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Saffron future contract yield prediction using a modified quadratic model

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Abstract

The main purpose of this study is to predict the future yield of saffron contracts using a modified quadratic model, which is a library documentary research from the aspect of data collection, and from the aspect of results, it is applied and quantitative research. The time period of the quantitative part is a 5-year period from 2019/03/20 to 2023/03/20 in the form of daily frequency of the Ministry of Jihad, Agriculture and Customs of Iran from the website of the Iran Commodity Exchange, which was collected and the modified second-order model in terms of complexity, from The type of nonlinear polynomial problems that the proposed methods are modelled by coding in Matlab software environment with normal data. Overall, the results indicate that the neural network model has a higher reliance on power compared to the adjusted quadratic model in predicting the saffron contract yield, and the calculation results show that price fluctuations, cash price, transaction volume, and liquidity are the most important in order They have the contractual yield of saffron.

Keywords: Saffron contract yield, Modified quadratic model, Neural network
2020 MSC: 68T07

1 Introduction

The development of financial instruments in the last few decades has been one of the most important reasons for the development of financial markets in the world. "Derivatives" are part of these instruments or contracts that play a prominent role in the development of financial markets. These contracts are used to control risk in metals, energy, agricultural products, stocks and currency transactions. Among the derivative contracts, the futures contract is one of the most important in the financial and commodity markets. Despite the possibility of concluding futures contracts in the commodity and stock futures markets in Iran, limited theoretical researches have been conducted on the pricing of these instruments in Iran, and futures traders mostly determine the futures price empirically; That is, the actors of these markets, without knowing the factors affecting the future behavior of asset or commodity prices, proceed to determine the expected price and enter into a future contract. The use of Futures Contracts in different regions of the world today has become a common tool to manage the market risk of various assets such as agricultural commodities, metals, various types of energy and various types of securities such as company shares. Setting up and developing futures markets apart from risk management can have other valuable advantages such as facilitating

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the price discovery process and increasing the level of transparency and liquidity in the market. In this context, the establishment of future markets for agricultural products can lead to reforms in the market structure of these products in addition to the above functions [8]. The traditional market of agricultural products in Iran is facing many problems and structural disturbances. The severe fluctuations in the price of agricultural products, which has many negative consequences, is one of the most important problems in this regard; The lack of stability in the price of agricultural products by creating income uncertainty for the producers of these products increases the inherent uncertainty in this sector [16], the lack of transparency and fluidity of information in the local markets of agricultural products along with The widespread presence of middlemen in different parts of the distribution and marketing of these products is one of the other structural problems of the market in the agricultural sector of Iran, as well as the undeniable existence of the phenomenon based on completely unfair prices, forward purchasing, competitive, efficient and comprehensive purchase for the exchange of agricultural products and the inefficiency of the network. Distribution are some of the other problems that the agricultural sector in Iran is struggling with [11].

A successful futures contract is performed in several different stages according to the type of asset associated with the contract. Based on this, the first and most important step in designing commodity futures contracts is determining suitable and compatible commodities for exchange in such markets. For example, one of the famous methods that was used by Black to determine the characteristics of successful future contracts was the "commodity characteristics" approach [1]. Such as the possibility of storage, homogeneity, fluctuating prices, the large size of the cash market, the low cost of supply of goods, and also the history of failure in the forward markets are taken into consideration, and by considering this definition of the future contract, he came to the conclusion that the success of futures contracts The future depends on the size of the cash market, the fluctuations of cash prices, the ability to reduce the risk of these contracts, and also the cost of their liquidity. Considering the heavy dependence of Iran's economy on oil revenues, the importance of paying attention to the country's non-oil exports has a special position, and the identification of non-oil products that have a relative advantage and the ability to compete in the international arena is considered an important step in the development of this sector. In the meantime, agricultural products account for a major part of non-oil exports and future contracts, among which saffron is of special importance, and considering the heavy dependence of Iran's economy on oil revenues, the importance of paying attention to the country's non-oil exports from the position It has a special advantage and identifying non-oil products that have a relative advantage and have the ability to compete in the international arena is considered an important step in the development of this sector. In the meantime, agricultural products account for a major part of non-oil exports and future contracts, among which saffron is of special importance, so that in different periods, it was one of the major export products of the country, and Iran has more than And the export value of Iranian saffron has increased significantly in the last few years from 34 million dollars in 1997 to 96.7 million dollars in 2007 (survey of the production and export situation of saffron, 2008), on the other hand, currently And with the traditional transactions of this asset, it is possible to cover the risk for producers and market participants of many agricultural products, including; There is no saffron; Meanwhile, with the launch of these transactions, it will be possible to manage risk and cover risk well, so that producers and market participants can cover themselves against the risk of price changes and fluctuations. The pole of saffron production is located in Khorsan-Razavi and Southern provinces of the country. In 1995, according to the statistics of the Ministry of Agricultural Jihad, Razavi Khorasan had 257.6 tons and South Khorasan 51.1 tons out of 336 tons of the country's total production. Iran's share of foreign currency exports of saffron in 2016 was 42%, which went to countries such as Spain, Italy, UAE, Afghanistan, etc. in the form of large and bulk packages (lacking necessary quality) and in these countries with packaging Most of the world's reputable brands are offered to the market, which will reduce the price and hurt the Iranian saffron brand in the long run. According to the statistics of the Chamber of Commerce in 2016, the country's total saffron export was 207 tons with a value of 290 million dollars. Investors with a small amount of capital are able to control a large amount of assets and enter into a future contract by paying a small amount of the total value of a commodity. do Hence in; The current research among the future contracts of agricultural products in Iran, saffron is the choice of suitable and compatible goods for exchange in such markets, it has been selected and used in this study. Some studies have shown that, on average, only one third of the future contracts are successfully launched [6].

Various studies should be done on the reasons for the success and failure of futures contracts, as well as the characteristics and characteristics of successful futures contracts. For example, in this field, we can refer to the studies of Gray [9], Powers [18], Black [3], Brown et al. [5], Tashjian [20], Harris [10], Karagozoglu and Martell [13], Longin [14], mentioned Brorsen and Fofana [6], Pennings et al. [16], Pennings and Leuthold [17], Meulenberg and Pennings [15] and Bollen et al. [4].

So far, the development of contract yield forecasting is always an open issue, so that most researchers today tend to use intelligent approaches instead of using statistical and simple mathematical approaches, such as regression,

to identify variables that influence the problem of yield forecasting, as well as estimating the yield of contracts and predictability. The performance of futures contracts has created a lot of interest from academics and experts in various fields, and the Iranian saffron futures market has a unique trading mechanism with a curvilinear trading volume pattern. The modified quadratic discriminant function is a type of parametric estimation method. which is used to estimate multivariate normal functions. The above function replaces the outlier data with constant values (variance of each dimension) to avoid the disadvantages caused by outlier and special data and obtains it with the Maximum likelihood estimation method, which is a suitable method to find out better performance, therefore in Considering high-frequency data from saffron futures markets to check futures contract returns by considering the variables examined in this proposal can be effective, hence in the present research; First, it is analyzed with a statistical technique such as the non-linear programming model, which is based on the derivative of the objective function and financial issues (in forecasting problems), the modified quadratic function model for the advancements of mathematical programming.

2 Research literature

Brorsen and Fofana [6] investigated the effects of several factors on the success or failure of agricultural product contracts. In their study, these researchers paid attention to important factors including factors for which there is no data, such as homogeneity, vertical integration, concentration of buyers and the activity of cash markets. By using the Delphi method for features lacking data, the results of the above study indicated that the existence of an active cash market is a necessity for the success of futures contracts, in such a way that this factor alone can predict the success of the futures market. Also, the results of this study showed that other investigated factors such as vertical integration, homogeneity and concentration of buyers are also very important in explaining the differences between the volume of exchanges and the number of open positions of different futures markets. Over the past few decades, policymakers and economic planners have sought to find new ways to trade agricultural products that maximize their efficiency for market participants. For this purpose, various types of commercial contracts, including futures contracts, were further developed. A futures contract is a contract based on which the seller undertakes to sell a specified quantity of a specified commodity at a specified price at the current maturity, and in return, the buyer of the contract undertakes to sell that commodity by purchasing specified specifications. Christensen et al. [7] propose a framework that improves fit and predictive performance for a wide range of bond markets and states that commodity futures are related to futures prices and arbitrage relationships are unrelated to bond yields. Some studies have shown that, on average, only one third of the futures contracts are successfully launched [6]. This situation caused various studies to be carried out on the reasons for the success and failure of futures contracts, as well as the characteristics and characteristics of successful futures contracts. For example, in this field, we can refer to the studies of Gray [9], Powers [18], Black [3], Brown et al. [5], Tashjian [20]. On the other hand, not only is the prediction of contract returns important from a statistical point of view, but it is also significant from an economic point of view. Although today researchers are trying to predict the performance of contracts using the fastest methods including intelligent techniques, the need to provide high accuracy diagnostic systems or tools in this field is still felt more and more because most of the researches reviewed in the research background were also investigated, they are faced with low to moderate accuracy and few researches have been able to increase the accuracy of yield estimation in addition to simplifying the estimation execution time. Therefore, providing new solutions with high accuracy and at the same time fast can open a new way for future research.

Zhao et al [21], focused on particle swarm optimization to solve the portfolio optimization problem with cardinality constraints, and since how to efficiently choose these stocks to achieve higher returns and lower risk, it has become a hot topic of research in financial management. It turns out that this is usually the portfolio optimization problem (POP).is named. When cardinality constrained (CC) is added to limit the number of selected stocks to a certain value, the resulting CCPOP is more challenging with the following two problems: i) due to the complexity of the cardinality constraint in the final market, how to effectively deal with the cardinality constraint in the optimization sample problem for Achieving a practical solution is difficult and time-consuming. ii) The return and risk objectives of securities are always in conflict with each other and it is difficult to balance them. To better deal with the above problems, the paper focuses on CCPOP multi-objective (Mo) and proposes multiple populations co-evolutionary particle swarm optimization asset weight of the solutions (MPCoPSO) for multiple populations, which is based on multiple frameworks for multiple objectives. is constructed and has the following four advantages: In the first step, a hybrid binary and rea (HBR) is introduced to better represent the stock selection and asset weight solutions in MoCCPOP. In the second step, an innovative return risk ratio heuristic strategy R3 is introduced. H) based on the historical return and risk of each stock is proposed as a fast CC control method to achieve practical solutions. Thirdly, a new particle update method based on the BLS local search strategy to increase the chance of improving the accuracy of the solution and approaching The global Pareto front is designed. Last but not least, an elite hybrid competition

strategy is presented to help update the archive, which provides more promising solutions and diversifies to avoid the local global Pareto front. Two strategies First to effectively deal with the pothole CC helps, while the last two strategies are efficient in solving the multi-objective challenge. The evolutionary joint particle swarm optimization algorithm shows superior performance in solving MoCCPOP by comparing with some recent well-performing and advanced multi-objective optimization algorithms.

Kalaisi et al. [12], addressed the optimization of securities with cardinality constraints as a mixed quadratic programming problem. The aim of the study is to present a hybrid meta-heuristic algorithm that combines the important components of ant colony optimization, artificial bee colony optimization and genetic algorithms to solve the cardinality-constrained portfolio optimization problem. Computational results on seven publicly available benchmarks confirm the effectiveness of the hybrid fusion mechanism. In addition, comparing the results obtained from other methods in the literature shows that the proposed model is competitive with advanced algorithms.

Basirzadeh et al. [2], investigated the modified quadratic programming method to solve nonlinear programming problems. At first, the main problem is to transform the problem into a simpler equivalence problem with inequality constraints. Then, inspired by the sequential quadratic programming method and the linear equation machine method, a new model of the sequential quadratic programming algorithm was proposed to solve the main problem. In each iteration, the search instruction is generated by combining the two directions obtained from solving the quadratic programming subproblem and the linear equation machine, respectively. Furthermore; In order to overcome the Maratus effect, the higher order correction of the instruction is obtained from solving the machine of other linear equations. Two systems of linear equations have the same matrix of coefficients and only one of them needs to be solved after a finite number of iterations. By using the new search technique, the proposed algorithm has global convergence under appropriate assumptions. Finally, some numerical results were introduced to show the usefulness and effectiveness of the proposed algorithm.

Shams et al. [19] studied a comparison between the combined genetic algorithm-artificial neural network model and the modified quadratic discriminant function model to detect stock price manipulation in companies listed on the Tehran Stock Exchange. In the combined genetic algorithm-artificial neural network model, first, the data related to 316 stock exchange companies from the beginning of the first working day of 2018 to the end of the last working day of 2019, including 966 days, are entered into the genetic algorithm model, and finally, the weights related to each variable of this algorithm resulted Then, using these weights, perceptron artificial neural network was designed, trained and executed. Then, using the same data, the modified quadratic discriminant function model was designed and implemented, and its efficiency was proved. Finally, the results of the hybrid model of the genetic algorithm-artificial neural network were compared with the results of the modified quadratic discriminant function model using error measurement statistics. The results showed that the combined genetic algorithm-artificial neural network model has a much better performance than the modified quadratic discriminant function model in identifying stock price manipulation and classifying companies into manipulated and non-manipulated groups and has much less error.

3 Research methodology

Research question

What will be the comparative analysis of saffron future contract yield prediction using modified quadratic function model and neural network ?The present research is a library documentary research from the aspect of how to collect information. This means that all the necessary information is obtained from the sources that are written in books, writings and previous researches available in libraries or archives of organizations. Since the result of this research is an applied research and the present article; It is of a quantitative type that the time period of the quantitative part of this research is a 5-year period from 2019/03/20 to 2023/03/20 in the daily frequency of the Ministry of Jihad, Agriculture and Customs of Iran, which was collected from the website of the Iran Commodity Exchange. In order to design a meta-heuristic hybrid model by combining bird, bat, and cuckoo models, Matlab software is used and multiple and pairwise comparisons of different samples are used, which problems cannot be solved accurately due to their complexity, and the quadratic model is modified. They can obtain a set of suitable solutions in an acceptable time for polynomial nonlinear problems, which after parameter settings, the modified quadratic model will be used, and this model, in terms of complexity, is of the type of polynomial nonlinear problems that the proposed methods by coding in The Matlab software environment is modeled with normal data, and calculation results are presented for each test problem, as well as suggestions at the end.

3.1 Modified quadratic function model

First, we consider nonlinear programming problems in the form of relation 6 [2]:

$$\begin{aligned} &\min\ f_0(x) \\ &s.t.\ f_i(x) \le 0, i \in I_1 := \{1, 2, \ldots, m\} \\ &f_i(x) = 0, i \in I_2 := \{m^{'} + 1, m^{'} + 2, \ldots, m\}. \end{aligned} \tag{1}$$

In which, $f_i : R^n \to R(i \in \{0\} \cup I_1 \cup I_2)$ The functions are smooth. The QP subproblem corresponding to equation 1 will be equation 7:

$$\begin{aligned} &\min\ \Delta f_0(x)^T + \frac{1}{2} d^T H d \\ &s.t.\ f_i(x) + \Delta f_i(x)^T d \le 0, i \in I_1 \\ &f_i(x) + \Delta f_i(x)^T d = 0, i \in I_2. \end{aligned} \tag{2}$$

In which $H \in R^{n \times n}$ is a symmetric positive definite matrix. Since the SQP algorithm may fail due to the presence of equality constraints in the QP sub-problem, we use a new method proposed by Mayne and Polak to solve the problem. In this method, we consider relation 38 instead of the main problem:

$$\begin{aligned} &\min\ \Delta F_c(x) := f_0(x) - c \sum f_i(x) \\ &s.t.\ f_i(x) \le 0, i \in I. \end{aligned} \tag{3}$$

In which, $I := I_1 \cap I_2$ and $c > 0$ especially when $I_2 = \Phi$ then $F_c(x) = f_0(x)$. (4)

We show the feasible space of relation 4 as relation 5:

$$\Omega := \{x \in R^n; f_i(x) \le 0, i \in I\}. \tag{5}$$

Also, since equation 5 has only inequality constraints, the corresponding QP subproblem will also have only inequality constraints. Therefore, the SQP algorithm is always successful under suitable conditions. The special advantage of this algorithm is that the starting point of repetition can be chosen arbitrarily, that is, this point can be feasible or impossible. In the modified algorithm, we consider the following QP subproblem.

$$\begin{aligned} &\min\ \Delta F_c(x)^T d + \frac{1}{2} d^T H d \\ &f_i(x) + \Delta f_i(x)^T d \le \varphi(x), i \in I^+(x)\ s.t. \\ &f_i(x) + \Delta f_i(x)^T d \le 0, i \in I^-(x). \end{aligned} \tag{6}$$

In equation 7:

$$\begin{aligned} &\varphi(x) := \max\{0, f_i(x), i \in I\} \\ &I^+(x) := \{i \in I, f_i(x) > 0\} \\ &I^-(x) := \{i \in I, f_i(x) \le 0\} \end{aligned} \tag{7}$$

In order to estimate the probability distribution functions, in common and old models, the characteristics of the variables are extracted from the targets [8]. Probability function estimation methods are divided into two categories: Parametric and Non-Parametric. In parametric estimations, the shape of the probability function is known and the probability function is estimated using the training sample vectors. Multivariate normal distribution is often used as the probability function, because it is easy to work with and if the number of samples is sufficient, it also gives good results. In these functions, mean and variance are calculated through vectors.

4 Analysis

4.1 Descriptive statistics of research variables

Table 1 shows the results of descriptive and econometric statistics related to the final variables of the research:

Table 1: Descriptive statistics of research variables

INF	**LIQ**	**CPF**	**P**	**VOL**	**LTD**	**RFUT**	
Inflation	Market liquidity	Fluctuations in cash prices	production	Number of transactions	Length of trading period	Initial security deposit rate	
21.92	96/ 23014238 3640	-0.09	114.687	15729.66	54.52	102/0	mean
64.11	23.20	17.99	61.17	11.51	45.65	0.177	Std. Devinition
8.05	2.92	0.07	1.00	2.39	0.68	0.330	Skewness
7.96	11.99	0.46	5.72	7.18	-0.027	0.400	Kurtosis
18.41	27.25	6.001	31.82	24.63	11.92	3.57	Jarque-Bera

Table 2: Descriptive statistics of research variables

INF	**LIQ**	**CPF**	**P**	**VOL**	**LTD**	**RFUT**	
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64.11	23.20	17.99	61.17	11.51	45.65	0.177	Std. Devinition
8.05	2.92	0.07	1.00	2.39	0.68	0.330	Skewness
7.96	11.99	0.46	5.72	7.18	-0.027	0.400	Kurtosis
18.41	27.25	6.001	31.82	24.63	11.92	3.57	Jarque-Bera
WELFE	**PRO**	**DRO**	**ARB**	**CR**	**INT**	**EXC**	
Welfare result	Cash prices	Drought	Arbitrage efficiency	Commercial grade	Interest rate	exchange rate	
25.05	36.871274	0.99	17.65	227123.67	36.56	1.00	mean
12.01	31.00	46.88	29.59	15.90	71.77	30.55	Std. Devinition
0.25	31.47	0.56	-2.39	0.10	0.49	1.64	Skewness
0.37	191.87	-1.44	3.69	-1.41	-1.22	41.77	Kurtosis
6.74	112.25	6.021	10.96	5.042	16.97	23.97	Jarque-Bera

As shown in Table 1, the average yield of futures contracts in two groups of Nagin saffron futures contract and stringed saffron futures contract is 0.1; In addition, in order to examine the distribution of returns compared to the normal distribution, first the dispersion index of returns (unconditional standard deviation of returns) is examined; As can be seen, the value of the standard deviation of the mentioned series is a small number; This is also confirmed by the skewness and kurtosis statistics; The values related to skewness and kurtosis indicate that the efficiency distribution does not deviate much from the symmetrical distribution, and this is also confirmed by the values of the Jarek-Bara statistic. The results of the ADF test also show the mean of the series at the 5% error level and indicate that there are no long-term fluctuations.

In relation to other variables, the theorem is slightly different and the majority of independent variables deviate from the normal distribution; Although this deviation is not significant in absolute numerical terms, it is statistically significant. It is worth mentioning that regarding SQDF-based modeling, the non-normal distribution of the dependent variable leads to a violation of the assumptions of this method for parameter estimation. Therefore, the normality of the distribution of the dependent variable of the research is investigated.

4.2 Fitting the SQDF test

In order to test the ability of the SQDF model to estimate the yield of future contracts, after forming the long-term covariance variance matrix (LRCOV) of the research variables, the constant values of the equation and the values of the quadratic coefficients of the equation are estimated.

Table 3: Coefficients of the adjusted quadratic equation

Cofficient	T statistic	variable
2.71	0.380	$\beta 0$
2.48	0.075	LTD
2.69	0.041	VOL
2.57	0.022	P
3.51	0.051	CPF
2.52	0.380	LIQ
2.67	0.075	INF
2.81	0.041	EXC
-2.39	-0.022	INT
3.91	0.051	CR
4.85	0.380	ARB
2.71	0.380	DRO
2.48	0.075	PRO
2.69	0.041	WELFE
0.385	**R^2**	
87.630	**(0,000)**	**F**

Table 4: The results of SQDF

Prediction method	MAD	MSE	RMSE	MAPE
SQDF	38.9088	9.1642	40.2073	3.6112

Table 5: Comparison of different prediction models

log(PL)	MSFE	MAFE	Prediction method
-688	0.025	0.094	DMA $\alpha = \beta = 0.\ 99$
-355	0.046	0.124	DMA $\alpha = \beta = 0.\ 90$
-315	0.043	0.121	DMA $\alpha = \beta = 0.\ 95$
-250	0.051	0.127	DMA $\alpha = 0.\ 99$; $\beta = 0.\ 90$
-295	0.045	0.124	DMA $\alpha = 0.\ 99$; $\beta = 0.\ 95$
-259	0.039	0.117	DMA $\alpha = 0.\ 95$; $\beta = 0.\ 99$
-492	0.041	0.117	DMA $\alpha = 1$; $\beta = 0.\ 99$
-341	0.046	0.125	DMA $\alpha = 1$; $\beta = 0.\ 95$
-430	0.052	0.128	DMA $\alpha = 1$; $\beta = 0.\ 90$
-303	0.040	0.117	DMA $\alpha = 0.\ 99$; $\beta = 1$
-429	0.038	0.117	DMA $\alpha = 0.\ 95$; $\beta = 1$
-353	0.046	0.116	DMA $\alpha = 1$; $\beta = 1$

The results of table 9, which are calculated based on α=β=0.99%, which has the lowest level of prediction error. In traditional models, independent variables in the entire time period either have a significant effect on the dependent variable or this effect is meaningless; But in TVP-DMA methods, an independent variable can have a significant effect in a period of time and a meaningless effect in a period. Based on the number of periods in which the research variables had a significant effect on efficiency and the significance level of prioritizing the research variables are:

Based on the results of cash price fluctuations with the most effective period, the most important factor in changes in yield of saffron futures contracts has been evaluated. In the following, the probability of influencing the most important variables on the yield variable in different periods has been investigated. Examining the probability of presence of each variable in predicting yield helps policy makers to have a correct view of the manner, intensity, and

Table 6: Prioritization of variables affecting efficiency

Prioritization	variable
9	LTD
2	VOL
3	P
1	CPF
5	LIQ
6	INF
7	EXC
10	INT
11	CR
12	ARB
8	DRO
13	PRO
4	WELFE

probability of impact on yield in case of implementing a policy. The mentioned results are presented in graphs 1 to 7. In the graphs presented in the right part, the probability of occurrence of the best model is presented, and in the left part, the probability of the variable being effective at the time of each variable is presented.

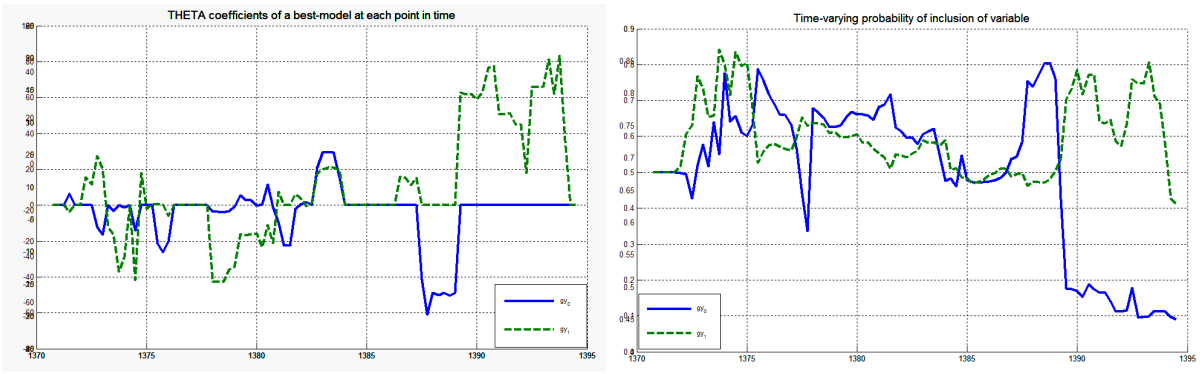

Figure 1: The probability of the best model occurring and the probability of price fluctuations being effective on returns

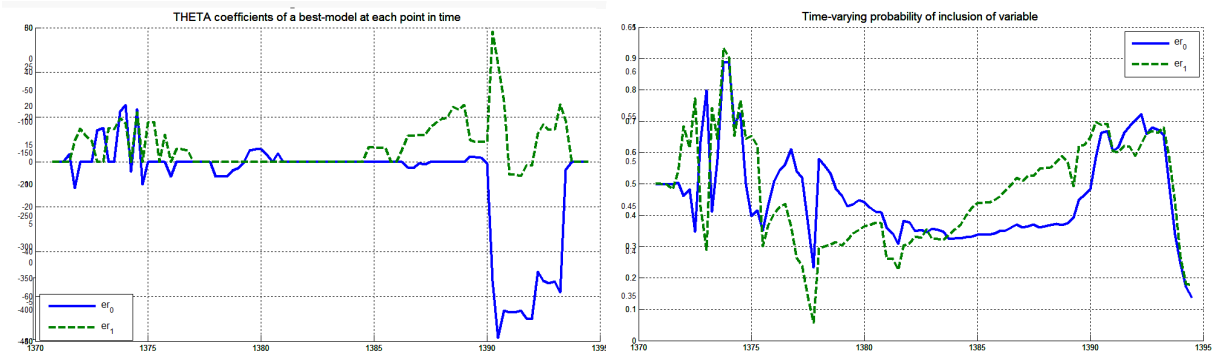

Figure 2: The probability of the best model occurring and the probability of the volume of transactions

The coefficients of independent variables help to identify this point, how much the values predicted by the network change with the change of the values of the independent variable. Table 5 shows the coefficients of each of the independent variables. According to this table, price fluctuations, cash price, volume of transactions and liquidity are the most important respectively.

To determine the best neural network model that has a high predictive ability and also has the lowest MSE (mean square error), the best parameters of the network must be determined. The parameters related to artificial neural

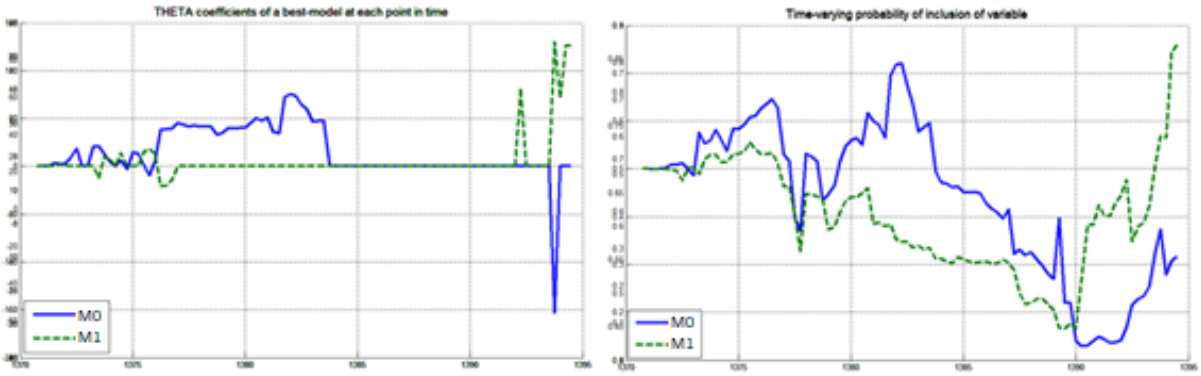

Figure 3: The probability of occurrence of the best model and the effective probability of cash prices in predicting returns

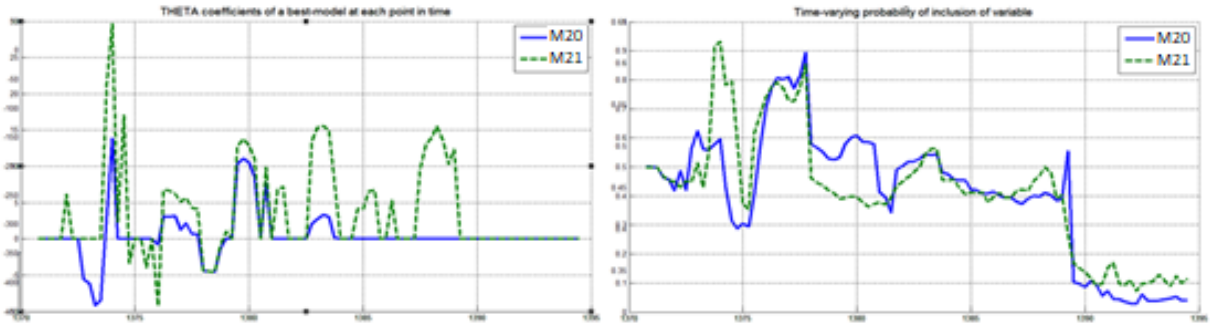

Figure 4: The probability of the best model occurring and the probability of welfare fruits being

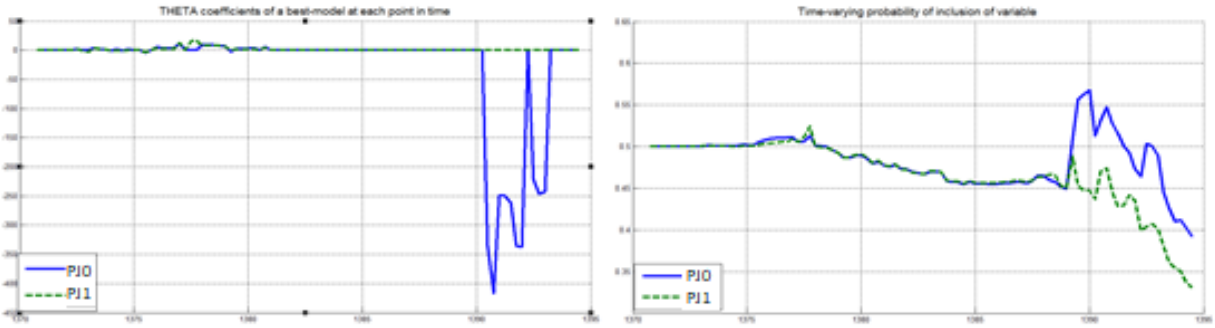

Figure 5: The probability of occurrence of the best model and the probability of market liquidity being effective in predicting returns

networks for model design include the number of hidden layers, the number of neurons in each hidden or intermediate layer, transformation function, learning function, learning rate, and the number of repetitions of training.

Figure 8 and 9 show the results of the comparison of different methods (results of model prediction and actual values):

5 Findings

The move towards the liberalization of part of the prices in the third program of economic development of Iran was the basis for the formation of commodity exchanges in Iran. The price liberalization and price determination based on the supply and demand mechanism brings a new risk to the economic actors as the risk caused by the fluctuation of commodity prices. One of the tools that companies can use to manage the risk caused by price fluctuations are futures contracts.

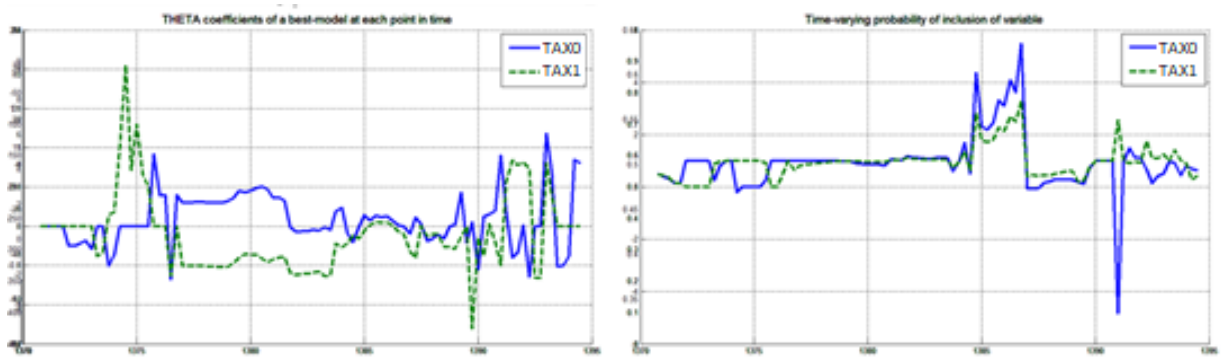

Figure 6: The probability of the best model occurring and the probability of the inflation rate being effective in predicting returns

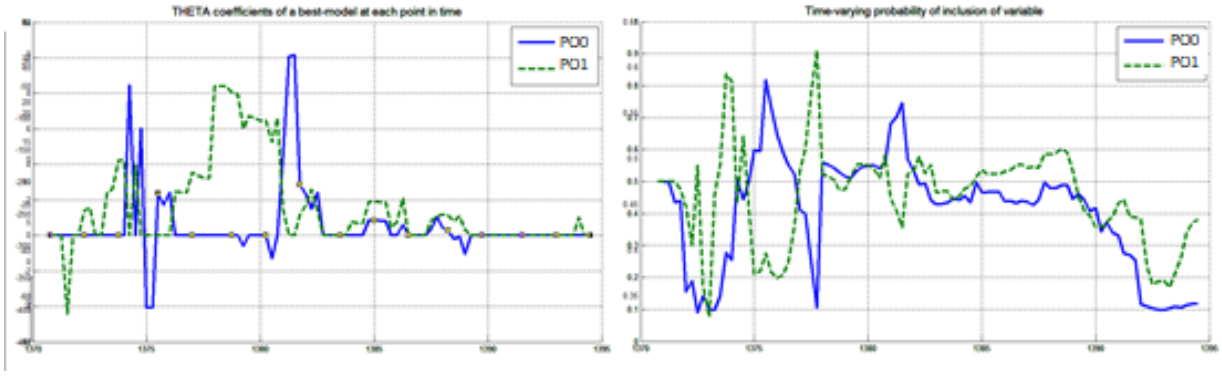

Figure 7: The probability of the best model occurring and the probability of the arbitrage efficiency being effective in predicting the efficiency

Table 7: . Coefficients of independent variables resulting from artificial neural network

Normalized-cofficient	cofficient	Variable
26.7%	0.047	LTD
85.5%	0.151	VOL
94.4%	0.167	P
98.7%	0.177	CPF
89.2%	0.162	LIQ
20.1%	0.035	INF
42.36%	0.109	EXC
15.6%	0.028	INT
27.1%	0.048	CR
25.2%	0.044	ARB
41.5%	0.073	DRO
22.3%	0.036	PRO
39.2%	0.091	WELFE

Table 8: The results of SQDF

Prediction method	MAD	MSE	RMSE	MAPE
Artificial neural network	31.46.82	55.18315	13.1049	0.9365

Based on the obtained results, cash price fluctuations with the most effective period have been evaluated as the most important factor in the yield changes of saffron futures contracts, and similarly, according to the coefficients of independent variables obtained, price fluctuations, cash price, transaction volume and liquidity are also The order is most important, hence the future contract for saffron, despite the fact that it can serve the economy as a suitable tool to manage the risk caused by price fluctuations, but there have been criticisms of this type of contract. One of the

Figure 8: The results of the efficiency model estimation by the SQDF method

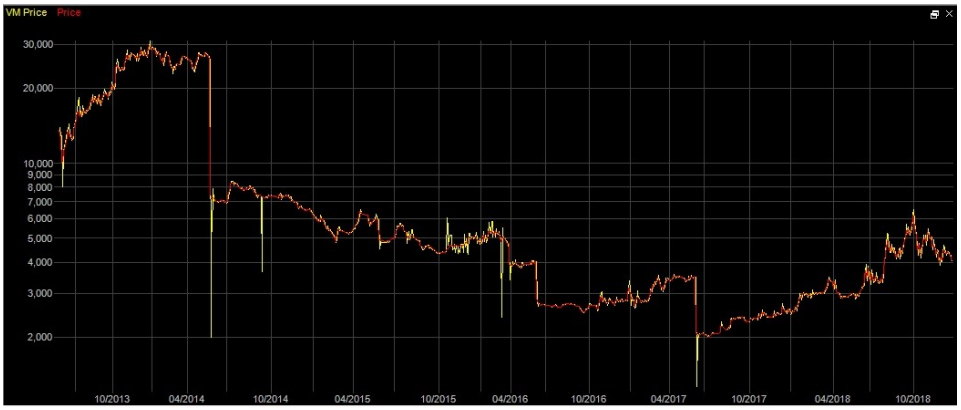

Figure 9: The results of model estimation by artificial neural method

criticisms of futures contracts is the effect of the transactions of a group of traders in this market under the name of speculators. The presence of speculators in the futures market, in addition to creating a risk transfer mechanism, helps to increase market liquidity, but it has been claimed that the extreme activity of this group has caused disruption in some markets. This issue led to the establishment of laws in the United States, based on which the body supervising the futures market is given the authority to control the activity of speculators in the futures market by changing and creating collateral, because when the collateral increases, the volume of transactions In Iran Commodity Exchange, it decreases under the condition of stability of other conditions; Therefore, collateral is not a suitable tool for market management and can only be used as a tool to prevent the default risk of traders.

It is added at the end; Except for the 4 variables of price fluctuations, cash price, trading volume and liquidity are also the most important for predicting saffron future contract yield, 10 other less important variables also show the explanatory power of the model in predicting saffron future contract yield and according to the test results Since the MAPE and RSME statistics for the neural network model are lower than the adjusted quadratic model, it can be concluded that the neural network model has a higher reliability in predicting the future yield of saffron contracts compared to the adjusted quadratic model.

In previous researches that used modified quadratic programming, like the current research, they concluded that this artificial neural network model has global convergence under appropriate assumptions and has very little error, as a result of this research, with the results of the programming model The second level suggested by the research of Kalaisi et al. [12], Basirzadeh et al. [2], Shams et al [19].

Table 9: The results of SQDF

	Neural network	Modulated quadratic neural network
MAPE	0.9365	2.6112
RMSE	13.1049	40.2073

5.1 Recommendations

According to the research question based on the comparative analysis of saffron contract yield prediction using modified quadratic function model and neural network, the following suggestions are made:

- Examining the probability of the presence of fluctuations in cash prices with the most effective period has been evaluated as the most important factor in the yield changes of saffron futures contracts, therefore; In case of implementing a policy, policy makers should have a correct view of the manner, intensity and extent of the probability of impact on efficiency.
- According to the results of this research, which states that price fluctuations, cash price, volume of transactions and liquidity are the most important in predicting future returns of saffron contracts, investors should consider these variables as key variables in investing in derivatives
- It is suggested to the managers and policy makers of the stock exchange, considering the nascent nature of the futures market in Iran, by getting to know the influencing factors except for the 14 variables obtained from this research in the return of futures contracts, which is the main determinant of the possibility of its continued existence, other variables other financial and political measures that aim to provide mechanisms for the use of factors to increase returns when necessary and create movement in the market.
- Saffron futures contract is a way to cover the risk of price changes. That is, two parties who are exposed to opposite risks (one is the risk of price increase and the other is the risk of price decrease) face each other and neutralize each other's risk. Since this work is done through the operation of updating the accounts, it can be said that the juridical nature of these contracts is "commitment to transfer the guarantee amount daily".
- Commodity exchange transactions, including saffron, are not very prosperous inside the country, and in terms of financial feasibility - due to the lack of infrastructure and the lack of advantages and sanction conditions - there are many problems that at first glance make it impossible to launch these contracts abroad. They seem impossible. Finally, understanding the importance and strategic position of these contracts in determining the price of saffron can clear the space for the prosperity of saffron exchange transactions and cause more exports of this product and higher foreign exchange earnings. In this regard, therefore, if policy makers and stock market traders want to be more effective in the future in the puzzle of determining the price of saffron, they should take action to create such a stock market and financial and executive problems and solutions to face them should be explained more in the policy proposals section.

5.2 Comparative research proposals

- Exploration in the international environment to exploit and identify existing opportunities to create future contracts and compare with the results in Iran;
- Investigating the performance of the algorithm on the models about additional practical limitations such as transaction costs and the minimum number of transactions...;
- Localization and modeling of factors involved in other agricultural products such as cumin, pistachio, etc.;
- Modeling in other products such as silver, gold box, etc.;
- Investigating the purchase of a car from the commodity exchange;
- Designing a model to explain other types of important products in future contracts;
- Designing a model to explain the types of export products and future contracts;
- Examining models such as hierarchical analysis process or TOPSIS for prioritizing the factors of future contracts;
- Using the Dimtel method for weighting and ranking the factors of future contracts;
- Analysts analyze different datasets from Dow Jones, Nasdaq100, FTSE100 and FF49 to demonstrate the performance of the proposed method.
- Considering the effects of other variables on the price of effective future contracts: for example, the global price of gold, oil, the degree of investment risk, etc.

- Examining the impact of other influential non-financial variables;
- The effect of other macro economic variables on future contracts yield;
- The effect of limiting the price of futures contracts on reducing the effect of its protection against inflation;
- Solving the problem by considering various types of statistical
- societies such as stock exchange and over-the-counter or separating the industry for other similar industries;

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