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Applying Optimized Mathematical Algorithms to Forecast Stock Price Average Accredited Banks in Tehran Stock Exchange and Iran Fara Bourse

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ABSTRACT

The effective role of capital in every country flows through giving guidelines for capital and resources, generalizing companies and sharing development projects with public, and also adding accredited companies stock market requires appropriate decision making for shareholders and investors who are willing to buy shares based on price mechanism. Forecasting stock price has always been a challenging task, since it is affected by many economic and non-economic factors and variables; therefore, selecting the best and the most efficient forecasting model is tough and essential. Up to now applying weighted mean called weighted mean price has been used to forecast industry average price for companies in the stock market and investors were forecasting based on this method. First we have identified 10 accredited banks in TSE and 10 banks in Iran Fara Bourse. In this article, by applying one of the mathematical optimizing techniques, industry means got calculated based on optimized parameters and compared with the industry average; in this statement we strived to find another variable that could forecast with less deviation. In the following study, by calculating frequency level of deviations, average for price forecasting in banking industry during five years is examined. Finally, the research suggests that, instead of using mean of industry average, it is better to use mean average of golden number, which will lead us to more accurate results.

1 Introduction

Financial system of each country has very important role in health, growth and success of the economy of that country. Financial institutions, includes banks and financial institutes, as Intermediary institutions, play an effective role in preparing and the allocation of financial resources. Every country who has more advanced financial system, can maintain their financial stability, both in national and international level. The historical trend shows that, in developed countries, there is a positive alignment between economic growth and growth of financial systems. Since the economic resources are limited, in order to direct the whole economy in the correct path, right allocation of these resources to the real parts of the economy is essential. On the other hand, the development planners, indirectly, can

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have an effective role in guiding the whole economy through planning and managing this section of economy [17]. Given the rapid development of the banking sector, it is reasonable to expect that the performance of banks has become the centre of attention among bank managers, stakeholders, policy makers, and regulators [12]. The purpose of stock price prediction is to explore the development law of stock market so as to provide a scientific basis for stock investments. As the stock price volatility is caused by many factors, it is difficult to grasp the uncertainty of these factors affecting stock prices [14]. Predicting stock price is an important objective in the financial world, since a reasonably accurate prediction has the possibility to yield high financial benefits and hedge against market risk [1]. In the beginning of the 21st century, however, some economies indicated that future stock prices are at least partially predictable [15]. Therefor a lot of prediction algorithms have been explored and showed that stock price behaviour can indeed be predicted [10]. However predictable, it remains hard to forecast the stock price movement mainly because the financial market is a complex, evolutionary, and non-linear dynamical system which interacts with political events, general economic conditions and traders 'expectations [11]. The stock price prediction is that, based on accurate survey statistics and stock market information, scientific methods are used to predict the future tendency of stock market from the history, current situation and stock market laws. There are many factors that affect the stock market development. Uncertain interactions between these influence factors are very complex, which will lead to prediction deviations. With development of the national economy and in-depth understanding of stock market, it becomes increasingly important for stock investment and risk management to use a reasonable and effective method to accurately predict and the stock price trend [14].

In this research, we present the application of fuzzy time series to forecast stock price average based on a set of data that we have extracted from banking industry of Iran during 5 years (March 2013 - March 2018) among banking industry which has been extracted for five years activities from March 2013 to March 2018 and by using golden ratio algorithm, we determine stock price average based on calculated price with golden ratio algorithm for each bank and then we compare the average of bank's golden numbers with the mean of banking average industry for five years on annual basis.

The main purpose of this research is reaching to a mathematical model for right and systematic assessment of stock price average in the way of having minimum deviation and also developing forecasting model in market for users and analysts.

2 Research Background

After the launch of the CSI 300 index futures in China, the study of index futures price variation in the Chinese market is of great significance, in order to solve the problem of financial time series analysis and prediction, the researchers used the exponential smoothing method, ARIMA[1] model, and the state space model and Kalman filter model. However, these models hardly fit nonlinear data. To solve this problem, some scholars propose neural network model which simulates the working principle of the neuron and support vector machine model based on the statistics. Although all of the above models can better solve the precise data analysis prediction, they barely deal with fuzzy data [32].

With the further research and application of the uncertainty phenomenon of systems, there raise some studies related in this area. In order to solve the fuzzy data, Zadeh proposed the concept of fuzzy sets

[1] Autoregressive integrative moving average

in 1965 and then Pawlak presented the rough set theory. Song and Chissom put forward the concept of the fuzzy time series, which refers to the time-series data consisting of fuzzy set value. Then Chen and Hwang extended the fuzzy time series into a Binary model. On the basis of the original model, Hurang and Yu extended the order of the model to N-order, and then used the new model to predict the weighted stock index of the Taiwan Stock Exchange, and found that the method is useful to predict prices [9]. Meanwhile, Sadaei et al proposed the fuzzy time series model with the fixed weights [26]. On the basis of Yu's model, Cheng, Chen and Chiang [3] proposed the fuzzy time series model based on the trend weights. Further there are more researchers studying the fuzzy time series. Jilani et al [13] and Nan et al [19] combine Heuristic model with the fuzzy time series and integrate detailed questions into the model, which improves the prediction accuracy of the model. These studies include how to improve fuzzy time series models and how to use these models into practice activities [32]. In addition, some researchers utilized the superiority of the neural network in predicting non-linear data and thus combined the neural network model with the fuzzy time series model [2].

In addition, a hybrid fuzzy time series model and simulated annealing algorithm [24], chaotic time series with ant colony optimization [22], fuzzy neural network based on genetic algorithm [23], wavelet neural network method based on rough set attribute reduction 14] and fuzzy time series based on Fibonacci sequence are used for forecasting stock price and index in financial markets and stock exchanges inside and outside the country. In financial markets such as Tehran Stock Exchange, P/E[2] coefficient, which is one of the most well-known instruments for evaluating stock prices in financial markets, is considered necessary for shareholders, investors, analysts and corporate executives.Safa & Panahian used harmony research metaheuristic algorithm to select optimal variables that affecting P/E and then, modelling is done through multivariate regression based on panel data [28]. Rezaei and Elmi [25] modelled the reaction of stock price in the stock market by the behavioural finance approach. In order to forecast the stock price, the final price data of companies listed on Tehran Stock Exchange was analysed. In this study, Bayes rules was used to estimate the probability of the model change.

In other article that is written by this writer and published in Financial Engineering and Portfolio Management article, with a different look, a combined fuzzy time series with golden ratio algorithm is applied for forecasting stock data from each banks.

3 Theoretical Principles and Research Literature

Three components have a significant role in our study

3.1 Forecasting and Estimation

The trend of forecasting has been considered by scientists for many years due to its dynamic and complicated nature. Also it is a controversial matter because of its ambiguity and variables that affect market index in one day. Economic conditions, investor's feeling to a particular company, and political events are effective variables in stock prices. Thus stock market is sensitive to rapid changes, which is caused by random fluctuations in prices. According to irregularities and instabilities in the stock behaviour, investing in this market has its high risk; therefore, achieving knowledge to minimize the risk and forecast the trend is vital [8]. In financial theories, forecasting prices is one of the most important and perhaps most developed available topic that various different models are designed

[2] Price to Earnings ratio

to forecast share price, which each of which has specific features and assumptions [27].

3.2 Fuzzy Logic

Fuzzy systems that are used in uncertainty conditions are created based on fuzzy set theory. These systems convert many ambiguous concepts and variables to a solvable mathematical model and they improve decision making in uncertainty situation [27]. In this article forecasting data are rationalized by fuzzy membership function values, therefore, time series method is combined with fuzzy.

3.2.1 Fuzzy Time Series

A time series is defined as a set of sequential observations which can be either continuous or discrete. Time series analysis is widely used by researchers studying methods of stock market forecasting and logistical regression models based on traditional statistical assumptions. Financial forecasting problems are usually handled using traditional time series methods such as autoregressive moving average (ARMA) model, autoregressive conditional heteroscedastic (ARCH) model, and generalized ARCH (GARCH) model [7]. But these methods require extensive historical data and assumptions such as normality postulates. Unlike conventional time series which deal with real numbers, fuzzy time series are architecture by fuzzy sets. Fuzzy time series are frequently applied into producing stock price predictions due to the handling capability of linguistic value datasets to produce accurate forecasting results. Nowadays, it has been widely and successfully utilized to forecast nonlinear and dynamics datasets in such widely varying domain including course enrolment, temperature, traffic accidents, tourism demand and stock market [4]. Fuzzy theory was originally developed to deal with problems involving linguistic terms. Time series models had failed to consider the application of this theory until fuzzy time series were defined by Song and Chissom. They proposed the definition of fuzzy time series and methods to model fuzzy relationships among observations. The framework of Song and Chissom's model include six steps: (1) define and partition the universe of discourse; (2) define fuzzy sets for the observations; (3) fuzzify the observations; (4) establish the fuzzy relationship; (5) forecast, and (6) deffuzify the forecasting results [30]. In the evolution of fuzzy time series models, Chen proposed another method to apply simplified arithmetic operations in forecasting algorithms rather than the complicated maximum-minimum composition operations, which are presented in Song and Chissom's models. In subsequent research, Chen proposed several methods, such as high order fuzzy relationships and genetic algorithms to improve his initial model [5].

Additionally, Huang pointed out that the length of intervals affected the forecasting accuracy in fuzzy time series and proposed a method with distribution-based length and average-based length to reconcile this issue. In Huang's model, two different length of intervals were applied to Chen's model and it was concluded that distribution-based and average-based length could improve forecasting accuracy. Although this method demonstrates excellence in forecasting, we argue that it creates too many linguistic values to be identified by analysts, since, according to Miller, establishing linguistic values and dividing intervals would be a trade-off between human recognition and forecasting accuracy [16].

3.3 Mathematical Optimization

The purpose of optimization, according to limitation and needs of a problem, is finding the best acceptable answer. Optimization in mathematics, economics and management refers to select the best membership of a set of achievable members. In the simplest form, it is trying to get maximum and minimum value of data with systematic selection of them from an accessible set and calculating the value of a real function.In mathematics, nonlinear optimization includes those issues in which relations between variables are nonlinear. The goal is to maximize or minimize the value of the multi-objective function, or a multiplicity of the objective function with or without constraints [18]. In this research, golden ratio method is used as one of the sequential search method which is subset of direct algorithm in single-variable problems without constraints.

3.3.1 Golden Ratio Algorithm

The Golden Ratio (GR), represented by the Greek Letter Phi(Ø), is known since ancient times also as the Golden Ratio, Golden Number, Golden Proportion, Golden Mean, Golden Section, Divine Proportion and divine section as a mathematic parameter with important symmetric and harmonic properties [31]. The golden ratio, as an irrational, continuous and non-repeating number, with the value of 1.61803398…, can be considered as the first number of a family which can generate a set of generalized Fibonacci sequence [29]. The Fibonacci numbers is a series of terms $\{Fn\}_{n=1}^{\infty}$ recurrence equation:

Fn = Fn-1 + Fn-2

This result in a series of terms of the type 1,1,3,4,5,8,13,21,34,55,89, 144,…, in which the ratio of two consecutive terms trend to the golden ratio value, as stated in the formula Ø = Fn/Fn-1 = 1.61803398…[20]. The golden ratio, the Fibonacci sequence and also its q-deformed or "quantum" extension are widely applied in modern sciences, particularly in theoretical physics, mathematics and computer science, but also in art, architecture, economics and natural sciences [21]. The multiple connection of these mathematical concepts with our life environment it led to their labelling with the term of "divine aesthetics" [6]. In previous computations, since the calculation are comparable with industry average price, the golden ratio algorithm is used for annual average of each bank and the results are presented in the final table.

4 Research Methodology

From the reviewed literature, we have found that the issues, such as determining the reasonable universe of discourse, discovering proper recurrence information, inspecting the data distribution within linguistic values and applying stock analysis theory in fuzzy time series models, can be further discussed. To deal with these problems at one time, we propose a new fuzzy time series model based on golden ratio algorithm. There are three refined processes factored into our model:

A. The use of a fluctuation-weighted method to represent the patterns of stock price fluctuations in history.

B. The use of the spread centre of each linguistic value as a defuzzified value.

C. Using golden ratio algorithm to forecast the most golden price and the golden price average of every banks in future years.

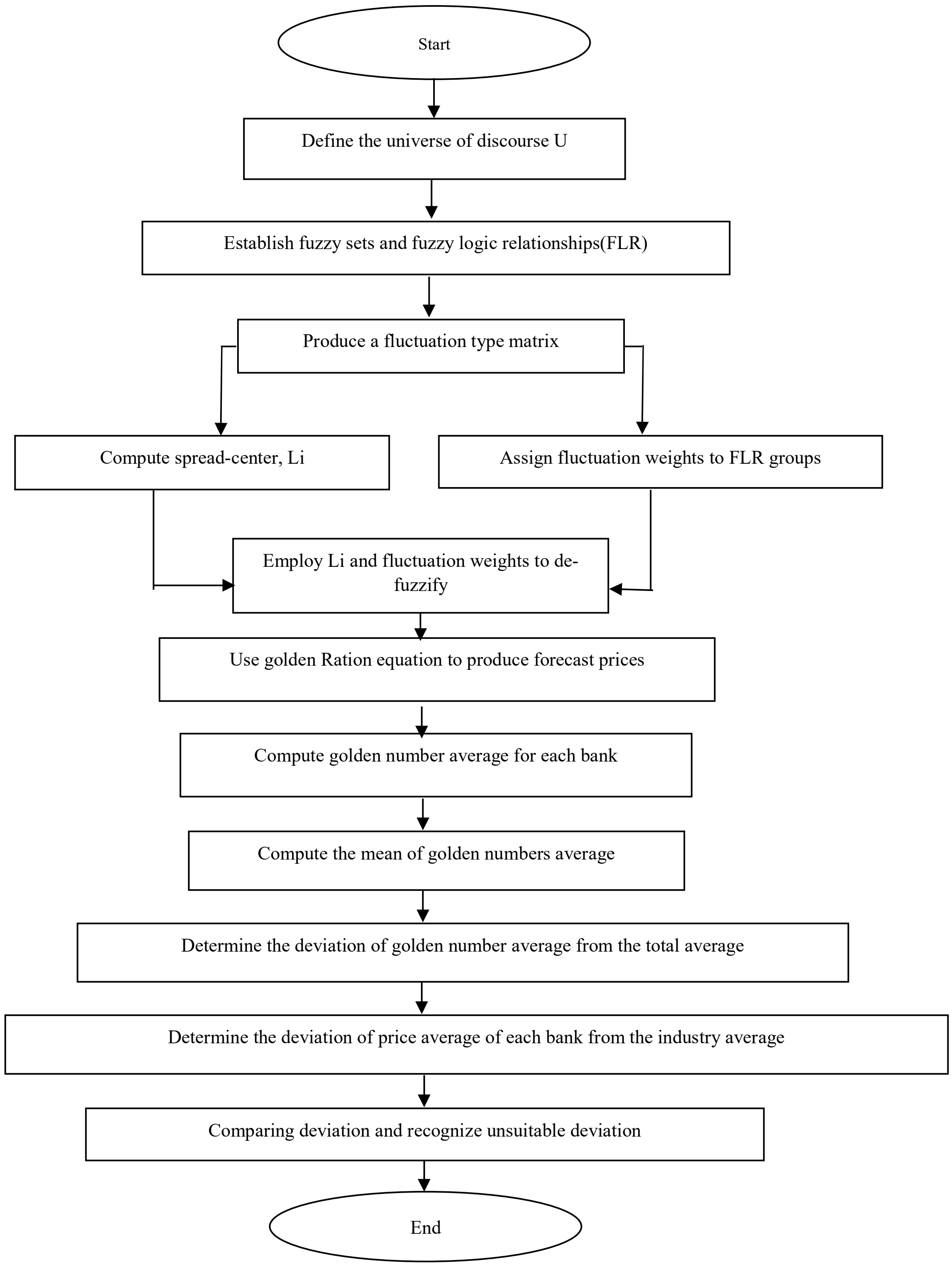

Fig.1: Flow Diagram of Research

According to above description, we need a work flow chart to calculate prices based on proposed relationships. It can be seen in the following flow chart that there are 8 steps.

4.1 Solving Strategy

After introducing the chart, each steps will be described in detail.

Step1) Define the universe of discourse U:

The universal set is specified in the form of U= [min, max] that covers all data (stock prices) in the study period.

Table 1: Define the universe of discourse U

Max	P_{max}
Min	P_{min}

→ U= [min, max]

In this article, the universe of discourse is divided into seven linguistic intervals; in other researchers, the length of intervals could be shorter or longer.

L1 = (very low price), L2 = (low price), L3= (little low price), L4 = (normal price), L5 = (little high price), L6 = (high price), L7 = (very high price)

Table 2: Set intervals

Partitioning Intervals	Range
I_1	R_1
I_2	R_2
I_3	R_3
I_4	R_4
I_5	R_5
I_6	R_6
I_7	R_7

Step2) Establish a related fuzzy set:

In this step, the fuzzy sets, L1, L2, …, Lk for the universe of discourse are defined by:

$$\begin{aligned} &L1=a11/u1+a12/u2+\ldots+a1m/um \\ &L2=a21/u1+a22/u2+\ldots+a2m/um \\ &\ldots \\ &Lk=ak1/u1+ak2/u2+\ldots+akm/um \end{aligned} \quad (1)$$

In Eq. (1), the value of aij indicates the grade of membership of uj in fuzzy set Li, where aij ϵ [0,1], $1 \leq i \leq k$, $1 \leq j \leq m$. If the maximum membership of the stock price is under Lk, then the fuzzified stock price is labelled as Lk [2].

Table 3: Assign a related linguistic value to each stock price

TIME	PRICE	LINGUISTIC VALUE
1	P_1	L_i
2	P_2	L_i
3	P_3	L_i
4	P_4	L_i
5	P_5	L_i
. . .	. . .	. . .
n	p_n	L_i

Establish FLRs [3] for linguistic time series. One fuzzy logical relationship is composed of two consecutive linguistic value. For example, the FLR (Li ⟶ Lj) is stablished by Li(t-1) and Lj(t).

Table 4: FLR table

FLR table
$L_i(t=1) \longrightarrow L_j(t=2)$
$L_i(t=2) \longrightarrow L_j(t=3)$
$L_i(t=3) \longrightarrow L_j(t=4)$
$L_i(t=4) \longrightarrow L_j(t=5)$
. . .
$L_i(t-2) \longrightarrow L_j(t-1)$
$L_i(t-1) \longrightarrow L_j(t)$

Step3) Establish FLR groups, and produce a fluctuation-type matrix. The FLRs with the same left hand side[4] linguistic value can be grouped into one FLR group. All FLR groups will construct a fluctuation-type matrix. Each row of the matrix represents one FLR group and each cell represents the occurrence frequency of each FLR.

Step4) Assign fluctuation weight for each FLR group. Each FLR within the same FLR group should be assigned with a weight. For better understanding, for example if FLR groups are as follows:

$L1 \longrightarrow L2$

$L1 \longrightarrow L2$

$L1 \longrightarrow L1$

[3] Fuzzy logical relationships

[4] LHS

Table 5: Occurrence frequency of each FLR

		p(t+1)							Total
		L1	L2	L3	L4	L5	L6	L7	
p(t)	L1	$f(L_{11})$	$f(L_{12})$	$f(L_{13})$	$f(L_{14})$	$f(L_{15})$	$f(L_{16})$	$f(L_{17})$	
	L2	$f(L_{21})$	$f(L_{22})$	$f(L_{23})$	$f(L_{24})$	$f(L_{25})$	$f(L_{26})$	$f(L_{27})$	
	L3	$f(L_{31})$	$f(L_{32})$	$f(L_{33})$	$f(L_{34})$	$f(L_{35})$	$f(L_{36})$	$f(L_{37})$	
	L4	$f(L_{41})$	$f(L_{42})$	$f(L_{43})$	$f(L_{44})$	$f(L_{45})$	$f(L_{46})$	$f(L_{47})$	
	L5	$f(L_{51})$	$f(L_{52})$	$f(L_{53})$	$f(L_{54})$	$f(L_{55})$	$f(L_{56})$	$f(L_{57})$	
	L6	$f(L_{61})$	$f(L_{62})$	$f(L_{63})$	$f(L_{64})$	$f(L_{65})$	$f(L_{66})$	$f(L_{67})$	
	L7	$f(L_{71})$	$f(L_{72})$	$f(L_{73})$	$f(L_{74})$	$f(L_{75})$	$f(L_{76})$	$f(L_{77})$	
Total									

The FLR of L1 → L1 occurs once and the weight is assigned 1. However, The FLR of L1 → L2

curs twice, therefore, the second FLR is assigned as 2. In the weighted methods, the FLR weight is determined by its order of occurrence. Here, we provide an equation to compute the fluctuation weight assigned for each FLR, which is defined in (2) (where W Li → Lj represents the assigned weight for the FLR, Li→ Lj ,f(Li→ Lj) is the occurrence frequency of Li→ Lj and k is the occurrence order of Li→ Lj.

$$W\ Li\rightarrow Lj = \sum_{k=0}^{f(Li\rightarrow Lj)} K \quad (2)$$

The sum of the weight of each FLR should be standardized to obtain a fluctuation-weighted matrix, Wn(t). Eq. (3) defines the standardized weighted matrix:

$$Wn(t) = [\frac{w1}{\sum_{k=1}^{i} wk}, \frac{w2}{\sum_{k=1}^{i} wk}, \dots, \frac{wi}{\sum_{k=1}^{i} wk}] \quad (3)$$

Table 6: Weighted Matrix

WEIGHTS							
	L1	L2	L3	L4	L5	L6	L7
L1	W_{11}	W_{12}	W_{13}	W_{14}	W_{15}	W_{16}	W_{17}
L2	W_{21}	W_{22}	W_{23}	W_{24}	W_{25}	W_{26}	W_{27}
L3	W_{31}	W_{32}	W_{33}	W_{34}	W_{35}	W_{36}	W_{37}
L4	W_{41}	W_{42}	W_{43}	W_{44}	W_{45}	W_{46}	W_{47}
L5	W_{51}	W_{52}	W_{53}	W_{54}	W_{55}	W_{56}	W_{57}
L6	W_{61}	W_{62}	W_{63}	W_{64}	W_{65}	W_{66}	W_{67}
L7	W_{71}	W_{72}	W_{73}	W_{74}	W_{75}	W_{76}	W_{77}

Step5) Compute each spread center of linguistic value:
The linguistic spread center matrix, Ldf (t), can be generated by each spread center of the linguistic value.

Table 7: Each spread center of linguistic value

P(t)	N	Mean
L_1 PRICE	N_1	M_1
L_2 PRICE	N_2	M_2
L_3 PRICE	N_3	M_3
L_4 PRICE	N_4	M_4
L_5 PRICE	N_5	M_5
L_6 PRICE	N_6	M_6
L_7 PRICE	N_7	M_7

Step6) Deffuzify: From step 4 and 5, the standardized weight matrix and linguistic spread center matrixes can both be obtained. In this step, the matrix is used to generate initial forecasts. This process is called "diffuzification" (defined in Eq. (4)).

Forecast (t+1) = Ldf(t) Wn(t) (4)

Step7) Forecast prices based on golden ratio algorithm

Table 8: Defuzzification prices

Defuzzify(t)	
L1	Df_1
L2	Df_2
L3	Df_3
L4	Df_4
L5	Df_5
L6	Df_6
L7	Df_7

By using golden ration equation (defined in Eq. (5)), we compute the optimum point to forecast prices for next years.

Golden Number(t+1) = P(t) + 0.618(Forecast(t+1)-P(t)) (5)

Table 9: Forecasting prices based on golden ratio equation

Time	Price	Linguistic Value	Deffuzify	Forecast(t+1)	Golden Number
1	P_1	L_i	Df_i	-	G_1
2	P_2	L_i	Df_i	F_2	G_2
3	P_3	L_i	Df_i	F_3	G_3
. . .	. . .	. . .	. . .	. . .	. . .
n	p_n	L_i	Df_i	F_n	G_n

Step8) Compute golden number average for each bank

$$\text{Mean (G)} = \frac{G1+G2+G3+\cdots+n}{n} \tag{6}$$

Step9) Compute the mean of golden numbers average

$$\text{Mean (Gi)}= \frac{Mean(G1)+Mean(G2)+\cdots+Mean(Gn)}{\Sigma ni} \tag{7}$$

Step10) Determine the deviation of golden number average from the total average

$$\text{D (Gi)} = \text{Mean (G)} - \text{Mean (Gi)} \tag{8}$$

Step11) Determine the deviation of price average of each bank from the industry average

$$\text{D (Ai)} = \text{Mean (A)} - \text{Mean (Ai)}: \quad \{ \text{Mean(A)}= \frac{A1+A2+A3+\cdots+n}{n}, \text{Mean(An)}= \frac{Mean(A1)+Mean(A2)+\cdots+Mean(An)}{\sum ni} \} \tag{9}$$

Step12) Comparing deviation and recognize unsuitable deviation

$$\text{Deviation} = \text{D (Ai)- D (Gi)} \tag{10}$$

Table 10: Compute Deviation

Banks	D (Actual Price)	D(Golden Number)	Deviation
1	$D(A_1)$	$D(G_1)$	D_1
2	$D(A_2)$	$D(G_2)$	D_2
3	$D(A_3)$	$D(G_3)$	D_3
4	$D(A_4)$	$D(G_4)$	D_4
. . .	. . .	. . .	. . .
52	D(An)	D(Gn)	D_n

Table 11: Comparing deviation and recognize unsuitable deviation

State	If	Then	Results
1	D(Ai) >D(Gi)	D > 0	Suitable
2	D(Ai) <D(Gi)	D < 0	Unsuitable
3	D(Ai) = D(Gi)	D = 0	Indifferent

4.2 Data Analysis

As Tehran Stock Exchange is based on solar years (Farvardin 1392 – Farvardin 1397), so these times are considered to be the same as the months of the year (March 2013 – March 2018).

In year 2013 among 17 comparable banks, totally there are 6 suitable deviations. For Khavarmiane, Ayande and Hekmat Iranian banks, there is no way for comparison because their symbols were already closed.

Table 12: Comparison results analysis of price deviations in 2013

Item	BANKS	Difference(A)	Difference(G)	Deviation
1	Ansar	166/74	166/11	S
2	Saderat	1181/76	1182/68	U
3	Mellat	327/12	327/56	U
4	Tejarat	23/91	22/85	S
5	Parsian	667/67	667/98	U
6	Pasargad	348/51	349/01	U
7	Post bank	5478/34	5471/23	S
8	Khavarmiane	-	-	-
9	Sina	261/23	275/26	U
10	Karafarin	8/63	13/02	U
11	Eghtesad novin	490/94	504/02	U
12	Tourism	1035/69	1042/50	U
13	Resalat	1530/87	1532/68	U
14	Shahr	243/39	234/28	S
15	Ghavamin	772/43	768/75	S
16	Hekamt	-	-	-
17	Day	926/46	927/03	U
18	Sarmaye	78/67	79/09	U
19	Saman	82/21	80/69	S
20	Ayande	-	-	-

In year 2014 among 17 comparable banks, totally there are 10 suitable deviations. For Khavarmiane, Ayande and Resalat Iranian banks, there is no way for comparison because their symbols were already closed.

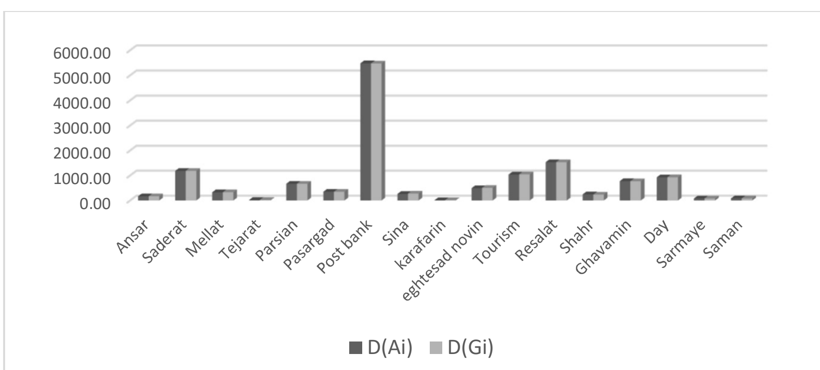

Fig.2: Analysis of comparison results of price deviations in 2013

In year 2015 among 18 comparable banks, totally there are 13 suitable deviations. For Khavarmiane, Ayande banks, there is no way for comparison because their symbols were already closed.

Table13: Comparison results analysis of price deviations in 2014

Item	BANKS	Difference(A)	Difference(G)	Deviation
1	Ansar	562/75	563/43	U
2	Saderat	1181/90	1180/07	S
3	Mellat	118/80	120/61	U
4	Tejarat	997/23	995/56	S
5	Parsian	987/25	983/41	S
6	Pasargad	13/42	7/29	S
7	Post bank	1689/44	1688/94	S
8	Khavarmiane	-	-	-
9	Sina	173/40	178/31	U
10	Karafarin	385/51	387/40	U
11	Eghtesad novin	373/35	374/07	U
12	Tourism	431/56	446/14	U
13	Resalat	-	-	-
14	Shahr	517/88	517/58	S
15	Ghavamin	16/70	15/16	S
16	Hekamt	870/77	868/20	S
17	Day	267/84	266/08	S
18	Sarmaye	302/80	306/31	U
19	Saman	50/84	50/14	S
20	Ayande	-	-	-

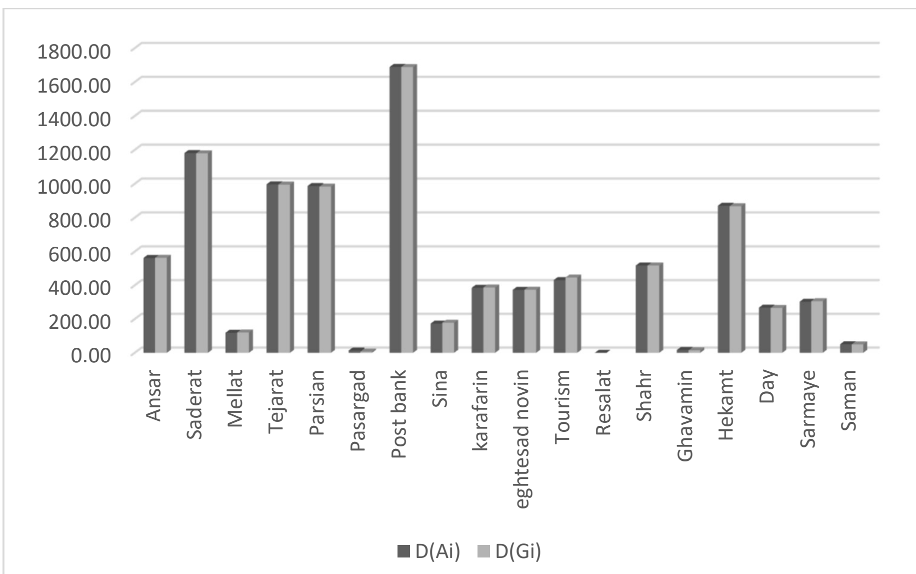

Fig.3: Comparison results analysis of price deviations in 2014

In year 2016 among 20 comparable banks, totally there are 15 suitable deviations.

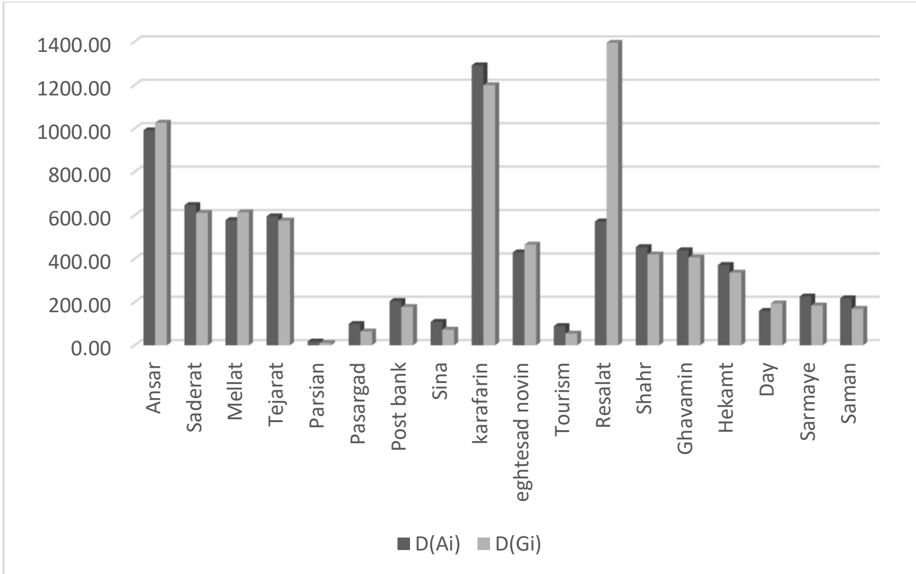

Fig.4: Comparison results analysis of price deviations in 2015

In year 2017 among 14 comparable banks, totally there are 7 suitable deviations. For Saderat, Parsian, Pasargad, Resalat, Day, Sarmaye banks, there is no way for comparison because their symbols were already closed.

Table15: Comparison results analysis of price deviations in 2016

Item	BANKS	Difference(A)	Difference(G)	Deviation
1	Ansar	664/98	687/41	U
2	Saderat	517/86	452/96	S
3	Mellat	395/40	379/49	S
4	Tejarat	563/70	542/50	S
5	Parsian	315/67	293/18	S
6	Pasargad	416/80	393/99	S
7	Post bank	489/75	511/44	U
8	Khavarmiane	1147/74	1170/11	U
9	Sina	204/42	182/55	S
10	Karafarin	1434/64	1457/84	U
11	Eghtesad novin	780/38	802/11	U
12	Tourism	303/65	280/36	S
13	Resalat	532/56	508/68	S
14	Shahr	742/13	718/57	S
15	Ghavamin	833/98	811/34	S
16	Hekamt	331/00	307/85	S
17	Day	26/18	4/17	S
18	Sarmaye	227/01	201/80	S
19	Saman	533/84	97/56	S
20	Ayande	431/68	407/29	S

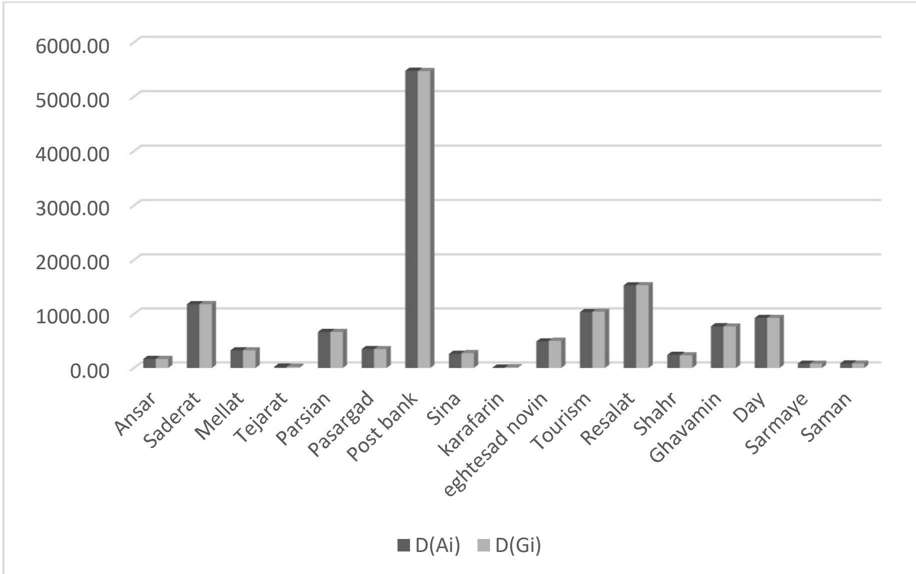

Fig.5: Comparison results analysis of price deviations in 2016

Table 16: Comparison of the total suitable and unsuitable price deviations in 5 years

BANKS	Suitable Deviation Frequency	Unsuitable Deviation Frequency	Closed Stock Symbol Year
Ansar	1	4	-
Saderat	4	1	-
Mellat	1	4	-
Tejarat	4	1	-
Parsian	3	1	2017
Pasargad	3	1	2017
Post bank	4	1	-
Khavarmiane	1	1	2013-2014-2015
Sina	2	2	2017
Karafarin	2	3	-
Eghtesad novin	1	4	-
Tourism	3	2	-
Resalat	1	2	2014-2017
Shahr	4	1	-
Ghavamin	4	1	-
Hekamt	3	1	2013
Day	2	2	2017
Sarmaye	2	2	2017
Saman	4	1	-
Ayande	1	1	2013-2014-2015
Sum	50	36	

5 Conclusion

In this article, the banking industry average of Tehran Stock Exchange and Iran Fara Bourse banks and the golden numbers average for five consecutive years (2013, 2014, 2015, 2016, 2017) are calculated and then the level of their deviation from the mean are compared. According to table 16, there are 50 suitable deviations and 36 unsuitable deviations. Using the mean average of golden numbers in comparison with the mean of industry average (which is the routine criteria that used by the analysts) lead us to more accurate results and will help us to have more precise forecasting.

Since the number of suitable deviations that we have concluded from golden ratio are more than unsuitable deviations. Therefore, the estimation error of golden ratio is closer to the reality. As a result, it has fewer amounts of errors which will shows the calculated estimation error of banking industry average is more than calculated golden number average. It is obvious, if we increase the number of years in the study, we would have more accurate results. Finally, the results suggest the users to apply the golden ratio average index instead of industry average index in their calculations, since it is closer to the reality.

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