

# A Kind of Application of Fuzzy Theory :Stock Market Rational Investment Model

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**Abstract.** Fuzzy theory is a kind of mature control theory. Fuzzy control theory has solved a lot of difficult problems that traditional control theory can't solve. This paper tries to introduce fuzzy theory into the stock market speculation action control , and simulate the stock buying and selling actions according to the similitude of market investor thinking way and fuzzy theory.It aims at exploring a new kind of investment logic based on fuzzy theory and provides theoretical foundation and mathematical model for stock market software development. The investment guiding software can reasonable guideinvestors invest rational and help the healthy development of stock market.

## 1.Introduction

The stock market is unpredictable. In fact, "1 percent profit,2 percent break-even and 7 percent loss" is the fact that does not dispute in the stock market. The main reason why investors losses is their irrational actions. In short, choose a stock on the stock market, its price is high or low is not an accurate problem, but a fuzzy problem. A same stock, some investors think it's price is low and buy, some people think that the price is high and sell, thus the problem which the price is low or high, bullish or bearish can use the principle of fuzzy mathematics to analyze. Given a stock price, it is low or high prices are not clearly defined. We can adopt the method of fuzzy mathematics for its fuzzy expression. So we can simulate investors rational speculation using fuzzy mathematics theory.

## 2.The Assessment of stock price and fuzzy expression

According to set theory, the stock assess of investors is just the set theory of influence factor about this stock.For example, the investors evaluate each stock are macroscope, fundamentals,capital movement and private investors mentality.Various factors will impact on stock price .Due to the influence of different information on stock prices at the same speed mutually, therefore shares of these factors produced by the information or change the reflection degree is not the same.Some react slow, some voidance rapidly, and others react excessive .This form some states of affect stock ptice:slow,sell out and excessive, and so on.Which the information produced by affecting factors is slow or excessive,is a fuzzy concept. We can construct some fuzzy set such as information slow, voidance and excessive to fuzzy analyze and process.

Here we explain the fuzzy expression of stock price information such as information voidance.If a factor changes,this will cause investors reappraise stock price so as to lead to act ofpurchase and sale.If investors evaluate price is 20 yuan, and the stock price is 10 yuan, real-time then investors will continue to buy.We take out the membership of voidance information. So we fuzzy the stock price affecting factors and find out its fuzzy expression.

$$A = \frac{a_1}{u_1} + \frac{a_2}{u_2} + \dots + \frac{a_n}{u_n} \quad (1)$$

### 3. Fuzzy logic and fuzzy transformation of the stock price evaluation process

Put a stock of all the information together, you can form the evaluation of the stock. Based on the evaluation, we can assess the stock evaluated price. Use a stock's current price divided by the stock price, can calculate a percentage value assessment, I call it the stock temporarily maturity. Make a change, if we already know the maturity of a stock, then with the current price divided by the maturity, is the evaluation price of the stock, as long as the market is effective, so stock prices will gradually close to this price.

Visible, if the membership is known, we can predict the future price of the stock according to the present price, so as to make business decisions.

$$p_e = p/z \quad (2)$$

If we introduce fuzzy logic and fuzzy analysis, we can also judge that the stock price is higher or lower putting aside the stock even now, thus decide to buy or sell. Because the core of fuzzy analysis is maturity and fuzzy conversion, now we can introduce fuzzy analysis application to stock price evaluation analysis.

Whether the price is the high or low belongs to the category of a fuzzy. If you want to do further analysis to it, we can construct some fuzzy set such as price low, price moderate and price high. For example, we can construct the followed fuzzy set of price moderate.

$$B = \frac{b_1}{p_1} + \frac{b_2}{p_2} + \dots + \frac{b_n}{p_n} \quad (3)$$

The price of the stock depends on many factors that affect stock price, therefore from the stock price influence factors to the real-time price of the stock there is a mapping relationship. In fact, we can build a kind of fuzzy relation between a collection of corresponding influence factors and the stock price.

$R: A \times B \rightarrow [0, 1]$ , This kind of fuzzy relations is the key to set up smart investment model. We are looking for this kind of fuzzy relations.

The reality importance of  $R$  is to convert membership of all kinds of affecting factors and get the membership of stock price assessment. By it to the membership degree of many factors on the fuzzy set according to the set standard fuzzy processing, in fact this kind of treatment can be done by fuzzy transform,

$$B = A \cdot R$$

$R$  is a matrix and it conclude the a set of stock price assessment condition. We call it assessment matrix.

Evaluate transformation calculation process can be divided into two steps, first calculate direct influence factors, and then calculate the effect of risk appetite. Once the price of the evaluation process is abstracted into fuzzy transformation, we can begin to do stock classification, screening and ratings through the fuzzy set operation. To implement the operations of fuzzy relations through a variety of investment strategies, through fuzzy matrix to control the adjustment of the portfolio, and so on, so as to realize the computer intelligent investment.

This just the stock simulate operation core idea based on fuzzy mathematics.

### 4. Stock investment simulation model

The stock investment model system flow that I design is as follows.

First of all, we can input information and data that influenced by factors of the above four aspects, express as a vector or convert into matrix. Secondly, we analyze the data confirm stock maturity and construct membership matrix. Lastly, we convert all kinds of membership into fuzzy, get the stock maturity construct maturity matrix, do fuzzy calculating and decide to buy or sell.

The process is that informationize all the influence factor to the price of the stock and make clear if the information can be digitalized. Fuzzy the former and get its membership. For the latter, the

membership can be got by specialist. Then we can compose a membership vector with a stock memberships of all affecting factors and get the stock's maturity.

$b_i = A_i \cdot R_{1i} \cdot R_{2i}$ , After getting the maturity of a stock, a domain of the maturity of the stock limit through the expert, in their respective scope of stock respectively delimits the category, buying, on the sidelines, selling for all kinds of stock in a single stock, in its operating condition to trigger when they perform the corresponding operation.

For example, we put the low maturity of the stock of a fuzzy set, divided into buying stocks. We will buy a stock trigger when buying a stock condition is established at a certain moment. The fuzzy logic of simulation investment model can be realized among influence factors fuzzy, stock assessment and classify and buying and selling decision.

### 5. Data input and fuzzification

In the processes of data input, most of the information can be represented using numerical factors, a few factors cannot. Therefore, all factors can be divided into two categories, part can be represented with accurate indicator of value, the rest of those factors cannot be used accurately. We should change accurate index into fuzzy index.

We set up fuzzy logic about stock analysis, buying and selling. After translation and process, we can provide suggestion of operation. Fuzzification let numerical value that investors should be considered in the stock investment factors convert into fuzzy Numbers. The membership confirm is the core problem. You had better adopt the experts suggestion. In a certain factors affecting itself can not be quantified, such as sentiment, can only use expert advice, set membership degree directly by experts or investors. In the case of most of the quantitative indicators can be obtained by numerical, generally can be changed to index values brought about by the share price of the actual changes and should change the ratios of set membership. Some factors change, the actual changes of stock price in the market can be obtained, and change need neural network introduced to realize learning function later.

That is the weight of the factors of price changes, and each factor change rate as a function of stock price rate of change, need get through the neural network to realize. This is a key problem for the simulation model.

### 6. Stock assessment and classification

When all the influence factors are transformed into fuzzy element, we can obtain the information membership degree of these factors. The membership degree is listed into column vector, further is formed the matrix, then by fuzzy transform the maturity of each stock by fuzzy conversion. We can further classify stock and rating with the maturity of the stock price. Relatively simple stock price assessment USES the simple fuzzy operators such as intersection or evaluate and can be achieved, even classical mathematical algorithm can be used to calculate, such as arithmetic average method, or the weighted average method to do this. In the stock classification logic design, the most simple operation is the cut sets of fuzzy matrix. Cut set in stock is a class of shares. The more complex stock assessment and classification need to design the fuzzy relationship and operation to complete.

Assuming that there are m stock in the stock pool, the price of each stock is effected by n factors, there are:

$$U = u_{ij} = \begin{pmatrix} u_{11} & u_{12} & \dots & u_{1m} \\ u_{21} & u_{22} & \dots & u_{2m} \\ \dots & \dots & \dots & \dots \\ u_{n1} & u_{n2} & \dots & u_{nm} \end{pmatrix} \quad (4)$$

Fuzzy set are constructed respectively three information: dull, clearing and excessive. The membership degree of the information can be determined according to the membership degree seeking rules of a list of U .

$$A_j = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ \dots & \dots & \dots \\ a_{n1} & a_{n2} & a_{n3} \end{pmatrix} \quad (5)$$

( Ai1, ai2, ai3 express slow, clearing and excessive respectively)

We can construct a fuzzy relation from the price factors to stock C, the stock price is constructed three fuzzy sets: low, medium and high prices. The above-mentioned  $A_j$  and fuzzy relationship matrix C fuzzy arithmetic  $A_j$ , it is concluded that  $B_j = C A_j$ , C,  $B_j$  is the fuzzy sets to evaluate the price of the stock, then we can classify the stock on the basis of  $B_j$  using expert system.

### 7. Investment decision process

The most simple decision can set a different domain values through the expert system. If exceeding the domain values we can implement the corresponding operation. For example, set a domain values of membership degree, below this threshold gives buy orders; Instead, also for membership set a selling domain values, exceeding the domain values gives sell order. Investors' appetite for risk is divided into three types: risk aversion, risk neutral and risk preferences, in between of the three to withstand the risk level of increase, so the different investors have different preferences. Due to investors' appetite for risk is different, their shares of the same degree of maturity evaluation is distinct, their membership degree of stock buying and selling of the threshold Settings are different. Assumption investor is risk aversion, the maturity of 0. 2 of the following is divided into buying, 0. 2-0. 8 is divided into the sidelines, 0. 8 above is divided into selling.

### 8. Summary

The purpose of establish this simulation model is to explore the application of fuzzy mathematics in securities investment, but the design part of the neural network has not been elaborated. In fact, even in the design of fuzzy control, the key part still need to use neural network and genetic algorithm. So detailed work needs further study.

### References

[ 1] Jijian Xie, Chengping Liu. Fuzzy mathematics method and its application (the third edition) . Huazhong university of science and technology press, 2006, pp.68-125.  
 [ 2] Lynch, P. One Up on Wall Street: How to Use What You Already Know to Make Money in the Market, Beijing: Mechanical Industry Press, 2010, pp.19-65.  
 [3] Li Yu, Intelligent Control and Intelligent System [M]. Beijing: Mechanical Industry Press, 2007, pp.89-110.  
 [4] Jing Zhu. Fuzzy Control Theory and System Principle [M]. Beijing: Mechanical Industry Press, 2005, pp.128-160.  
 [5] WANG R, CAO W M, XIE W X. Fuzzy coverage for sensor networks [ J]. Chinese Journal of Scientific Instrument, 2009, 30 ( 5 ) : 954-959.  
 [6] Information on [http://baike.baidu.com/link?url=VLsjZaAXoo\\_MC6UMGnZIL1DzSEa51ATHcfNrHwSvE7sZ5W9ZcAZpp1KeBuA0bsE7h2MuLDp5HF1Nn03SUMx7wa](http://baike.baidu.com/link?url=VLsjZaAXoo_MC6UMGnZIL1DzSEa51ATHcfNrHwSvE7sZ5W9ZcAZpp1KeBuA0bsE7h2MuLDp5HF1Nn03SUMx7wa)

