Studying the performance of contrarian strategies in Tehran stock exchange with using Fuzzy approach

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Mohammad Nasiri
PhD student of Managerial Finance, Islamic Azad University, Science and Research Branch,
mohammadnasiri1359@gmail.com

Abstract

During recent years, examining the performance of contrarian strategies has been taken into consideration by scholars and stock market's activists, though several evidences are available based on profitability of this type of strategies, much of them have been referred to American and European's stock markets. In current study, the act of these strategies will be examined in Tehran's stock exchange over a time spanning 2007 and 2009 by using Fuzzy approach and by computing portfolios' return comprising stock with indices such as low Price/Earning, small size, high payout ratio, low market value/book value and by cross sectional weighted data analysis method. Results show that meaning relation between valuable stock with low Price/Earning, small size, and high payout ratio is tendered offer by Fuzzy Expert System

Keywords: value strategies, Fuzzy approach, valuable stock, size effect, market abnormalities.

1. Introduction

Efficient market theory is the most important component of theories that several scholars have studied it in the financial domain. Main subject of efficient market theory is that how much stock market has acted successfully in acquiring and processing data, i.e. to what extent the price of financial assets reflects data related to capital market. Accordingly a definition was discussed regarding efficiency in the domain of investing arguments. In this definition, capital market efficiency has been applied a mode that at any moment of time, stock price must be an estimation of its cash flows values in future by considering investing risk and based on the effect of all related data [22]. It hadn't gone on much time of suggesting this theory that many researches in various countries introduced signs of some disorders in contradiction with this theory and provided opportunities for investors, so that these abnormalities are used. Including techniques that are propounded for applying these abnormalities are contrarian strategies.

After Second World War, a set of new theories was presented to financial society which titled "Modern finance theories". Recommended perspectives in terms of these theories had essential differences with whatever had been suggested before them, since that extensively used by capital market's practitioners [23].

This theory, for the first time was offered collectively by Fama (1970), after that became the subject of many researches. But soon after, it faced several challenges, Fama's evidences and findings which are themselves introducers of efficient market theory imply abnormalities and disorders that questioned this prevailing theory. Presence of other calendar abnormalities including the effect of week's transactions days, year's special months effect, holiday's effect and etc, also other disorders like primary stock publication effect, commissioned stock effect, the effect of stock with low Price/Earnings and etc, all indicate the existence of a certain model and predictable procedure in the behavior of stock price that question the basis of efficient market theory [3].

Likewise in Tehran's stock exchange some studies have been carried out around the examination of market efficiency which mainly indicates the lack of efficiency (at weak level) in Tehran's stock exchange market [11]. In value strategies, investor takes action stock selecting regarding several types of abnormalities in the market such as size effect, Price/Earning effect, effect of book value/market value and payout ratio, in order to be able to acquire abnormal returns with regard to market [5].

Many years, these strategies have been used by Wall Street's well known investors like Graham and Warren Buffet. These strategies recommend investors to buy stock which aren't currently considered by market and have characteristics like low Price/Earning, high payout ratio, low market value/book value, and small size [17]. In recent years, many researches in various countries have engaged in performance measurement of contrarian strategies.

As noted, the issue is complex; this complexity is resulted from number of interfered variables in it. Recent variables add ambiguity component on decision makings. In addition to recent components, decision making about such issues has been depended on experts' knowledge; experts' knowledge isn't a matter which can simply convert it to a model for decision making; although in respect of characteristic, many traditional tools for modeling, reasoning, and computation are absolute, certain, and accurate (Zimmermann, 1996, 1). Common decision making models use Binary Logic in dealing with verbal variables and experts' knowledge, while such decisions enjoy continuous nature (attachment degree or level). In order to deal with such situations require proper decision making tools with these conditions. It seemed that in such cases, Fuzzy Mathematics will be a suitable instrument for modeling.

Regarding above reasons, in this study Fuzzy Mathematics is used for designing an expert system which can use as an advisor. Input of this expert system will be indices (P/E, market value, BV/MV, DPS/EPS), and its output is decision about stock's buy, maintenance, or sales.

For people who operate in stock market arenas, question (what stock must be bought, or sold, or even maintained?) isn't a new one. This is an issue that is as old as investing discussions. Being more complicated the issue of stock's buy, and sales, making decision has been difficult in this case too. A problem which investing managers deal with, isn't the issue of investing in firm's stock, but also is appointment of stocks that must be bought, sold, and maintained. This matter requires that investing strategies in stock must be appointed clearly. Since investment in cited cases, without primary measurement and considering effective factors in its situation, will be accompanied by results such as wasting organization's resources, investors and customers' dissatisfaction, and in its worst form, organization's discredit or bankruptcy, so this is crucial that organization uses a proper decision making model for this affair.

In current study, we tried to design an expert system by Fuzzy Logic Mathematics, so that choose stock by it for buy, sales, or maintenance.

2. Literature and Review

In different countries several studies have been done about the subject of this research which their start background of accomplishment is referred to 1980s. Some of most important researches include:

Jonathan C. Mun, Geraldo M. Vasconcellos & Richard Kish (2000) by using data pertaining to Canada and America's stock markets during 1986 and 1996, considered to study the performance of contrarian strategies in these markets. By non-parametric regression, they found out contrarian strategies whether in America or Canada has had positive performance, but their performance have been better in Canada. They didn't also found evidences based on existence of January effect in these markets [14]. Kodjovi Assoé & Oumar Sy (2004) by Fama and French's three factors model, engaged in studying the contrarian

strategies performance in Canada stock market between 1964 and 1998. They ascertained that previous winners are future losers and vice versa. Their research results confirmed the existence of size effect in January [6]. Bernardus Nugroho (2005) by studying Australia stock market between 1993 and 2002 discovered that book value/market value, transactions volume and cross-sectional distribution of returns can explain added return referred to contrarian strategies [2]. In other study which performed by Doeswijk (1997), also abnormal return of these strategies was verified in Germany stock market. By using data related to accepted firms in Germany stock exchange over a span of 1975 and 1995, he found that there wasn't a significant difference between portfolios risk consisted of popular and valuable firms [7]. Kyriazis and Diacogainnis (2004) by dividing accepted firms in America stock exchange discovered 3 groups that firms which during 1992 and 2002 had high Price/Earning, high payout ratio, low Beta's coefficient, and small size yielded high return. They also didn't found evidences based on presence of market value/book value effect. Similar to what ever will be done in this study, for testing their hypotheses, they used weighted cross-sectional data analysis method [5]. Joseph Kang, Ming-Hua Liu & Sophie Xiaoyan Ni (2002) by data related to accepted firms in China stock exchange during 1993 and 2000, ascertained that over short-run and mid-term time spans contrarian strategies yield abnormal return especially regarding small firms [14]. Stefano Mengoli (2004) also by data referred to Italian firms between 1950 and 1995 discovered that sales of popular stock and buying valuable stock yield abnormal return [20]. Similarly Ming-Ming Lai, Krishan Guru & Fauzias Mat Nor (2003), by data referred to accepted firms in Malaysia stock market between 1987 and 1999 described positive the performance of contrarian strategies. They also found that abnormal returns often happen for small firms [10]. In another study about Turkey stock market, Bildik and Gülay (2002) ascertained that during 1991 and 2000 contrarian and momentum strategies have had abnormal returns. They also obtained documents based on existence of size effect, Price/Earning effect, and market value/book value effect [2].

Studies have been done about abnormal returns in Tehran stock exchange, but current study has been examined these abnormalities in terms of contrarian strategies, and less research has been found that hereafter has been considered these market's abnormal entities. Few Persian preformed researches which to some extent are related to some aspects of this study can refer to following cases:

Reza Raei and Alireza Sh. Zavvareh (2006) in a study titled by "performance measurement of investing strategies in Tehran stock exchange", considered to examine performance of valued and developmental stock firms as well as small and large firms in contrast to each other [24]. The result of these researches showed that over a considered time span, stock of developmental firms had a higher return by comparison with stock of valued firms. Likewise small firms have had a higher

return than large firms. In another research titled by "applying cross-sectional method in relation to study the effect of firm's size and book value/common stock's market value on stock return and profitability of accepted firms in Tehran stock exchange", which carried out by Gholamreza Derakhshande. D (2004), relationship of firm size and BE/ME with return and profitability has been studied as criteria which must be used in investing decisions of Tehran's stock exchange firms. The results of this study shown that by using cross-sectional method during 1998 and 2002, they indicate the existence of direct significant relationship between firm size with return and profitability, and reverse significant relationship between BE/ME with return and profitability after 1999. Meanwhile relationship of BE/ME with return and profitability is stronger than relationship of size with return and profitability. Hossein Sedqhi. Kh (2008) in another study, "studying, identifying, and describing investors' prevailing behavioral styles in Tehran stock market", has specified the type of individuals' behavioral styles in Tehran stock market, by studying influential non rational factors on investors' decision making style. Furthermore, women and men investors' behavioral styles have been examined and compared in four age-groups.

3. Research Methodology

Current study is practical and descriptive type. In the beginning every year, firms have been arranged from minimum to maximum regarding Price/Earning (Π/E), market value/book value (M□□□), size (market value) and payout ratio, and then divided into three categories. For instance, about Price/Earning, firms that their Price/Earning mean is lower than all, place in "firms with low Π/E" portfolio. So, 30 firms from 90 firms have placed in "low ratio…" group, 30 firms in "high ratio…" group, and also 30 firms are between these two groups.

For data analysis, after appointing and ranging input and output variables, for Fuzzification variables has been used triangular numbers and Mamdani method will be applied for Fuzzy inference, also MATLAB software is used for doing computations, expert system codification, and defuzzification.

In this section, research method and also modeling algorithm have been explained. As well other subjects which discussed in this chapter include research method, data collection method, data collection tool, the manner of tool' validity and reliability assessment, research variables, variables Fuzzification, Fuzzy inference, modeling algorithm, and model test which will be reported in detail as follows.

Fuzzy

In Oxford dictionary, the term Fuzzy is defined as ambiguous, inaccurate, confused, and indistinct.

Expert System

Expert system is a system that uses human's knowledge captured in computer for problems which their solution involves applying human's expertise. It is a

computer program which has a wide knowledge base in a limited domain, and applies a complex inferential reasoning for doing tasks instead of expert. Main difference of expert systems with other software is that expert system processes knowledge whereas they process data.

Fuzzy Expert System

Fuzzy Expert System is an expert system which instead of Boolean Logic uses Fuzzy Logic. In other words we can consider it a knowledge-based or rule-based system that has been used Fuzzy Logic in its knowledge base and deduces by user's input data and Fuzzy inference. Therefore, Fuzzy rules and membership functions have been considered components of a Fuzzy system knowledge base (Lucas, Karoo, and Mohammadian, 2004, 16). These systems are a type of expert system in which instead of Two-value Logic, uses Fuzzy Logic. Fuzzy expert systems are a set of membership functions and rules which are used totally for reasoning.

4. Variables' definition and research model

Per share book value:

Stock book value is equivalent to firm's net assets. Per share book value indicates employed capital in firm based on book quantities. It's calculated as follows:

$$\text{Per share book value} = \frac{total\ stockholders'\ equity}{number\ of\ published\ common\ stock}$$

Different indices have been expressed for introducing firm size. In some studies, book value of total firm's assets has been used as firm size index. Another determination index of firm size is firm's sales. Fama and French (1995), Johnson & Jensen and Murser (1997) applied total firm's market value as a size index.

In this study, because inflation has influenced on total firms' assets, and in fact book value of total assets has considerable difference with their market value, market value has been used for measuring firm size. In current research, firm size means total stock market value which is obtained by "number of common stock × its last market price" in stock exchange's notice-board.

Book Value/Market Value:

Stock market value also is determined by last market price of common stock × number of published stock. For obtaining this variable, book value of stockholder's equity divided by its market value.

$$\text{Book Value/Market Value} = \frac{firm's\ \text{common stock book value}}{firm's\ \text{market value}}$$

Payout ratio:

After the end of fiscal year, firms take action to divide obtained earnings depended on profitability rate and by considering their required cash flow amount. A percentage of Earning per Share (EpS) is called Dividends per Share (DpS), which is paid in cash to stockholder. In order to compute this variable, $\frac{DPS}{EPS}$ and multiplied by 100.

5. Data analysis process and method

After determining and ranging input and output variables, triangular numbers have been used for variables Fuzzification, and Mamdani method will be applied for Fuzzy inference. Also MATLAB software is used for ding computations, expert system codification, and defuzzification.

Model's variables

System's input variable:

System's input variables include P/E, market value, BV/MV, and DPS/EPS.

System's output variable:

It is designated score to each activity for selecting strategy to buy, maintain, and sell.

Fuzzification verbal variables:

Regarding that studies variables are verbal variables, Fuzzy sets theory has been selected as appropriate modeling tool. In this method triangular functions will be used for Fuzzification. The reason of applying this type of Fuzzy numbers is its simplicity and commonness. In several studies has been verified the efficiency of these triangular numbers.

Fuzzy inference:

In practice, Mamdani or Larsen's inference is used for Fuzzy inferences which are respectively based on MIN and multiplication operators (Taheri, 1999, p.179). In current study also has been used Mamdani inference.

Modeling algorithm

In order to achieve research goals, modeling algorithm has been codified by using theoretical concepts – which in summary pointed out them in chapter 2 - as figure 1-3. Our hypothesis, question, Fuzzy algorithm has high potency for stock buying, sales and maintenance in Tehran stock exchange.

6. Finding

As indicated before, also is seen in the figure, this modeling algorithm is composed of 5 main stages. These 5 stages include:

Stage 1: system designing
Stage 2: Fuzzification
Stage 3: codifying inference rules
Stage 4: model testing
Stage 5: defuzzification

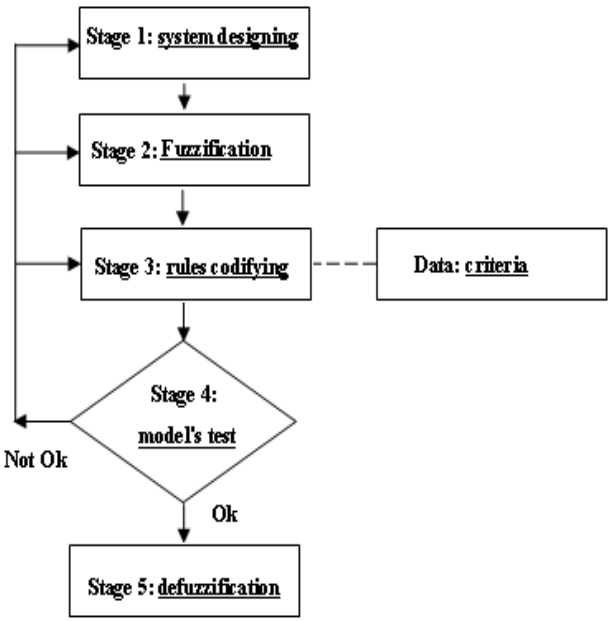

Figure 1-3. Conceptual model algoritm

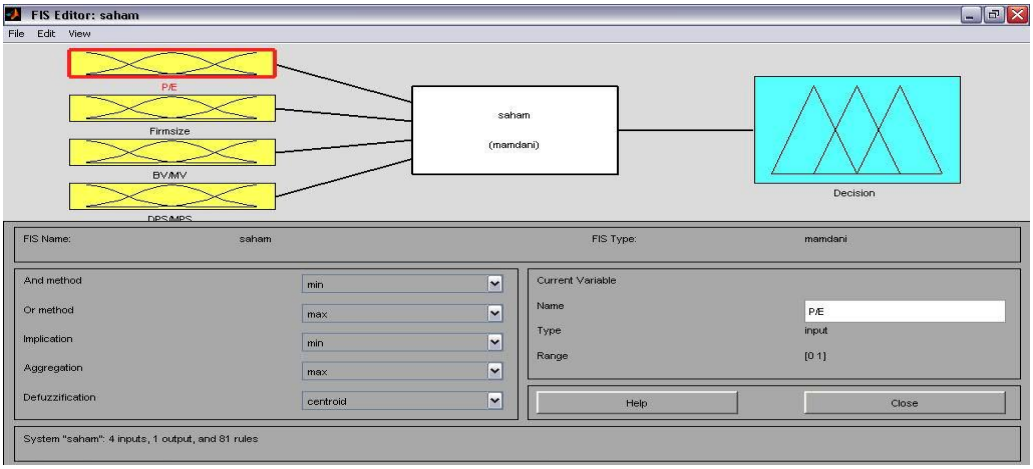

Figure 2.3

Stage 1: system designing

First stage in modeling a system by Fuzzy Logic is definition and determination the number of inputs, outputs, and rules which relate inputs to output. Figure 2.3 has shown all these unknowns, so that each of decision criteria, one of Fuzzy system inputs and designated score to per share describes only Fuzzy system output variable and IF-THEN rules, rules governed by system. Therefore, a system with 4 inputs, 81 rules as shown in figure, forms Fuzzy model of decision making matrix. As noted, by studying subject's literature, decision criteria included P/E, market value (firm size), BV/MV, and DPS/EPS which each of them must be at first sight converted to Fuzzy numbers.

Stage 2: Fuzzification

In this stage, verbal variables referred to each decision criteria converted to Fuzzy numbers respectively as system input and output. As noted before, triangular function has been used for variables Fuzzification. A three options range with same distances has been used for P/E, market value (firm size), BV/MV, and DPS/EPS variables. Equivalent Fuzzy numbers of recent variables have been shown in figures 3.3, 3.4, 3.5, and 3.6.

Input variables Fuzzification

Criterion 1: Fuzzification of P/E criterion has been carried out according to following verbal variables.

Table 1.3 Verbal variables of P/E

Fuzzy number	P/E	P/E
(0 0 0.5)	Low	Low
(0 0.5 1)	Average	Average
0.511	High	High

P/E as one of 4 system inputs has three low, medium, and high states. As shown in figure 3-3, through Fuzzy functions and MATLAB software can be converted this criterion to Fuzzy number.

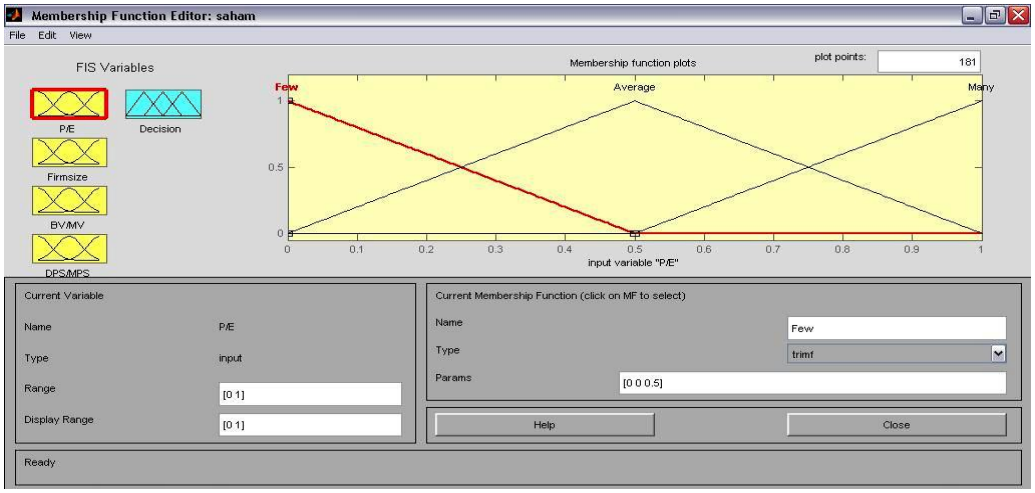

Figure 3.3 Fuzzy number of P/E criterion

Criterion 2: Fuzzification of market value criterion has been performed based on following verbal variables.

Table 2.3 Verbal variables of market value (firm size).

Fuzzy number	market value (firm size)	market value (firm size)
(0 0 0.5)	Small	Small
(0 0.5 1)	Medium	Medium
0.511	Large	Large

Market value (firm size) as second criterion has three small, medium, and large states. As shown in figure 3-4, by Fuzzy functions and MATLAB software can be changed this criterion to Fuzzy number.

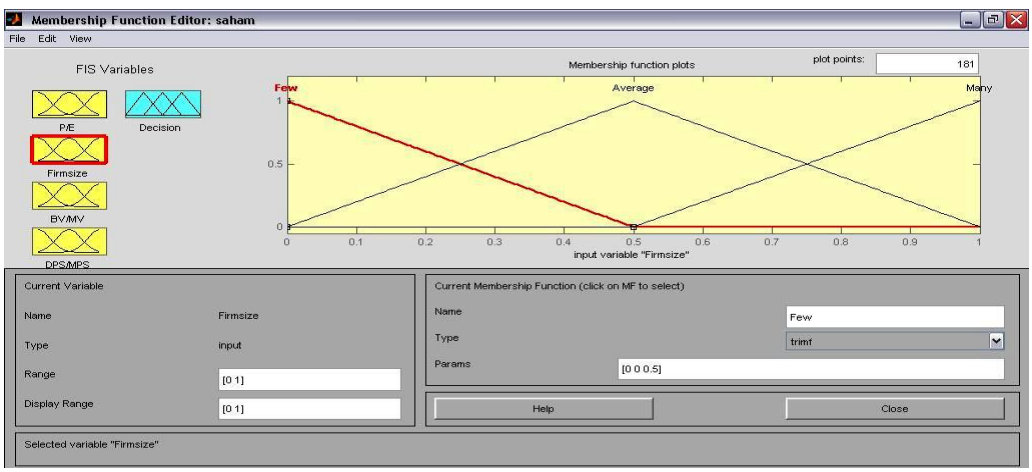

Figure 4.3 Fuzzy number of market value criterion

Criterion 3: Fuzzification of BV/MV criterion has been done in conformity with following verbal variables.

Table 3.3 Verbal variables of BV/MV.

Fuzzy number	BV/MV	BV/MV
(0 0 0.5)	Low	Low
(0 0.5 1)	Average	Average
(0.511)	High	High

BV/MV is another criterion which has three low, medium, and high states. As shown in figure 3-5, by Fuzzy functions and MATLAB software can be converted this criterion to Fuzzy number.

Criterion 4: Fuzzification of DPS/EPS criterion is performed according to following verbal variables.

Table 4.3 Verbal variables of DPS/EPS.

Fuzzy number	DPS/EPS	DPS/EPS
(0 0 0.5)	Low	Low
(0 0.5 1)	Average	Average
(0.511)	High	High

DPS/EPS is fourth criterion which has three low, average, and high states. As shown in figure 3-6, by Fuzzy functions and MATLAB software can be converted this criterion to Fuzzy number.

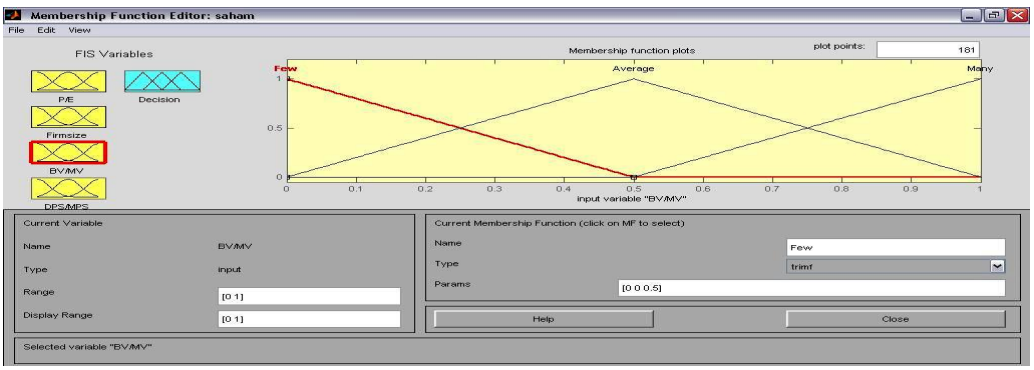

Figure 5.3 Fuzzy number of BV/MV criterion

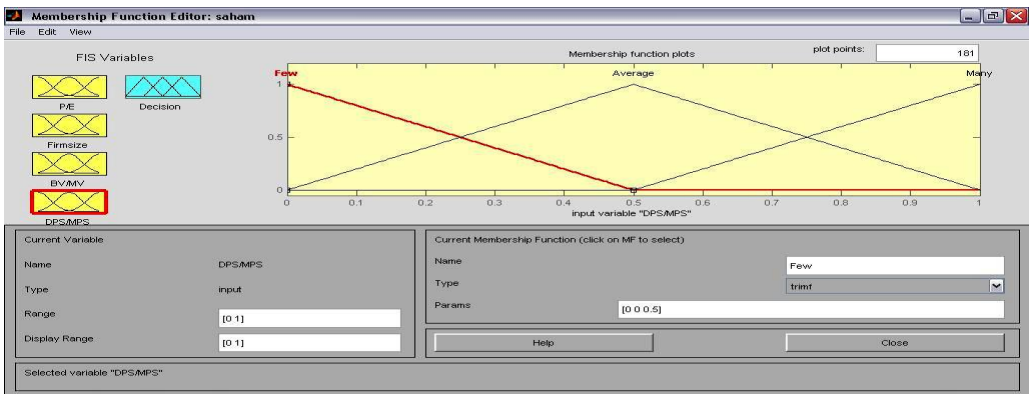

Figure 6.3 Fuzzy number of DPS/EPS criterion

Fuzzification of output variable

As expressed, our system's output is designated score to per share for buy, sales, and maintenance, which is defined by verbal variables in system and model as follows:

Table 5.3 Verbal variables of stock score.

Fuzzy number	Activity's score	Activity's score
(0 0 0.5)	Low	Low
(0 0.5 1)	Average	Average
0.511	High	High

Designated score to per share for buy, sales, and maintenance is output criterion which has three low, medium, and high states. As shown in figure 3-7, this criterion can be changed to Fuzzy number by Fuzzy functions and MATLAB software.

Stage 3: codifying inference rules (inference engine)

IF-THEN rules which have been introduced in model, and are our knowledge base, have been planned regarding supervisory and advisory professors and experts' views. Here we have 81 rules with respect to four rating criteria and existence of three verbal variables for each of them, which in figure 3-8 has shown these rules entered to software.

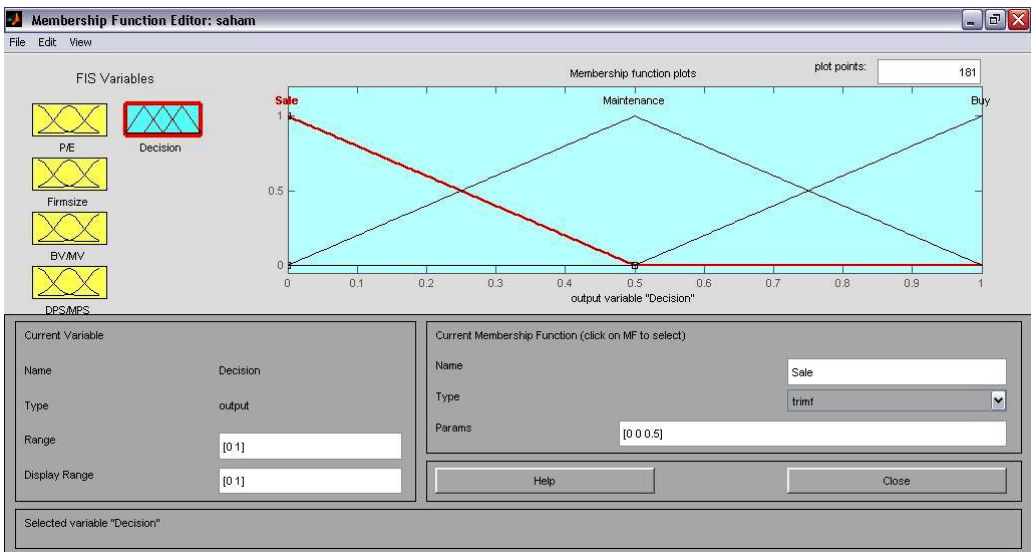

Figure 7.3 Fuzzy number of stock number.

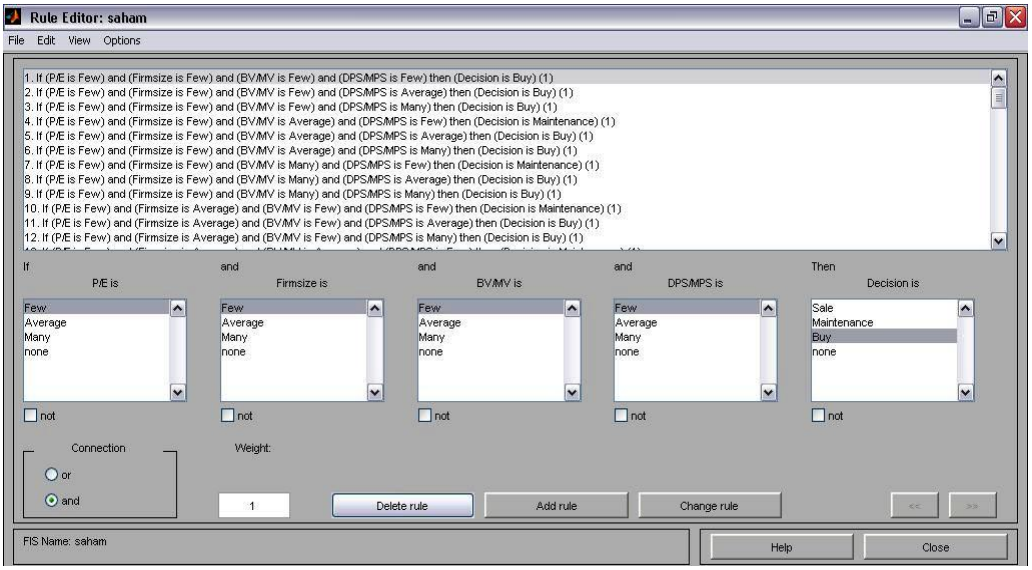

Figure 8.3. This is the knowledge base which has been codified by experts.

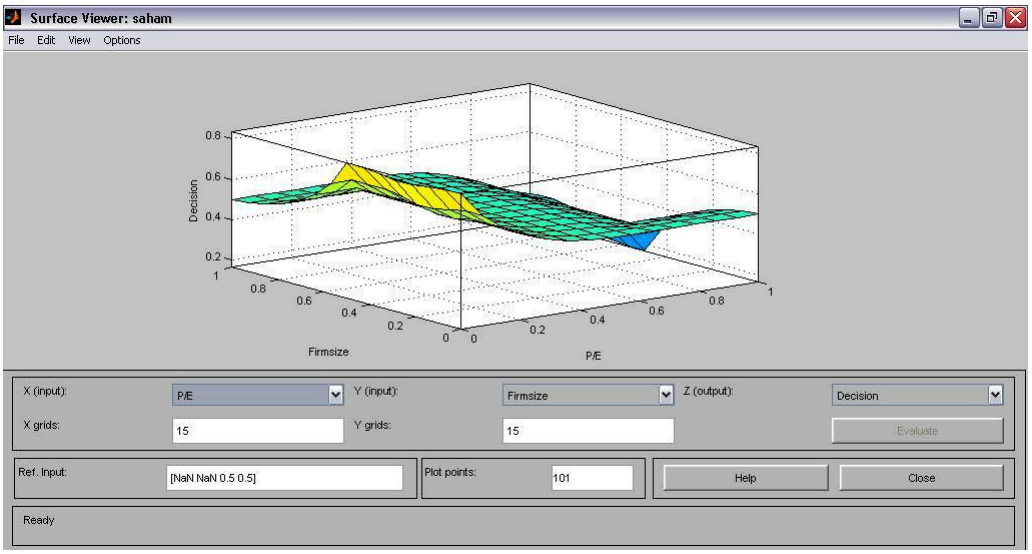

Figure 9.3 3D model of knowledge base.

Stage 4: model testing

In this section, we consider several cases for model testing and demonstrating system efficiency (clarifying system's performance).

a. RENA investing firm

This firm has been selected for testing during a financial period (for example 2009), which we called briefly it *A*. For calculating criteria (indices) which include

P/E, market value, BV/MV, and DPS/EPS, we referred to information of that financial period which is as follows.

We have used following formula for defuzzification:

$$x_{max}^{(1)} = \frac{m_1 + m_M + m_2}{3}$$

$$x_{max}^{(2)} = \frac{m_1 + 2m_M + m_2}{4}$$

$$x_{max}^{(3)} = \frac{m_1 + 4m_M + M_2}{6}$$

$$Z^* = max\left\{x_{max}^{(1)}, x_{max}^{(2)}, x_{max}^{(3)}\right\}$$

After entering these inputs to system, result presented by system is according to figure 1.4, as follows.

0.62 obtained as score to stock *A*, which it means stock buying in expert system.

a. SAIPA firm

It has been chosen for testing during a financial period (like 2009) which we called briefly it *B*. For computing criteria (indices) include P/E, market value, BV/MV, and DPS/EPS, we referred to information of that financial period which is as follows.

Table 6.3

Defuzzi ficationed	Fuzzy number	Range	Value /Percent	Index	Row
0.16	(0 0 0.5)	Low	3	P/E	1
0.16	(0 0 0.5)	Low	64.42%	DPS/EPS	2
0.91	0.511	High	2292985	Market value	3
0.5	(00.51)	Medium	1.07	BV/MV	4

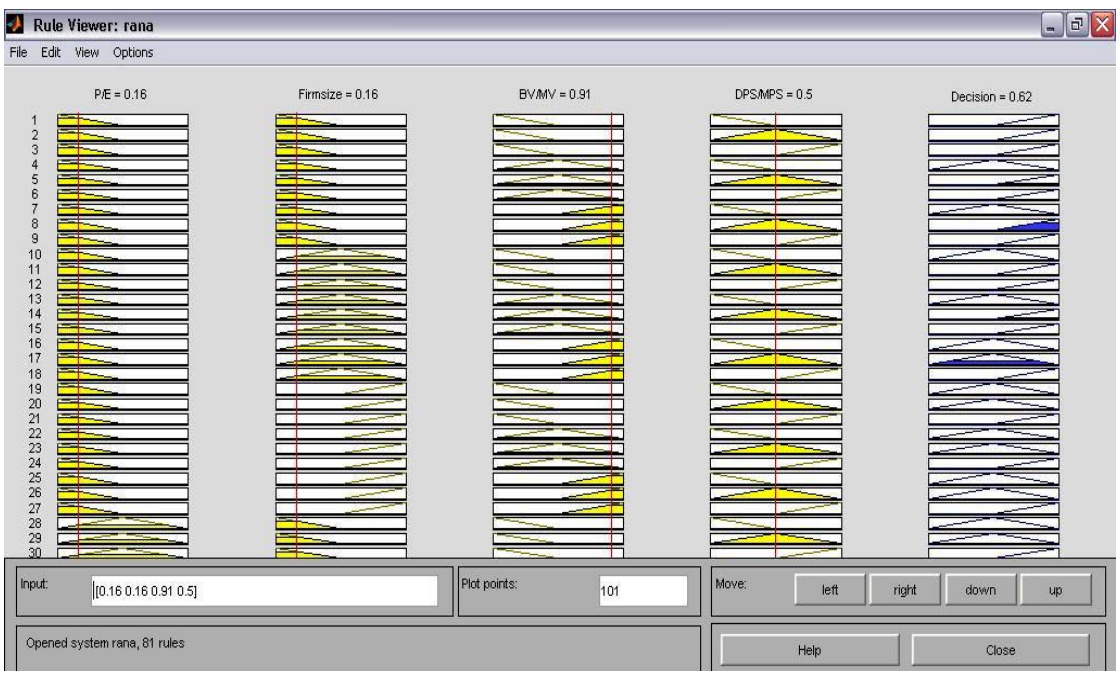

Figure 1.4 Expert system output for *firm A*'s stock.

Table 7.3

defuzzificationed	Fuzzy number	Range	Value/Percent	Index	Row
0.16	(0 0 0.5)	Low	2.8	P/E	1
0.5	(00.51)	Medium	77.79%	DPS/EPS	2
0.91	(0.511)	High	17683110	Market value	3
0.5	(00.51)	Medium	1.06	BV/MV	4

We use following formula for defuzzification:

$$x_{max}^{(1)} = \frac{m_1 + m_M + m_2}{3}$$

$$x_{max}^{(2)} = \frac{m_1 + 2m_M + m_2}{4}$$

$$x_{max}^{(3)} = \frac{m_1 + 4m_M + M_2}{6}$$

$$Z^* = max\left\{x_{max}^{(1)}, x_{max}^{(2)}, x_{max}^{(3)}\right\}$$

After entering these inputs to system, result presented by system is according to figure 4.1, as follows.

0.509 obtained as score to stock *B*, which its concept in expert system is stock maintenance.

a. SHAHDIRAN firm

This firm is selected for testing during a financial period (like 2009), which we called briefly it *C*. For computing criteria (indices) include P/E, market value, BV/MV, and DPS/EPS, we referred to information of that financial period which is as follows.

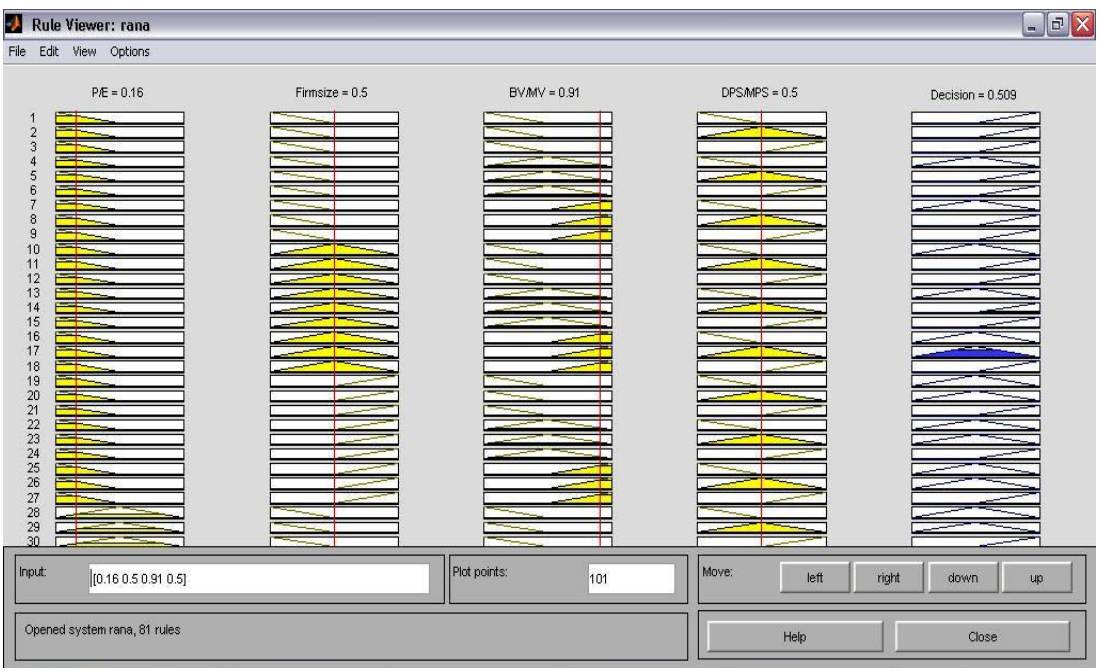

Figure 1.4 Expert system output for *firm B*'s stock.

Table 8.3

defuzzificationed	Fuzzy number	Range	Value/Percent	Index	Row
0.91	(0.511)	High	37.4	P/E	1
0.16	(000.5)	Low	66.67%	DPS/EPS	2
0.16	(000.5)	Low	166118	Market value	3
0.5	(00.51)	Medium	1.13	BV/MV	4

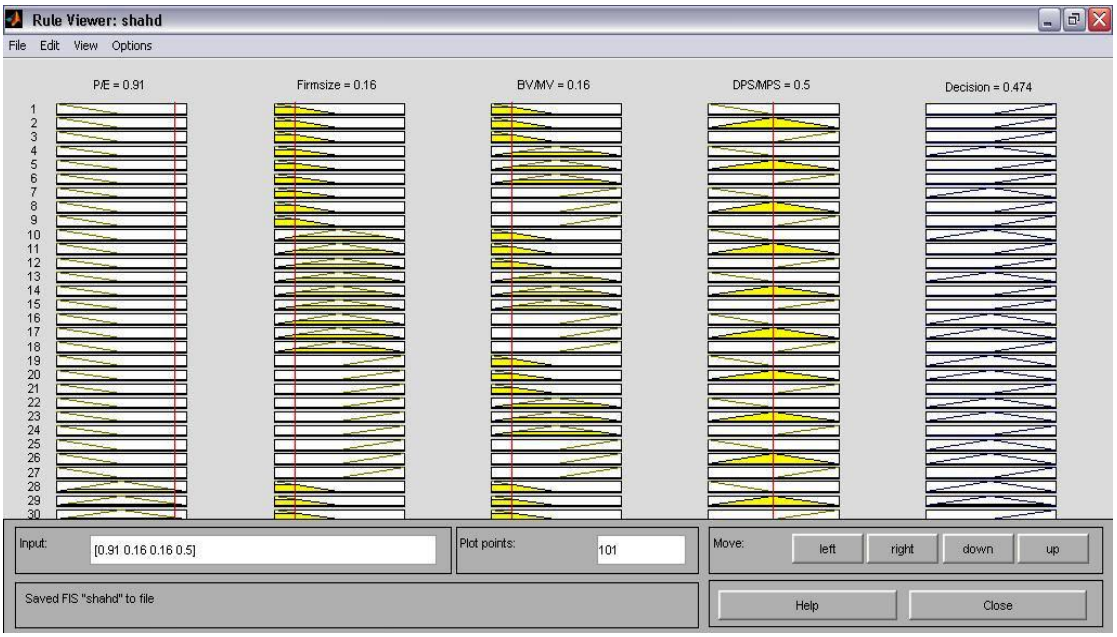

Figure 1.4 Expert system output for *firm C*'s stock

We have applied this formula for defuzzification:

$$x^{(1)}_{max} = \frac{m_1 + m_M + m_2}{3}$$

$$x^{(2)}_{max} = \frac{m_1 + 2m_M + m_2}{4}$$

$$x^{(3)}_{max} = \frac{m_1 + 4m_M + M_2}{6}$$

$$Z^* = max\left\{x^{(1)}_{max}, x^{(2)}_{max}, x^{(3)}_{max}\right\}$$

After entering these inputs to system, result presented by system is according to figure 4.1, as follows:

0.474 obtained as score to stock *C*, which its concept in expert system is stock sales.

Model's validation

Since our goal is presenting an applicable system, so it's a necessary matter to have sufficient validity of it in different conditions. Therefore, in order to validate model stages is used which its schema is as follows.

For system validation, obtained data in case related to stock selecting for buy (*A*)

was entered to expert system. 0.62 was obtained as score for stock buying (*A*). Then these data were given to three experts, and requested them to agree on proper score and offer. They also suggested average score for stock buying *A*. Therefore, model enjoys sufficient validity regarding the sameness of offered score by expert and expert system output.

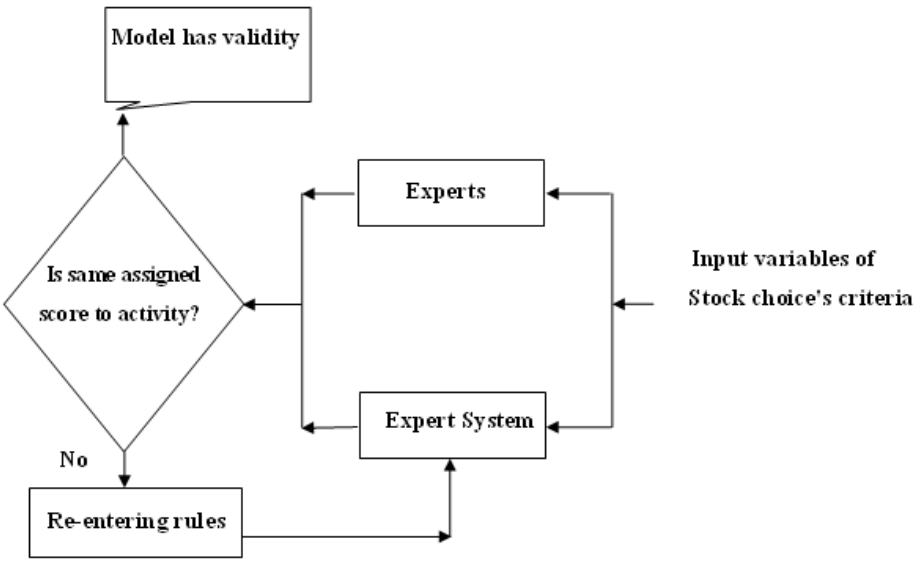

Figure 2.4. Model's validation

7. Conclusion

Studies related to stock have been mainly focused on several variables. As noted, in investing firms, decisions related to buy, sales, and maintenance are a part of decisions which have been made along organization's strategy, and a system must be established for its support. In this paper, an expert system has been studied by using Fuzzy Mathematics Logic which assists organization in prioritizing investment in stock market. By doing so, possible losses and damages have been reduced which emerge due to rash decisions.

Discussed system hasn't been a goal and is merely a tool for rating, and it has been applied when resulted in improving conditions. It's deserved to define our goals from investing before any action, then take action to make decision about capital market by this system.

As specified by system's output, prioritization score for stock buying, sales, and maintenance would be placed in one of defined spans according to following table.

Table 9.3 Expert system output

Fuzzy number	Activity's score	Activity's score
(000.5)	Low	Low
(00.51)	Average	Average
(0.511)	High	High

Implications

This article has been carried out with goal of determining appropriate mechanism for prioritizing stock buy, sales, and maintenance, which in this section we offer considered suggestions around discussed subjects.

Based on obtained results, we can say that such expert system seems necessary for helping organization's management for the sake of proper decision making, and as seen, obtained results and also experts' view itself confirms this matter.So:

1. It's suggested that organizations use such tools for primary studying any decision about outsourcing, by forming outsourcing committee consisted of executive managers and assistants in different work fields.
2. Since investing in stock market is as a strategic decision, so the need for strategic planning has been day by day become more severe for succeeding economic enterprises, and also codified system can guide in this discussion.

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