11	IND_RATIO

Table 5. Stock Price Crash risk based on number (training data -test data)

Lack of the Stock Price Crash Risk	the Stock Price Crash Risk	total	Predict the Stock Price Crash Risk
136	129	235	Number of correct predictions
78	89	167	Number of false predictions
214	218	432	total
Test data			
Lack of the Stock Price Crash Risk	**the Stock Price Crash Risk**	**total**	**Predict the Stock Price Crash Risk**
48	15	63	Number of correct predictions
38	7	45	Number of false predictions
86	22	108	total

Table 6. Stock Price Crash risk based on number (training data- test data)

Lack of the Stock Price Crash Risk	the Stock Price Crash Risk	total	Predict the Stock Price Crash Risk
82	140	222	Number of correct predictions
126	84	210	Number of false predictions
208	224	432	total
Test data			
Lack of the Stock Price Crash Risk	**the Stock Price Crash Risk**	**total**	**Predict the Stock Price Crash Risk**
26	34	60	Number of correct predictions
27	21	48	Number of false predictions
53	55	108	total

Table 7. Comparison of regression prediction power and particle cumulative algorithm

Test	Education	methods
55.56%	51.38%	logistic regression
58.88%	54.39%	Particle cumulative algorithm

Table 8. Results of the research (Ant Colony)

Multivative Regression		Ant Colony		year
MAE	MSE	MAE	MSE	
.1269	.2311	.1183	.2032	89
.1271	.2324	.1302	.2101	90
.1207	.2273	.1282	.2177	91
.1284	.2331	.1308	.2206	92
.1130	.2016	.1038	.1886	93

In order to compare the statistics and more accurately these differences, the non-parametric Mann-Whitney test is used. The results of each of the criteria for calculating the risk of Cash are presented separately in Tables (9) and (10).

In table (9), the results of the Mann-Whitney test regarding MSE error indicate that there is a significant difference between two models and the inequality hypothesis is accepted between the means. According to the results of the meanings column, the average colony of ants is 5.17, and the average of the regression 8.23. Therefore, the mean error of MSE in this method is less than regression, and this algorithm in this criterion has higher ability than multivariate regression in predicting the Crash risk.

In table (10), the results of the Mann-Whitney test for MAE error indicate that the difference between the MAE error in two methods of the ant colony algorithm and the multivariate regression is not significant in the skewness criterion and the assumption of the inequality of the meanings is not confirmed. Therefore, there is no significant difference between the two methods in predicting the risk of falling stock prices. According to the results of the column of the meanings, the mean of the ant colony's algorithm is 6.83, and these results are related to the regression of 6.17 and there is no significant difference. There is not much difference in these two methods in predicting the risk of stock price collapse.

Comparing the results of training data in two particle patterns and regression (Table 5 and 7)

Table 9. The results of the Mann- Whitny test(mse)- Ant Colony

Model	Group	N	Mean Rank	Sum of Rank	Sig
NECSKEW	Ant colony	5	5.17	31	.05
	Regresion	5	8.23	48.78	
	Total	10			

Table 10. Results of the Mann- Whitny test (mae)- Ant Colony

Model	Group	N	Mean Rank	Sum of Rank	Sig
NECSKEW	Ant colony	5	6.83	41	.74
	Regresion	5	6.17	37	
	Total	5			

shows that in the logistic regression model, 140 of the companies that have been at risk of collapse have been properly segmented and 84 companies were mistakenly segmented. . Also, 82 of the companies that did not have a risk of falling stock prices are correctly segregated, and 126 companies are misunderstood, while particle algorithm results show that 129 companies that have been at risk of falling are properly segregated 89 companies have been mistakenly disassociated. Also, 136 companies from companies that did not have a Stock Price Crash Risk were properly segmented and 78 companies were mistakenly segregated. Therefore, by comparing the results of the two main research models, the training data presented in Tables (5) and (6) It can be concluded that the correct number of predictions in the particle algorithm is higher compared to the logistic regression for companies that have a risk of collapse or the risk of falling stock. The results of the test data presented in two tables (5) and (6) show that in the logistic regression model, 34 of the companies that have been at risk of falling are correctly segmented and 21 companies are wrongly segregated have became. Also, 26 of the companies that did not have a Stock Price Crash Risk were properly segregated, and 27 were mistakenly broken down. In the particle motion pattern of 15 companies, companies that have been at risk of collapse have been properly segmented and 7 companies have been mistakenly disassociated. Also, 48 of the companies that did not have a risk of falling stock prices were properly segregated, and 38 were mistakenly broken down. In general, by comparing the results of the two models, it can be concluded that the predictive power of particle cumulative algorithm for training data is equal to %54.39 (235/432) for experimental data of 58.88% (63/108), while the predictive power of logistic regression is about %51.38 (222/432) and about 55.56% (60 108), respectively, These results are presented in Table (7). Therefore, it can be concluded that using the particle motion optimization algorithm to predict the risk of falling stock prices is more capable than logistic regression. In this case, the main hypothesis of the research is that the particle motion algorithm based algorithm is more capable of predicting the risk of falling stock prices than logistic regression. Evidence of this research suggests that the ability of meta - heuristic to predict the risk of stock prices Crash Risk is higher than the traditional method of logistic regression. The findings of this study have several key meanings that not only help to better predict the risk of falling stock prices, but also extends the application of newer methods of predicting financial issues, since the algorithm used in this Research, particle agglomeration algorithm, are inspired by nature, and copied systems of nature have a perfect advantage over manual man-made systems, it was expected that prediction using this algorithm would result in more favorable results than logistic regression In practice, this issue was confirmed. It is anticipated that these algorithms will result in better results in complex problems and with a greater number of variables, especially compared to conventional models such as regression. Therefore, it can be concluded that the use of ultra-fast algorithms results in better results than regression. According to the results of the second step, the ant colony algorithm has

a higher ability to regression in the mse error, while in the mae error this difference is not significant.

5. Discussion and Conclusions

Neural networks, in addition to providing more accurate predictions, do not have the usual problems of classical modeling, such as the reliability and inaccuracy of time series. In this regard, like the classic modeling, in order to solve the problems of correlation, coherence and heterogeneity of variances, the preparation of series when they are not financial variables. The proper operation of neural networks in comparison with other common methods indicates the existence of nonlinear relations between variables. In this research, we investigate the ability of two methods in the field of prediction (Particle cumulative algorithm, Ant Colony) in optimizing neural networks to predict the Crashs of listed companies in Tehran Stock Exchange and compare results with regression(Logestic and multivative) was considered as one of the most widely used statistical methods in financial forecasting. To this end, in the First Step using the combination of artificial neural network and genetic algorithm and using the feature selection method, 7 independent variables were identified as the most optimal independent variables. In the next stage, these variables were entered as independent independent variables into particle cumulative algorithm. In The Second Step, The particle algorithm was used as a feature selection, and this time, to calculate the Crash risk, the NCSKEW criterion was used. Finally, the optimal variables were entered into the Ant Colony algorithm and the results were compared with the multivariable regression. In the second step, MSE and MAE were used to compare the results. The results of the research show that the particle Swarm Optimization and Ant colony are more able than traditional regression (lojestic and multivariable) to predict the Crashs. Therefore, the research hypothesises are confirmed The results show that the use of the exchange algorithm to optimize the cumulative motion of particles to predict the risk of stock price in Tehran Stock Exchange is more capable of logistic regression. The findings also indicate that the use of equity return variables, financial leverage, audit quality, market value to book value of equity, working capital management, the ratio of non-executive members of the board of directors to the members of the board of directors, Separating the responsibilities of board members as independent variables in models for predicting the Crashs does not greatly affect the ability to predict the risks of stock prices. The approaches used in this research as representing artificial intelligence methods are more accurate and efficient than classical statistical methods such as simple regression and logistics, and can be used as techniques used to predict the risk of falling into work taken. Since there has not been a study to predict the Crashs using the particle motion algorithm and comparing it with traditional methods, both inside and outside the country, the results of this study can not be compared with the results of previous studies in this field has been compared only with the use of statistical techniques such as logistic regression . But in other areas of research, Zhang et al. (2004) have used traditional statistical methods and artificial neural networks to predict the profits of each share. The results indicate the superiority of artificial neural networks compared to Statistical methods were also suggested by Sperminzin (2013) in the field of foreign exchange forecasting that the flying algorithm is a more appropriate model for forecasting exchange rates. Zhang and Chen (2008) also achieved similar results to predict the stock index. In the country, Demuroi et al. (2011) also predicted the Tehran Stock Exchange index using the flight search algorithm and compared it with the Chentian methods. The results indicate that the error of this model is much less than traditional ones. Also, Amir Hosseini and Davar Panah (2015) the gold price prediction found that using a combination pattern of birds with a genetic pattern has a predictable accuracy. Foroughi (2013) also showed that the combined model of artificial neural network and particle motion optimization algorithm based on multivariate model with 91.7% accuracy per share predicts. The results of the research are consistent with this research. Given that the flying algorithm is a highly potent, highly predictable approach, it is suggested that capital market players and macroeconomic decision makers propose other financial issues such as corporate financial crises, future cash flows And ..... on the Stock Exchange, as well because of the high precision of this method, it is suggested to be used in economic matters such as exchange rate, gold, oil, etc. According to the results of the research, in the future research, other feature selection methods such as ant anchor algorithm, particle accumulation and metamorphic methods can

be used to select the best independent variables. In addition, by doing any research, the path to the new path opens, and the continuation of the path involves conducting other research, so doing research such as predicting the risk of falling stock prices can be found in patterns such as cuckoo algorithm, colony bee Honey, a firefly algorithm that has various types of metamorphic techniques, comparing the results of different patterns with each other and with the traditional logistic regression method. Use more technical displays (independent variables) as inputs of feature selection methods. Investigating and testing the impact of independent variables on the risk of falling stock prices for loss-making companies compared to profitable companies, as well as small companies compared to large companies as well as during the company's life cycle; and testing each of the models of this research for various industries . In general, the methods used in this research can be of great help to capital market players, especially investment funds, and also to help develop smart stock trading software as other notable points for the application of research it is suggested.

The most important limitation of the research is as follows:

The lack of adjustment of financial statements items due to inflation, which may affect the results of the research. The lack of control of some of the factors influencing the results of the research, including the impact of variables such as economic factors, political conditions, the status of the global economy, laws and regulations, etc., are beyond the reach of the researcher and may affect the investigation of relationships. The present study has been approved by using the data of 107 companies admitted to Tehran Stock Exchange and investment, leasing and insurance companies have been excluded from the statistical society due to their specific nature of activity, so these results are in the hands of ready can not be generalized to all companies.

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