

Forecasting gold coin futures price by support vector regression and hybrid model

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ABSTRACT

In recent years, Futures trading in Iran Mercantile Exchange on Azadi's gold coin, had been increased and taken into consideration by many trader. In this study ,by using regression methods , and machine learning methods such as artificial neural network , Support Vector Regression and The new hybrid model, has been investigated gold futures prices forecasting. The data have been used is 480 days from March2017 until November 2018. The new hybrid model include three prediction algorithms: Artificial neural network (ANN), Support Vector Regression (SVR) and Regression model. First, we utilize them independently to single-step forecast the gold futures price, and then integrate the three forecasts into a final result by a combining strategy. Method for combination is linear, based on finding, the new hybrid model is better of them. The experiment verifies that by combining the single algorithm considerately, a better performance can be received.

Key words: Azadi's gold coin futures, artificial neural network, Support Vector Regression.

Introduction

Gold as a investment commodity used to maintain the value of money. In Iran, important part of capital and savings is in the form of gold coins and in the gold market, marketers trying to make a profit with follow global gold prices, exchange rate and etc. The price of gold on world markets rose steadily in the first half of 2017 and gold coins appreciated in line with that. Rather than cashing in their coins for a profit, Iranians continued to buy coins in ever larger numbers. Fears about the domestic economy, particularly the risk of soaring inflation and a wobbly currency is the reasons that people are drawn to these safe assets as gold coins. Treasured as a store of value, Iran's gold coins, minted over centuries, are also culturally important.

Decline in Tehran Stock Exchange Index, increasing rate of exchange and global gold price led to volatility on domestic gold. On the other side, the derivative (new financial instrument) has uncertainty, that gold coin futures is not exempt from this type. Therefore, risk of financial instrument (futures) and

fluctuations of commodity (gold) cause to make problem more complicated, and having the Prediction is more important.

Accordingly, the aim of this study is to forecasting gold coins futures price, so, experiment different model to decrease errors. Based on the literature review, and interview with major traders, have been understood four variable influence effect in gold coin futures in Iran that conclude global ounce of gold, Dollar, index stock, gold coin in spot market. And finding SVR, ANN, and regression outperformed better of another model. Firstly, we utilize them independently to single-step forecast, and then integrate the three forecasts into a final result by a combing strategy. The rest of the paper is organized as follows: In Section 2, we review the literature. In section 3, simply describes futures contract specifications and models used in this paper. The detailed experiment setup and the corresponding analysis are shown in section 4, and finally some concluding remarks are described in section 5.

Literature review

Studies about Predicting the price of gold and the price of futures contracts, is few.

In Iran, Ahmadi by using of Box – Jenkins method to investigated whether gold futures is able to forecast, ARIMA is applied that show appropriate results. [1]

Pousti and et al. present two regression functions to estimate gold coin futures price based on gold coin price, foreign exchange rate, and price of gold traded globally and trend of time in Iran mercantile exchange (IME). [2]

Samadi [3] and Rahmaniani [4] investigate volatility of gold futures contract, and in the different paper, examined Psychological barriers in gold prices, they stated that the gold price have visible psychological impact. [5]

For gold price forecasting, Zhou and et al. proposed an improved EMD meta-learning rate-based model. They adopt the EMD method to divide the time series data into different subsets. Second, a back-propagation neural network model (BPNN) is used to function as the prediction model in their system [6] AND Ongsrirakul Applied decision tree and support vector regression. [7]

Furthermore, Influence of Macroeconomic factors in gold market was examined, result show in UK, The role of the dollar in gold is confirmed but few other macroeconomic variables have an impact. Also, excess returns of the gold market had been intentioned in global studies, Ditchel evaluates the forecasting power of three approaches that have been applied successfully in a stock market prediction context: 1) technical indicators, 2) diffusion indices, and 3) economically motivated restrictions in predictive regressions. The results show that these prediction techniques do not result in superior forecasts of gold excess returns. Thus, this study confirms the findings of other studies that have demonstrated that future gold price fluctuations are difficult to forecast. [8]

But, an article stated that the hybrid model based on linear regression (MLR), support vector machine (SVM), artificial neural network (ANN), has high accuracy and outperforms in gold price forecasting. [9]

Risse had examined Combining wavelet decomposition with support vector regression in an economic forecasting environment using the excess-return series of the price of gold. Results derived from statistical accuracy underline the difficulty of beating simple historical mean forecasts when considering only a single predictor. Determinants that should be of particular interest in this context are inflation, the trade-weighted exchange rate, and commodity indices. Combining wavelet decomposition with support vector regression has obtained the best economic outcome of all alternative forecasting models, as well as the highest statistical accuracy over the full sample period. [10]

A study have modelled gold prices in India and shown it to have a long term relationship with the stock market index, exchange rate, US bond rates, oil prices and the consumer price index and found evidence that the role of gold as a portfolio hedge dominates its use as a luxury good in India and Gold prices are negatively related with oil prices, further indicating the role of gold as a hedge. Gold prices go up when the rupee is weaker implying that gold is a good hedge against the dollar. [11]

Most forecasting paper, related to the stock market, due to the similarity of gold futures to stock, used the same kind methods. Major variables in studies are stock index [12], historical prices [13], spot gold price [14], local currency exchange rate against us dollar [15].

Some papers, comprised combining models of ANFIS, NN, regression models, result show hybrid model of ANFIS is outperformed of others. [16, 17, 18]

Overview concept

A. Futures Contract

A financial contract obligating the buyer to purchase an asset (or the seller to sell an asset), such as a physical commodity or a financial instrument, at a predetermined future date and price. Futures contracts detail the quality and quantity of the underlying asset; they are standardized to facilitate trading on a futures exchange. Some futures contracts may call for physical delivery of the asset, while others are settled in cash. The futures markets are characterized by the ability to use very high leverage relative to stock markets.

B. Neural network

The foundation of the artificial neural networks paradigm was laid in the 1950s. Since then, ANNs have earned significant attention because of the development of more powerful hardware and neural algorithms. Artificial Neural Network is an artificial representation of the human brain that tries to simulate its learning process. Neural network modeling for complex data analysis has three main processes: problem identification, neural network modeling and data analysis. Fig.2 shows the neural network model.

C. SVR

In a regression problem, we are given a set of training patterns $(x_1, y_1) \dots (x_l, y_l)$, where $x_i \in R^n$, $i = 1, \dots, l$, and $y_i \in R$. Each y_i is the desired target, or output, value for the input vector x_i . A regression model is learned from these patterns and used to predict the target values of unseen input vectors. SVR is a nonlinear kernel-based regression method which tries to locate a regression hyperplane with small risk in high-dimensional feature space. It possesses good function approximation and generalization capabilities. Among the various types of support vector regression, the most commonly used is ϵ -SVR which finds a regression hyper plane with a ϵ -insensitive band. To make the method more robust, the image of the input data does not need to lie strictly on or inside the ϵ -insensitive band. Instead, the images which lie outside the ϵ -insensitive band are penalized and slack variables are introduced to account for these images. For convenience, in the sequel, the term SVR is used to stand for ϵ -SVR.

D. Regression model

Regression is a statistical technique for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. More specifically, regression analysis helps one understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed.

Regression analysis is widely used for prediction and forecasting, where its use has substantial overlap with the field of machine learning.

E. Hybrid models

The combining strategy is employed to merge the three forecast result of the single forecasts algorithm to form the final prediction of the stock price. Unlike the voting strategy common used in classification problem, Hybrid model is a simply linear combination of the three predictions.

Considering the different performance of the three algorithms, the weight assigned for different algorithms is proportional to their accuracies. The weight was determined by error of each model to total error.

Experiments and Results

A. Regression models

In this study, the nearest maturity futures price has been considered as the dependent, and independent variable concluded, ounce of gold price, foreign exchange prices, Tehran stock market index and prices of

Azadi's gold coins in the spot market. Data have been used from March 26, 2017 until November 26, 2018 that 480 working days. 400 day is applied for train model and 80 days for test.

Table 1, show Descriptive Statistics for variable, the data has normal distribution. Firstly, correlation between independent variable and others is represented, then apply regression, SVR, ANN, hybrid models and then error of prediction calculate by MAP, MPE.

Graphs of the variables based on time from fig. (a) to (d) is given.

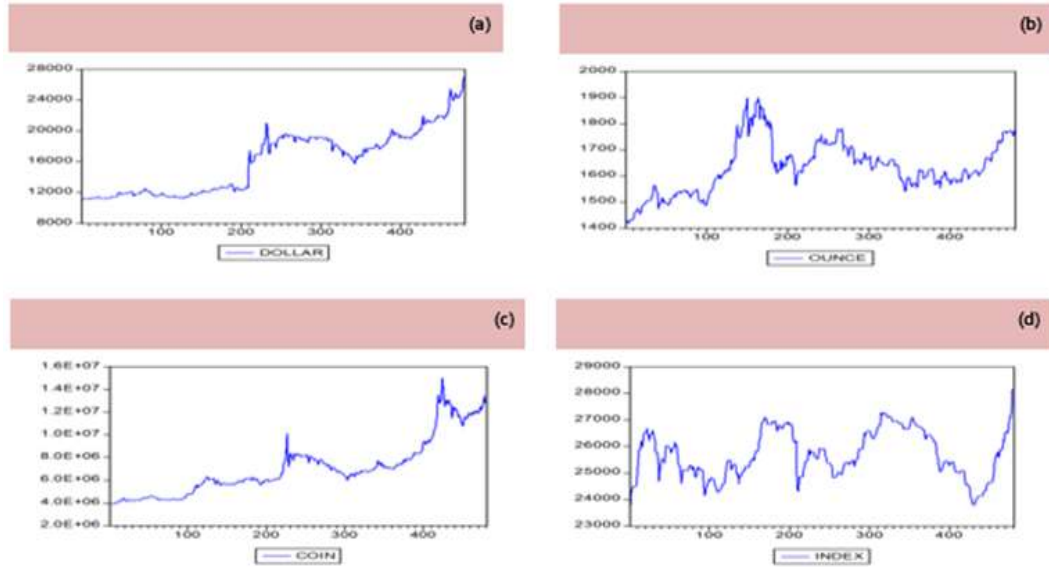


Figure 1: Plots of variable

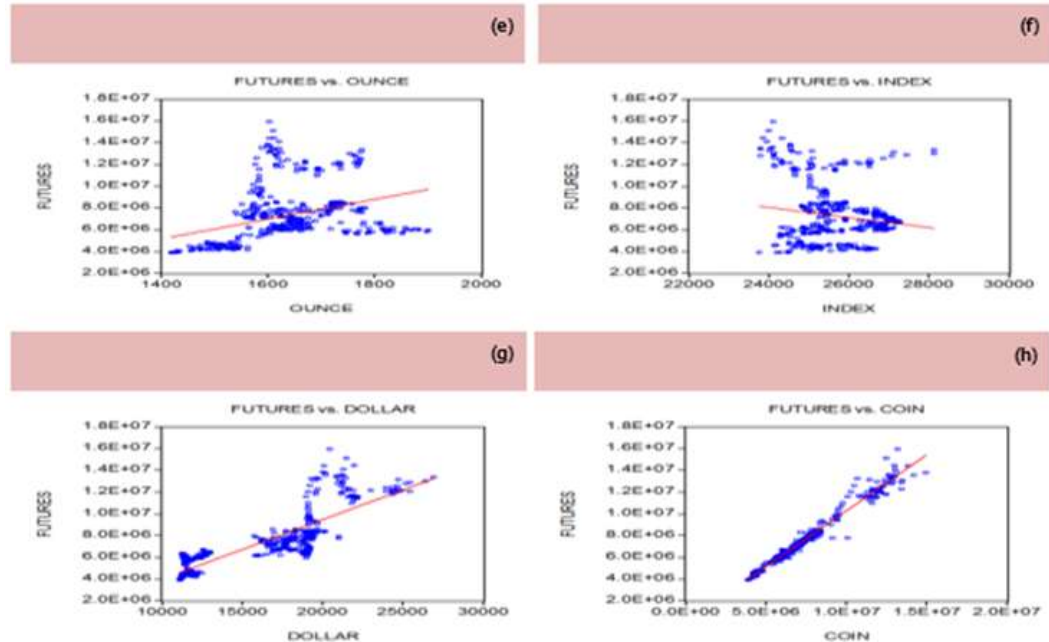


Figure 2: The correlation between variable

Fig. 2 represented that the correlation between FUTURES vs. DOLLAR, COIN, OUNCE, INDEX, is significant, the r-squared (R2) have been used to representing relationship between independent variable and gold futures price.

Table 1: Correlation coefficients of variables relative to futures contract

	COIN	DOLLAR	INDEX	OUNCE
R-squared	0.978508	0.725013	0.025271	0.119942

In equation of futures contracts on the basis of the regression all four variables are calculated as follows.

$$Futures\ contract = b_0 + b_1 * Dolla + b_2 * Coin + b_3 * Ounce + b_4 * Index$$

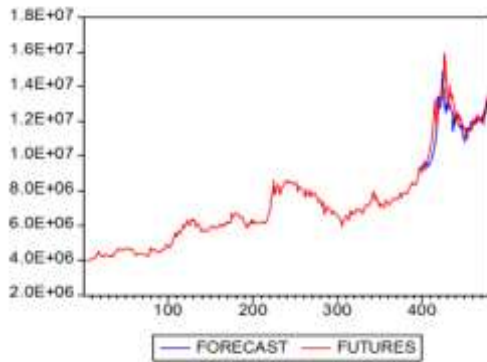
Table 2: Regression coefficients

Variable	COIN	DOLLAR	INDEX	OUNCE
Coefficient	0.976814	1.080416	7.365089	404.4634

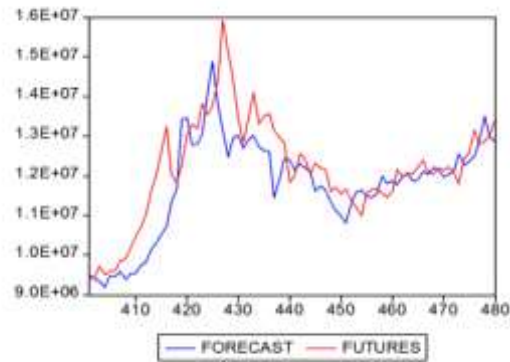
Finally, the obtained coefficients are as follows:

$$Futures\ contract = -586989.8 + 1.080416 * Dollar + 0.976814 * Coin + 404.4634 * Ounce + 7.365089 * Index$$

As mentioned, the first is 400 days to make regression model and then 80 days for testing.



(a) forecasting based on regression model



(b) difference between forecasting and actual futures

Figure 3: Regression model

B. Prediction With neural network (ANN) and (SVR)

To determine the optimal number of layers and neurons, several networks were implemented, At the end the network with two hidden layers 10 neurons in each layer with the lowest MSE, was selected. ANN and SVR models were implemented by MATLAB toolbox.

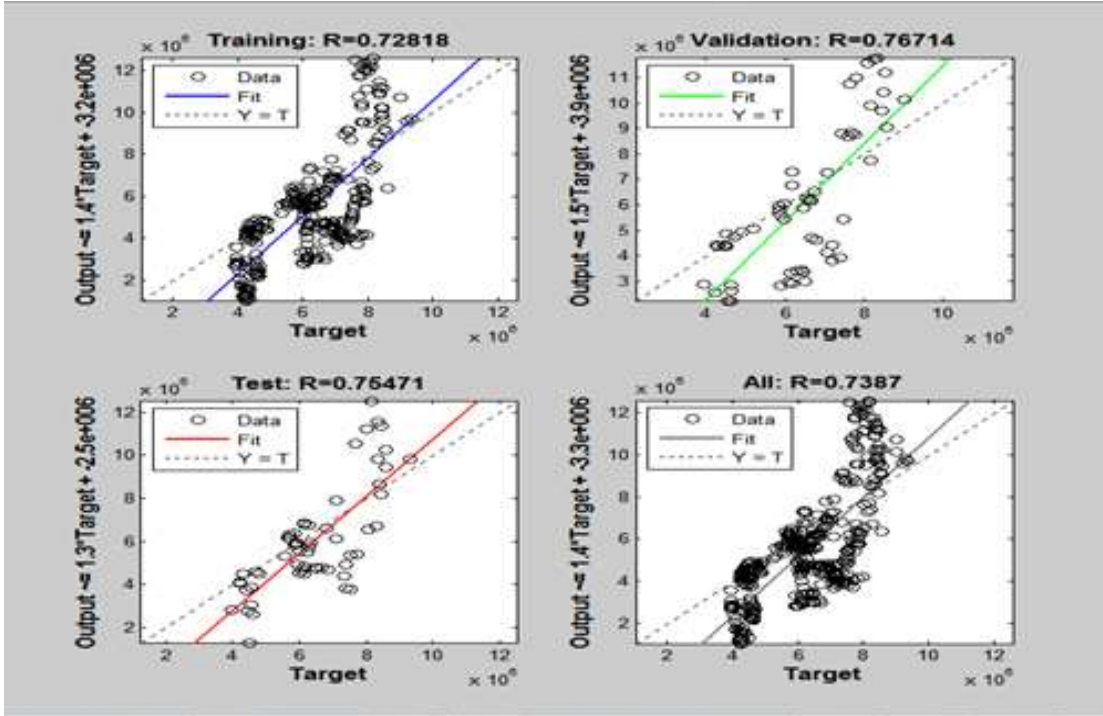


Figure 4: Fitness of ANN

Plots represent fitting of the neural network. In figure 4 and 5 the results of the SVR models for train and testing model represented.

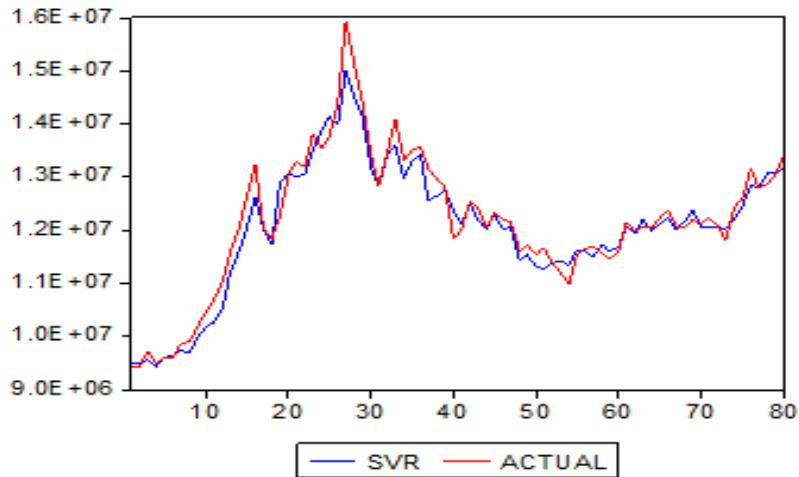


Figure 5: SVR model

This plot shows train data evaluation, error value and error histogram in train and test model.

C. Hybrid models

In follow figure illustrates comparison between the predicted values and actual values in hybrid model.

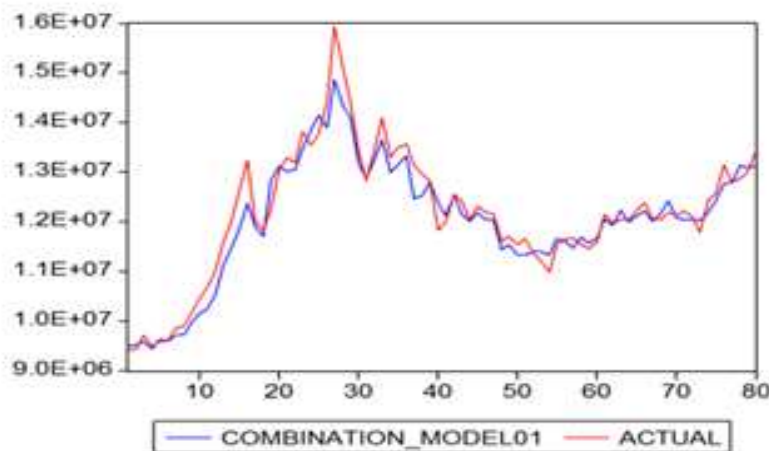


Figure 6: Hybrid model

Figure (7) shows the graphs compare the answers of different ways.

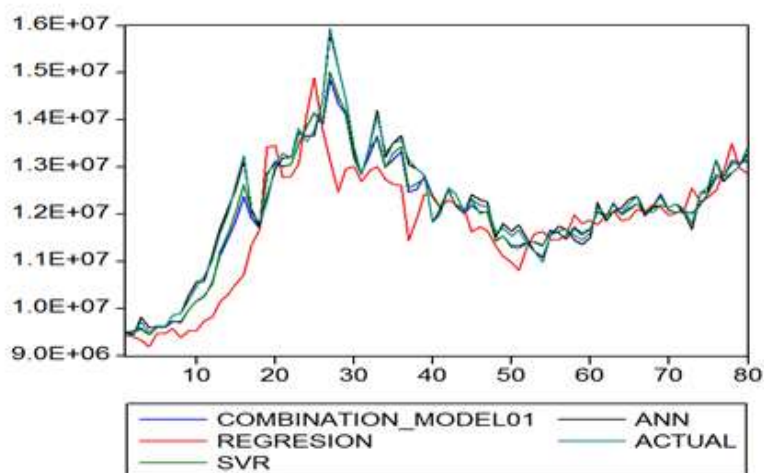


Figure 7: Total results

Also the results according to MAPE, MPE comparison results are summarized in the table (3).

Table 3: Error values obtained from different methods.

	Regression	SVR	ANN	combination model
MAPE	0.046722876	0.0260334	0.032398	0.021509765
MPE	0.030510245	0.0167314	0.202076	0.011040376

As can be seen in the results of the regression is acceptable and ANN is more precision, SVR higher accuracy and lower Error rate has, but hybrid model is the best forecasting accuracy. It is significant point that the regression error is higher than the results of the neural network, but the implementation of linear regression model is much simpler than the neural network.

Conclusions and Recommendations

In this study, based on the sensitivity of the price of gold, to predict futures prices for the gold coin in Iran Mercantile Exchange, four variables was considered including dollar rate , stock index value ,the global gold price and gold coin price in spot market. Four models were examined in this study, three models based on the literature review and the fourth is a new hybrid model. Hybrid model was linear combining of SVR, ANN and linear regression .The findings of study indicate that the model with the lowest error has most precision.

In this case, the prediction models were sufficiently accurate but to have a model in high accuracy, we can use Support vector regression and hybrid model. Finally, this study is able to model with High precision for forecasting futures price.

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