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Optimized Selection of Stock Portfolio by using the Fuzzy Artificial Neural Networks Web Model, ARIMA & Markowitz Model in Tehran Stock Exchange

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Abstract

Financial issues have always been the main topics of scholars' research. Fuzzy logic is one of the techniques that are widely used in this study in order to model the environmental uncertainty. The aim of this paper is combination of fuzzy logic and neural networks to select a basket (portfolio) of stocks. Web forecasting system based on fuzzy artificial neural networks that discovers fuzzy rules by using the past time data and predicts it is also applied in this learning algorithm. The data of this study have been collected weekly from the Tehran Stock Exchange. Output data Simulation had been collected from the stock market base using obtained output data. This paper first deals with the study of financial markets. After that the research models were described and by using the other linear techniques such as Markowitz and ARIMA models, stock price was predicted. Then performance of the models was investigated with two population mean test (t-student) at the 95% confidence level. At the end Fuzzy artificial Neural Web network was selected as the best model for decision- makers. To perform research models and analysis of Java source code and software PASW 18 and ISP Server and also JDK3.1 were used. Finally, practical suggestions were given.

Keywords: stock portfolio, Fuzzy artificial Neural networks, Web, ARIMA, Markowitz model

Introduction

Achieving continuous economic growth and long-term need to equip and optimize resource allocation in the national economy cannot be easily possible without the help of major financial markets, particularly extensive and efficient capital markets. In a healthy economy the existence of an efficient financial system is essential to the proper distribution of funds and resources. In financial markets, individuals and organizations that have shortage in resources are facing the individuals and organizations which have extra funds. It should be noted that the term "markets" is used as plural. This means that financial markets are very diverse and innumerous while one of them contains many organizations and individuals.

Basically, one of the fundamental goals of economic analysis is predicting economic variables correctly and thus helping policy makers to take the right decisions and appropriate with predicted values (Tyebi et. al, 2008). Financial markets as a system can be considered to be very different to other systems because of its complex mechanism and feedback. Essentially, the financial markets are an uncertain environment where individuals are engaged in exchanging and risk trading and if it is possible to predict the future, there would not be any more risk, or it would be greatly reduced. In fact, we're looking for future in the financial markets, that what will happen (Tang et. al, 2002). It seems that there is no general system for predicting stock prices. However, artificial neural networks are currently having the best performance compared to other models for assessing financial systems (Lee and Park, 1992). In this paper, by assuming that the future of financial markets and stock prices can be predicted, Web-based fuzzy neural networks and learning algorithm

will be used. In this study, neural networks are based on learning the relationships between financial and economic indicators which help to make decisions about buying or selling stock. The output of the model tells us what stocks to buy and which one to sell. There are many methods for predicting the stock prices so that they can be enumerated like this Feed- Forward Neural Networks, Recurrent Neural Network (D.T. Pham & Liu, 1999). Learning is used to train the network. In this method, the tolerances are specified for outputs. Learning algorithm is based on not having significant difference between the tolerances and outputs. There are many linear models used for predicting stock prices. In this study, both Markowitz and ARIMA linear model are used.

The most important limitation of this study is the specific features of research in the social sciences field. In other words, the effect of other variables that are out of the control of the researcher and possibility of influencing on the results is not far from mind. Variables such as change in management, unfavorable impact of inflation on financial information of corporate and educations and experience of corporate executives are some of the variables that can be effective. Although in this study was tried to eliminate the influence of these variables by choosing one various sample but adversely as research in science field there is no experimental situation available for scholar in Financial Management. As a result, by considering this situation, findings of the research should be used. Therefore, to reduce uncertainty and involving these variables, Fuzzy logic is used in this study.

Efficiency and risk of Investment

The most important concepts in the investment decision, is risk and efficiency. If each stock or portfolio of stocks in specific interval of time is bought, maintained and sold may grants a special efficiency to its owner. This efficiency includes changes in the cost and benefit of the property. Term profit rate is used to describe the rate of increase or decrease in investment during the maintaining assets period. A rate of efficiency 0.1 or 0.2 for a given period implies this point that respectively investment value has reduced 10 percent or increased 20 percent at the end of the course. Whenever future efficiency is predicted and be multiplied by the probability of each prediction and each of them should be added to others, the result would be the (expected efficiency rate). Expected rate of efficiency will inform Investor from the expected reward that would be achieved during a particular period. This prediction may not be accord to reality. Discrepancies between predictions and reality - that may be caused by unpredictable changes – show the lack of confidence (uncertainty) in the stock. In other words, if upcoming events are not fully predictable and some events are preferred to other events. We state that there are risks. To predict future, risk means that there is more than one result and none of the results are conclusive.

Basically accepting more risk by investors is associated with more expected risk efficiency. This means that by accepting more risk they demand higher efficiency of the market portfolio over the risk-free investments (such as treasury documents).The difference between market returns and interest rates is called Market Risk Premium, figure 1 shows the relationship between risk and expected efficiency. As you can see beta coefficient and risk Premium is equal to zero and for Treasury documents. While the market portfolio, has a beta correspond to zero and a risk premium equal to (rm - rf). Sensitivity of a stock to changes in the value of stock portfolios is determined by calculating the beta coefficient (ß).In other words, the beta coefficient is the final risk sensitivity of a stock against the variations of stock portfolio risk in stock market.

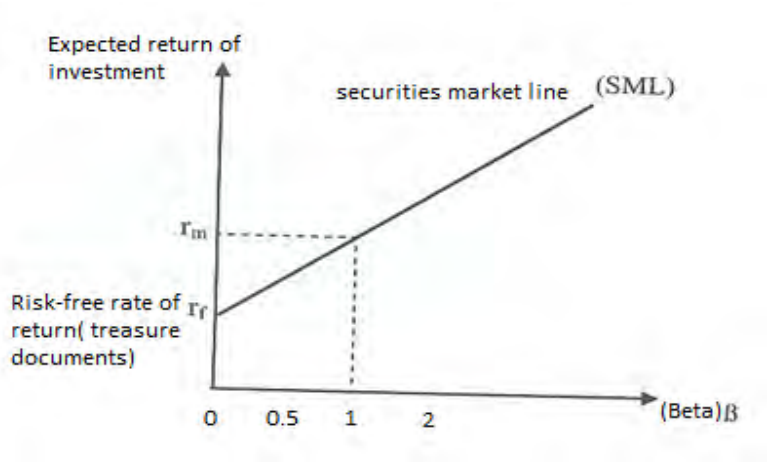

Figure 1.Expected Market Risk Premium * Beta = Expected Risk Premium of a stock

In the mid '60s, three economists William Sharpe, John Lentz and Jack Trainer answered this question that what would be expeced risk Premium when Beta is not zero or one. Their response to an asset pricing model or CAPM is well-known. This model led to significant results. It declares that in a competitive market, the expected risk Premium of each stock commensurate with beta coefficient. This means that all investments are in top figure changes along with in securities market's line. It means that there is a direct relationship between risk and efficiency of each stock with expected efficiency of the market.

Fuzzy Neural networks

The main problem in using expert systems in financial markets is that it is very difficult to formulate them and different conditions should be considered. The superiority of Fuzzy neural networks to Expert Systems is that there is no need to definite information and the system itself is based on fuzzy logic to formulate the rules. So highly recommended to use this procedure in turbulent and uncertain environments, (Tang et.al. 2002).

Before data processing by Fuzzy neural networks, data should be normalized to increase the predicted efficiency (azar and afsar, 2006). So a conversion is done on the neural network that sets input data from [L, H]. This will be done using the following relation:

$$X_{scaled} = mX_i + b \quad (1)$$

$$b = \frac{X_{\max}.L - X_{\min}.H}{X_{\max} - X_{\min}} \quad (2)$$

$$m = \frac{H - L}{X_{\max} - X_{\min}} \quad (3)$$

$$b = \frac{X_{\max}.L - X_{\min}.H}{X_{\max} - X_{\min}} \quad (4)$$

In this term, H and L are high and low limits of normalizing distance, and they are usually equal to 1 and -1.

Xmin and Xmax are the Minimum and maximum input values. According to fuzzy control system mechanism, Fuzzy neural networks usually have 5 task layers according to Figure 1 are as follows:

1) The first layer is the input layer
2) Fuzzy layer constructor
3) The third layer consists of rules layer and fuzzy logic layer includes words "and", "or".
4) defuzzification layer
5) And output layer

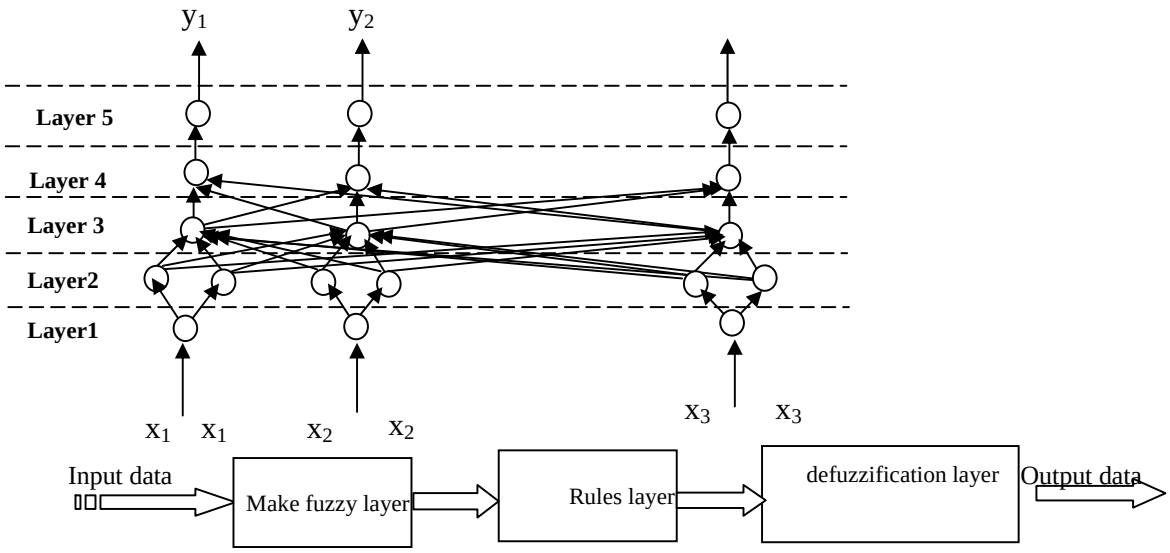

Figure 2. Architecture of neural - Fuzzy networks

Fuzzy neural network learning algorithm

In an n-input neural network, there are l output and m fuzzy rules of Then and if, explaining as follows: IF x_1 is A_1^k and … and x_n is A_n^k THEN y is B^k, So that X_i and Y are the fuzzy linguistic variables of input and output. Fuzzy linguistic values A_i^k and B^k described as fuzzy functions, which are the following:

$$\mu_{A_k^i}(x_i) = \exp[-(\frac{x_i - a_i^k}{\sigma_i^k})^2] \quad (5)$$

$$\mu_{B^k}(y) = \exp[-(\frac{y - b^k}{\eta^k})^2] \quad (6)$$

N inputs and l outputs as neural- fuzzy networks defined as logic function:

$$f(x_1,...,x_n) = \frac{\sum_{k=1}^{m} b^k [\prod_{i=1}^{n} \mu_{A_i^k}(x_i)]}{\sum_{k=1}^{m} [\prod_{i=1}^{n} \mu_{A_i^k}(x_i)]} \quad (7)$$

For n-dimensional vector of input data defined as xp (i.e., xp= (x1p, x2p,……, xnp)) and 1-dimensional output data vector yp ,that p is expressed as p=1,2,...,N, (i.e., N training data sets) ,p energy function is defined as below:

$$E^p = \frac{1}{2}[f(x_1^p,...,x_n^p) - y^p]^2 \quad (8)$$

to simplify, E and f^p are wrote respectively as form of E^p و $f(x_1^p,...,x_n^p)$.

for training the Input and output data the energy function must be differentiated.

For example, center inputs data of the output function with Differentiating $\frac{\partial E^P}{\partial b^k}$ are trained.

By differentiating ($\frac{\partial E^P}{\partial \delta^k}$), right and left values of function are trained. Then the learning algorithm is obtained from following relations.

$$b^k(t+1) = b^k(t) - \theta \frac{\partial E^P}{\partial b^k}\Big|_t \quad (9)$$

$$a^k(t+1) = a^k(t) - \theta \frac{\partial E^P}{\partial a^k}\Big|_t \quad (11)$$

$$\sigma^k(t+1) = \sigma^k(t) - \theta \frac{\partial E^P}{\partial \sigma^k}\Big|_t \quad (10)$$

$$\eta^k(t+1) = \eta^k(t) - \theta \frac{\partial E^P}{\partial \eta^k}\Big|_t \quad (12)$$

While η is the learning rate and t = 1,2, … . The main steps of the learning algorithm are as follows.

- Determine the input data and calculate the output.
- Calculation of error between the inputs data and output results
- Adapting the Communication weight and membership functions.
- After each new period of training, delete legislations and irrelevant unused nodes
- If the error is greater than the tolerance, return to first step.
- Java codes based on web are being used to run simulations.

Markowitz model

In 1950 Markowitz offered his proposed model for portfolio selection.

The most prominent points in Markowitz model is considering the investment risk not only based on the standard deviation of a design but also relating to investment risk set. (Bidgoli and Tlngy, 2004)

Markowitz model is as follows.

Relation number (13)

$$\text{Max } E(R_p) = \sum_{i=1}^{n} w_i E(R_i)$$

s.t :

$$1: \sigma^2_p < \text{var}$$

$$2: \sum_{i=1}^{k} w_i = 1$$

$$3: \text{VaR} = t^* \sigma_p - E(R_p) < v$$

Relation number (14)

$$\sigma^2_p = \sum_{i=1}^{n} w^2 I \sigma^2(R_i) + \sum_{i=1}^{n}\sum_{j=1}^{n} i\#j\, w_i w_j \text{COV}(R_i, R_j)$$

In this relation:

σ_p^2 = variance of stock returns

$\sigma^2(R_i)$ = variance of i-th stock efficiency

$Cov(R_i, R_j)$ Or $\sigma_{i,j}$ = Covariance of i-th and j-th stocks

W_i = percentage of the amount invested in i-th stock (proportion to total invest)

σ^2 = variance of Accepted efficiency of investor

Maximum acceptable value of capitalist at risk, which indicates How risky or risk averse investor is.

It shows how risky investor is as larger it is.

Var = represents the limit

Most of investor's Accepted variance, such as maximum acceptable at risk value, is related to investor behavior. In relation number 13, the first limitation indicates maximum variance of Accepted efficiency of investor. The second limitation indicates the total money in possession of investor. Relation number 14 shows the variance of stock efficiency.

ARIMA model

Time series (Zt) is generated by one Process of ARIMA with average of α from the box - Jane model.

Relation number 15)

$$\phi(B)(1-B)^d(Z_t-\alpha)=\theta(B)a_t$$

$$\theta(B)=1-\varphi_1(B)-\varphi_2(B)^2-....-\varphi_p(B)^p$$ ،

So that

$$\theta(B)=1-\theta_1(B)-\theta_2(B)^2-....-\theta_q(B)^q$$

B Polynomials are degree of p and q, B is one Backward operator, p,d,q are integers, and (Z_t) indicates the observed value of time series $t=1,2,...k$.

In the general formulation of ARIMA model there is four-stages. (Bidgoli and Tlngy, 2004):

1.Trial identification of the model of structure

2.Estimate of unknown parameters of the model.

3.Accuracy diagnosis Practising of model

4. A prediction with selective model

It is generally assumed that the overall pure error of model a_t is a normally distributed random variable with mean zero and variance σ^2 and independent of the observations.

Applied Researches

There are many researches on the optimal selection and predicting stock prices using neural-artificial networks are processed. That we can mention the research of (Wong and Lau, 1996) predicting the stock procedure. Also (Witt kemper & Steine,1996) predicted systematic risk of stocks using neural networks. In another study (Desai and Bharaty, 1998) predicted Great stocks by the neural network. Also (Kay, 1999) began to predict stock efficiency.(Fernandez and other, 1999) also began to predict the stock returns. Dhar and Chou (2001) tried to predict stock returns and earnings too. Alem Tabriz and others (2010) predicted the stock prices of Tehran securities stock market using artificial neural network. in the field of combination fuzzy logic and neural network,

extensive researches has been done. In a Research (Azar and Afsar, 2006) also began to predict stock prices using artificial neural- Fuzzy networks compared to time series. In another research (Koo et al, 2001) presented a feed forward neural network with fuzzy argument and utilizing the modeling of fuzzy Takagi.

Robert J. Van Eden (1996) investigated the application of neural networks in predicting stock prices. Abbasi and the others by considering the value of risk, tried to select the optimal portfolio presenting a model. Khasheei and Bijari (2007) also presented an ARIMA fuzzy model for predicting the exchange rate.

Research method

Present research is quantitative data type. From consequence viewpoint, is practical and its purpose is Descriptive and exploratory. Considering the past performance of corporation is assessed in this study or in other words, historic data of corporation is used, so the research from the research pattern viewpoint is past event pattern. Statistical population and data analysis are discussed in this part of the research. Statistical population in this research is the group of accepted (listed) companies in the Tehran securities exchange that have these Features:

1.Companies that have been accepted in Tehran security exchange prior to the year 1383

2.End of the financial year is the last of Esfand

3.Companies under investigation do not include the investment companies, and financial intermediation and holding.

In this study, data from 10 engaged companies on the Stock Exchange has been used.

These 10 companies have been selected this way that each one relate to one industry of bourse .these 10 companies cited in table 1.

For explanations of topic-Literature with library method, Library of Tehran Stock Exchange, Tehran University, Tarbiat Modarres University, Allameh Tabatabaei University, and the Institute of Science and Information Technology are used. Also in this case, scientific articles site of Jihad Collegiate (University) can be used. To access required data for processing research hypotheses documents study method according to the company presented information to the Stock Exchange is used. in this study a company will be Chosen that its average predicted efficiency is higher than its real rate.

Therefore, the data to all three models (neural networks and ARIMA and Markowitz) are inserted.

Lingo8 software for Markowitz model, PASW Statistics software for ARIMA model and java, ISP SERVER and JDK3.1 for neural networks – fuzzy are used.

T test was used to compare the mean of the two communities.

"T" Test for comparing two populations mean is calculated as follows: Because in this study variance samples are not equal, the relation is as follows where the "T" is:

$$t = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Relation number (16)

For Degree of freedom we have:

Relation number (17)

$$df = \frac{(\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}})^2}{\frac{(\frac{S_1^2}{n_1})^2}{n_1 - 1} + \frac{(\frac{S_2^2}{n_2})^2}{n_2 - 1}}$$

Research hypotheses are proposed as follows:

selected stock portfolio Efficiency of Neural - Artificial Fuzzy networks in comparison is equal to reality H0= μe - μe = 0

selected stock portfolio Efficiency of Neural - Artificial Fuzzy networks in comparison to reality is not equal. H1= μe - μe ≠ 0

selected stock portfolio Efficiency of Markowitz model in comparison is equal to reality. H0= μe - μe' = 0

selected stock portfolio Efficiency Markowitz model in comparison is not equal to reality. H1 = μe - μe' ≠ 0

selected stock portfolio Efficiency of ARIMA model in comparison is equal to reality . H0= μe - μe' = 0

selected stock portfolio Efficiency of ARIMA model in comparison to reality is not equal. H1 = μe - μe' ≠ 0

Table 1. Selected companies for Input into research models

Row	Company name	Industry type
1	Chador malu	Extraction of metallic minerals
2	Iran data processing	Consultation about software and software supply
3	Iran Khodro	Motor vehicles, trailers and semi-trailers
4	Jaber Pharmacy	Manufacture of materials and chemical products
5	Pars Oil	Coke and refined petroleum products
6	Rolling Steel Parts	Manufacture of basic metals
7	Iran Nectar	Manufacture of food products and beverages
8	Behran	refined petroleum products
9	Niro Moharreke	Classified Machinery manufacturing
10	Kaf	Manufacture of materials and chemical products

Model analyzing

To implement the model, at first we insert the collected data from Stock Exchange Organization to research models. PASW18 Statistics software for ARIMA model and Lingo8 software for Markowits model, and java code for neural networks – fuzzy were used.

Table 2 and 4 are expressing the predicted value by described models. Due to limitation of article pages, only one company is expressed as sample. And that is Niro Mohareke.

Table 2. Predicted values for neural-fuzzy network

	1st week	2nd week	3rd week	4th week	5th week
Web-based	20.763	19.851	19.386	19.2	19.116
Real valued	21.874	20.77	17.568	17.24	17.712

Also Figure 3 shows the predicted values by artificial neural - Fuzzy networks.

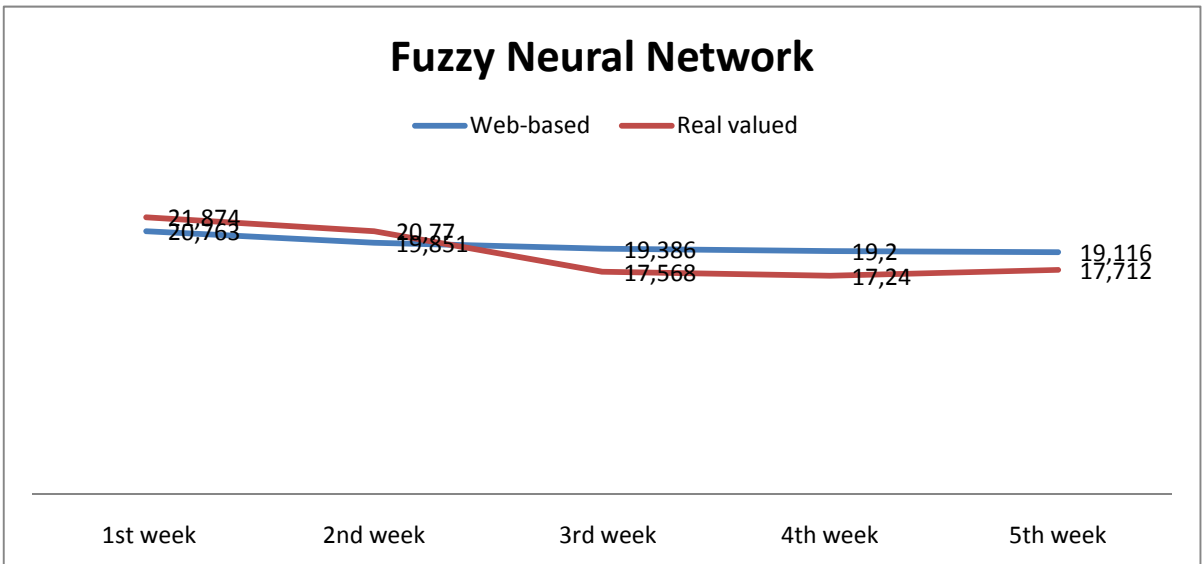

Figure 3. Predicted value for neural-fuzzy network

Table 3. Predicted values by ARIMA model

	1st week	2nd week	3rd week	4th week	5th week
ARIMA	17.13	18.6	23.32	12.5	14.5
Real valued	21.874	20.77	17.568	17.24	17.712

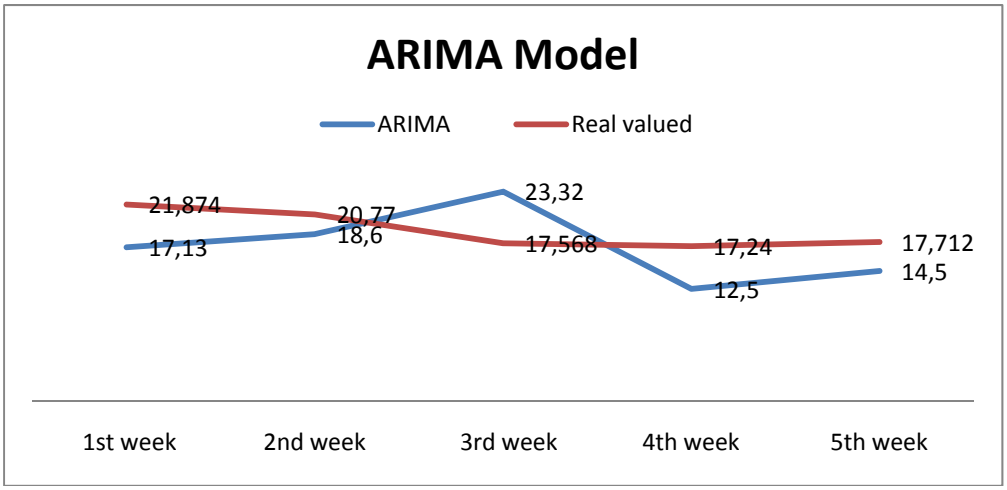

Figure 4. Predicted value by ARIMA model

Table 4. calculated values by Markowitz model

	1st week	2nd week	3rd week	4th week	5th week
Markowitz	11.03	13.4	27.7	36.1	9.3
Real valued	21.874	20.77	17.568	17.24	17.712

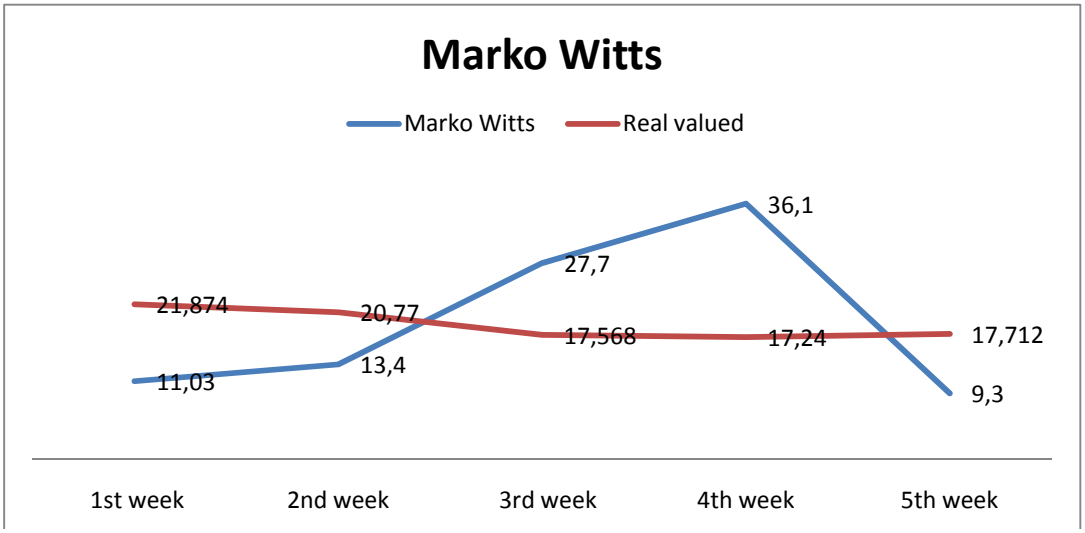

Figure 5. Predicted value by Morkowits model

As it is evident from the charts, Neural - Fuzzy networks, predicted values are closer to reality compared to other models. Then by considering the predicted value we begin the mean test of two populations. The table 5 shows the t-test to compare two population means and hypotheses proving. At first to compare two populations, variances of them should be calculated.

Table 5. t-test for Markowitz model

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Data	Equal variances assumed	3.730	0.00	.988	306	.324	2.91253E	2.94876E	2.88989E	8.71495E
	Equal variances not assumed			1.041	161.0	.300	2.91253E	2.79891E	2.61478E	8.43984E

According to the table and upper bound (upper) and lower bound (lower), the following is extracted:

1.Whenever upper bound and lower bound are positive, Subtraction of two populations are greater than zero and first population mean is greater than second one: $\mu_e - \mu_{e'} > 0$

Or $\mu_e > \mu_{e'}$

2.Whenever upper bound and lower bound are negative, Subtraction of two populations are lower than zero and first population mean is lower than second one: $\mu_e - \mu_{e'} < 0$ or $\mu_e < \mu_{e'}$

Table 6. t-test for artificial neural-fuzzy network

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Data	Equal variances assumed	148.882	.000	-15.549	142	.000	-23.89794	1.53692	-26.93614	-20.85974
	Equal variances not assumed			-15.549	72.86	.000	-23.89794	1.53692	-26.96112	-20.83476

Table 7. t-test for ARIMA model

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Data	Equal variances assumed	136.4	0.00	-15.549	142	.600	43.89794	1.53692	33.43443	50.71474
	Equal variances not assumed			-15.549	72.86	.800	43.89794	1.53692	33.48443	50.71476

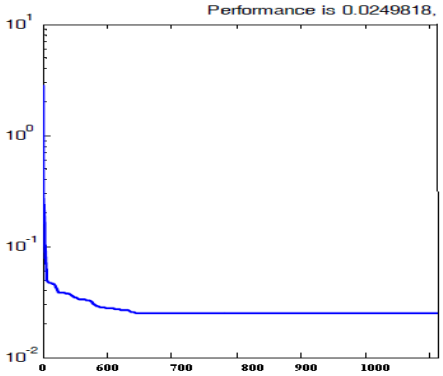

Figure 6. RMSE after training

According to the cited points and above table it is concluded that in order of 5% error for neural-fuzzy network, hypothesis 0 is rejected and hypothesis 1 is accepted. Also variance equality test (Levin's Test) is rejected For Fuzzy Neural networks, means that the variances are not equal. ARIMA and Markowitz models show that the actual values average (first population) is greater than the mean values have been predicted (predicted mean values). Considering that the Sig test is .05,

the null hypothesis is not rejected and we will accept it. Also, two population variance differences of the ARIMA and Markowitz models according to the test (Levin's Test) is not equal. Fallowing Figure shows the RMSE value after each iteration for artificial Fuzzy Neural Network.

Analysis of results

First research hypothesis was that the selected stock portfolio by using Fuzzy artificial neural networks model has higher efficiency than the same efficiency in reality. We use risk and 5 years efficiency of available financial companies to achieve the result of this hypothesis, in order to achieve an optimal stock portfolio among the 10 companies. The results of fuzzy neural network model shows that Between these 10 companies only 3 companies based on predicting of models, efficiency was increasing and the risk was declining over the time. Therefore, these three companies Chador malu Co., Inc. Kaf and Niro Mohareke Co. Were identified as the three shares in stock portfolio. Then efficiency of this stock portfolio was measured with the actual efficiency of the same stock portfolio .We find that the predictions of fuzzy neural network model is better than reality. It means that by using fuzzy artificial neural network model efficiency of selected stock portfolio is more than the same stock portfolio in reality. The second hypothesis of the study was that the selected stock portfolio by using Markowitz model has lower efficiency than the same stock portfolio in reality. To achieving this purpose 10 active corporate data in burse was used.

Finally, we find that efficiency that Markowitz model deliver from stock portfolio is lower in comparison with the same stock portfolio in reality. We used risk and weekly efficiency of 10 companies for 5 financial years to achieve this result. Selected Companies by Markowitz model are Chador malu Co., Behran Co. and Jaber pharmacy Co. The third hypothesis of the study was that the selected stock portfolio by using ARIMA model has lower efficiency in comparison with efficiency of the same stock portfolio in reality. We use 10 active companies' data in burse to achieve this purpose.

Finally, we find that the efficiency that ARIMA model delivers from stock portfolio is greater than the same stock portfolio in reality risk and weekly efficiency of these 10 companies for 5 financial years to achieve this result are used. But the RMSE value of neural network is less than ARIMA model. in fact the second hypothesis was confirmed. Selected Companies by ARIMA model are CHADORMALU Co., Behran Co. and Jaber pharmacy Co. According to the results related to the first and second and third hypotheses and considering that the predictions of artificial fuzzy neural network model is better than reality. But ARIMA and Markowitz model do not seem Efficient compared with the real model. We conclude that artificial fuzzy neural network model is more efficient in the field of optimization than Markowitz and ARIMA model. MSE and RMSE values were lower for Fuzzy neural networks in comparison with and ARIMA than Markowitz model.

Discussion and Conclusion

Time series analysis and prediction is an active area of research in recent decade. Prediction of time series accuracy (validity), in the most decision making processes is principled and vital. For this reason, the research for improving the effectiveness of time-series models has not been discontinued (stopped). Remarkable growth of fuzzy neural networks in recent years due to its practical nature has been highly regarded. In fact, the efficiency of neural network models especially fuzzy neural network, and also its excellence in comparison with other linear models has been proven in many studies. In present study, by comparing different models, efficiency of fuzzy neural networks have proved. Also in this paper a new strategy for choosing the optimal shares portfolio was implemented. The basis of Stock Selection was efficiency stock, which this criterion was used less in previous research. Also the combination of fuzzy logic and neural networks to solve the

problem of this research, which is the same selection of the optimal stock portfolio, was used. The results of fuzzy neural network model output, show the justified proposed model of study (Neuro-fuzzy).

According to the study field and conclusion, the following suggestions are proposed:

1.The organization and Securities Exchange are recommended to encourage Companies and investors to use Modern scientific methods in stock portfolio optimization and it should provide the facilities and necessary advices to achieve this aim.

2.Actual and potential investors, analysts and other stakeholders (beneficiaries) are recommended to use modern optimization methods such as using fuzzy artificial neural networks In order to achieve an objective investment that has the high efficiency and low risk.

Doing any research, opens the way towards a new direction and to continue, further research is required, therefore, the following research is suggested:

1.Selection of an optimized stock portfolio using models fuzzy artificial neural networks by considering the weight of each stock in the stock portfolio and also the type of available companies' industry in the stock portfolio

2.Review this research and performing with more observations that can increase the power of models.

3.Extending Markowitz model and adding restrictions such as financial transactions cost for buying and selling stocks.

4.Using other innovative techniques and initiatives in order to development of above research model and comparing the results with each other to provide a model with better efficiency for investors.

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