

# Application of Analytic Hierarchy Process in Selection Decisions

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**Abstract:** Because of the complexity and variety of factors affecting the stock price, it is a relatively difficult decision-making problem to evaluate and select a profitable stock. How to quantitatively analyze each stock has important significance for choosing stocks. In this paper, we use the analytic hierarchy process(AHP) to establish the stock selection model. We study the factors that affect the stock price fluctuation, and then make a quantitative analysis of the factors that can help the individual to make reasonable decisions when choosing stocks.

**Keywords:** Stock price; AHP; Decision

## 1. Introduction

Risks and opportunities in the stock market have been a big problem for shareholders and how to choose a good stock in stock market is a required course for investors[1].The stock market is affected by many complex many complex factors[2].Therefore, as a process which needs to use multi-level analysis to quantify, rank and select the various factors. [3]Analytical Hierarchy Process (AHP)is a tool to solve this problem [4].

There are some literatures with the analytic hierarchy process (AHP) to analyze, sort and filter stocks. Some articles analyze and compare a few of stocks using AHP method[5]. These literatures do not text AHP analysis result using the next year data.

Firstly, this paper constructs a model of AHP, build the target layer and standards layer comparison matrix .Then calculating the weight of each index relative to the target. In order to avoid artificially logic error, we consider its consistency checking results. Then, we use AHP model to evaluate five stocks according to 3 years data, and select the best stocks. Last, by comparing the selection result with the next year’s actual data, we can test whether AHP is a good method to select stock for investors[6].

## 2. Application of Analytic Hierarchy Process Model

Analytic Hierarchy Process, which is referred to AHP, divides elements that would be relevant to decision-making into objectives, guidelines and program levels, and makes qualitative and quantitative analysis to make decisions based on that[7]. Through establishing the hierarchical model ,we can calculate the weight of each index for the target[7].

### 2.1. Model

First, we classify factors which influence stock price movements and selection, then model with 3 Layers structure is established. First layer is the goal layer, in which  $A=\{B1,B2,B3,B4,B5\}$ .Second layer is criteria layer, including policy layer  $B1=\{C11,C12,C13,C14,C15\}$ , basic layer  $B2=\{C21,C22,C23\}$ ,technical layer  $B3=\{C31,C32,C33\}$ , information layer  $B4=\{C41,C42\}$ , capital layer  $B5=\{C51,C52,C53\}$ .Hierarchical model is presented below in Figure 1.

### 2.2. Construct comparison matrix and calculates the weight and consistency ratio

Some artificial logical errors may lead to a lower consistency ratio. In order to avoid this situation, we propose a new method. Before constructing comparison matrix, we assign various factors according to their importance and evaluate them with values between 1 and 9. When constructing a matrix, we consider the assigned values to decide size of each element in the matrix. By quantitativ-ing elements, to a large extent, we can avoid the logical error in the direct comparison between 2 elements, thus can enhance the consistent ratio.

$$A = \begin{pmatrix} 1 & 1/3 & 3 & 1/4 & 1/7 \\ 3 & 1 & 4 & 1/2 & 1/5 \\ 1/2 & 1/4 & 1 & 1/5 & 1/8 \\ 4 & 2 & 5 & 1 & 1/4 \\ 7 & 5 & 8 & 4 & 1 \end{pmatrix}$$

Characteristic vector  $W1=\{0.0633,0.1386,0.0422,0.2118,0.5442\}$  ; Characteristic values is 5.172 ; CI=0.043 ; RI=1.12 ; CR=0.0384

$$B1 = \begin{pmatrix} 1 & 3 & 3 & 1/3 & 1/2 \\ 1/3 & 1 & 1 & 1/5 & 1/4 \\ 1/3 & 1 & 1 & 1/5 & 1/4 \\ 3 & 5 & 5 & 1 & 2 \\ 2 & 4 & 4 & 1/2 & 1 \end{pmatrix}$$

Characteristic vector  
W21={0.1979,0.0661,0.0661,0.4086,0.2612 } ; Characteristic values is 5.0936 ; CI=0.0234 ; RI=1.12 ; CR=0.0209

$$B2 = \begin{pmatrix} 1 & 4 & 1 \\ 1/4 & 1 & 1/4 \\ 1 & 4 & 1 \end{pmatrix}$$

Characteristic vector W22={0.4444,0.1111,0.4444 } ; Characteristic values is 3 ; CI=0 ; RI=0.58 ; CR=0

$$B3 = \begin{pmatrix} 1 & 1/3 & 1/5 \\ 3 & 1 & 1/3 \\ 5 & 3 & 1 \end{pmatrix}$$

Characteristic vector W23={0.1047,0.2583,0.6370} ; Characteristic values is 3.0383 ; CI=0.0191 ; RI=0.58 ; CR=0.03300

$$B4 = \begin{pmatrix} 1 & 2 \\ 1/2 & 1 \end{pmatrix}$$

Characteristic vector W24={0.6667,0.3333} ; Characteristic values is 2 ; CI=0 ; RI=0 ; CR=0

$$B5 = \begin{pmatrix} 1 & 5 & 4 \\ 1/5 & 1 & 1/3 \\ 1/4 & 3 & 1 \end{pmatrix}$$

Characteristic vector W25={0.6738,0.1007,0.2255} ; Characteristic values is 3.0860 ; CI=0.043 ; RI=0.58 ; CR=0.0741

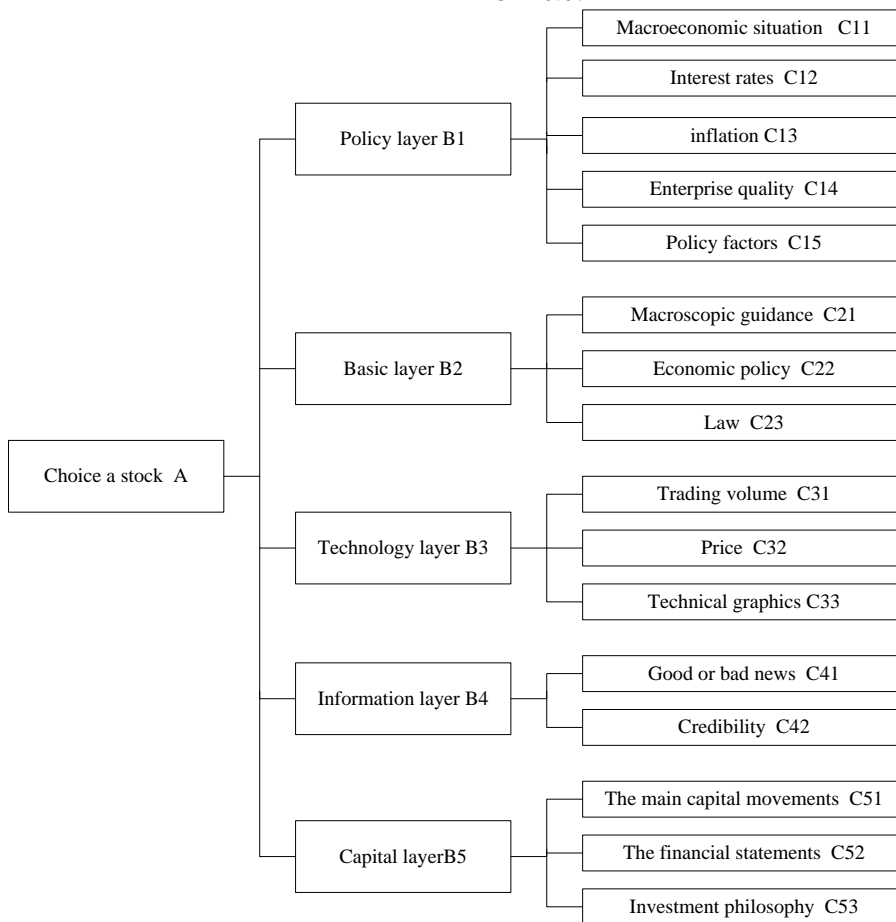


Figure 1. Hierarchical model

2.3. Calculate the weight of each index relative to the target

Obviously, the comparison matrix CR < 0.1 , which have passed the consistence tests. Feature vectors W1, W21, W22, W23, W24 and W25 respectively present the index's weight in the second layer relative to the target

layer and index's weight in the third layer relative to the second layer. Weights of the third layer index shown in Table 1 below.

**Table 1. The weight of each factor relative to the target layer**

Element	C11	C12	C13	C14
Weight	0.0125	0.0042	0.0042	0.0259
Element	C15	C21	C22	C23
Weight	0.0165	0.0616	0.0154	0.0616
Element	C31	C32	C33	C41
Weight	0.0044	0.0109	0.0269	0.1412
Element	C42	C51	C52	C53
Weight	0.0706	0.3667	0.0548	0.1227

### 3. Using the model for selecting stock

#### 3.1. Each layer index analysis and stock selection

In this paper, we select 16 indicators as the factors that affect the stock price selection, and divide them into 5 categories, includes technical layer, policy layer, information layer, capital layer and capital layer. Different index has different impact on the stock options. The previous text has calculated the weight for the target, we also need to analyze each index, according to the actual situation of the company's assessment of each of them in the company's score, the final weight of each company's total score and in accordance with the total score of the sort.

##### 1) Index analysis

The technical side, refers to a number of indicators and methods used to observe and predict the trend of the stock market and the inherent law. Mainly include:

(1) transaction volume. It is an important indicator of the stock market, has a great impact on the market trend. Sudden enlargement or narrowing of the trading volume tends to indicate a turning point in the market. Either from a rise to a fall, or from a fall to a raise.

(2) a new high or a new low point. A high or low point is the point of price of a stock which never has risen or fallen in the past. It is generally said that the stock market is going to rise when the quantity of stocks which get new high point is lager , and vice versa.

(3) technical figures. According to the analytical method of commonly used indicators, K-line theory, form theory, wave theory, trend theory and technology, and through specific graphics, index and calculation method, we can predict the future trend.

The so-called policy layer, refers to the relevant policy factors may have an impact on the stock market. Mainly can be divided into three aspects:

(1) macro - oriented, such as the government's economic policy, the long-term development strategy and the reform of state-owned enterprises and the reform of the relevant ideas and measures.

(2) economic policy, including changing in government fiscal policy, tax policy, industrial policy, monetary policy and foreign trade policy.

(3) some new policies and regulations according to the requirements of the development of the securities market , such as price limit, investment fund management approach and so on.

The so-called basic layer, refers to the situation of some fundamental factors affecting the stock market. Though basic layer analysis, you can grasp the basic factors that determine price movement. Includes:

(1) The macroeconomic situation. Stock market trends and changes is determined by a country's economic development level and economic status, and price fluctuations in the stock market also in largely reflects the changes in the macroeconomic situation. It is not difficult to find out from the history of the stock market, the stock market is in general accord with the economic cycle. In the period of economic prosperity, the business situation is good, more profitable, and the stock price is also rising. When the economy is depressed, the income of the enterprise is decreasing, the profit is declining, and the stock price is falling.

(2) Interest rate level. Among factors that affect the stock market, interest rate is a sensitive factor. In general, when interest rates rise, corporate operating costs increase, profit reduction, then accordingly will make the stock price fall down. On the other hand, when the interest rate is reduced, there may be more funds invested in the stock market. Thus stimulating the rise of stock prices. At the same time, due to lower interest rates, lower operating costs, it may promote the stock price rise accordingly.

(3) Inflation. Overall the disadvantages outweigh the advantages, because it will boost the stock market bubble. In the early days of inflation, will prompt the stock price to rise. But when inflation to a certain extent, it will push up interest rates, which prompt stock price to fall.

(4) Enterprise quality. For the specific stocks, the impact of the price level of the main factors is the inherent quality of the enterprise itself, including the financial situation, operating conditions, management level, technical ability, market size, industry characteristics, development potential on a series of factors.

(5) Political factors. It refers to the direct or indirect influence on the political aspects of the stock market, such as international political situation, political events, the relationship between countries, an important political leaders transform and so on. All of these will have a great and sudden impact on share prices. This is also an important aspect should be considered.

The so-called information layer is closely related to the information of company news, national policies, natural disasters, international events. These events will directly affect investors' investment psychology and judgments,

so the stock market trend has a very important impact. Elements in information layer mainly include:

- (1) Good or bad news. Good news is favorable factors or news which could stimulate the stock price rise. Bad news will bring negative impact on the stock market news.
- (2) Message credibility. Funds are often the main advantages of the use of propaganda to create a short atmos-

phere, in order to facilitate their positions. Bad news of the truth needs to be combined with the policy side, the technical side, such as a comprehensive decision. The so-called capital layer refers to the market liquidity level, display funds ample range search, namely the market have how much money can be used to invest in the stock.

**Table 2. Factor score sheet**

Stock name	Range price(%)	Turnover rate(%)	Range of amplitude(%)	Interval volume(Unit)	Interval volume(Yuan)
Zhengzhou coal machine	26.31	327.80	67.80	4516692823.00	28356552796.00
ZTE	38.50	395.47	56.73	11077689751.00	164551083248.55
Green holdings	148.79	627.09	149.80	3250337743.00	30091655607.00
Lukang pharmaceutical	61.96	1120.44	138.45	6516223409.00	49136270765.00
Phecda technology	58.61	1547.92	180.75	1212246213.00	29975804471.06

(1)Main funding trends. Main flow of funds index is a very practical indicator for investors. If a stock has the involvement of the main funds , the trend must be affected.

(2)Financial statements. Financial statements are prepared by the accounting standards, to the owners, creditors, government and other relevant parties and the public and other external accounting entity to reflect the financial position and operating accounting statements. The financial statements include the balance sheet, the income statement, the statement of cash flows or changes in the financial position, schedules and notes. The financial statement is the main part of the financial report, does not include the report of the directors, the management analysis and the financial statement and so on.

(3)Investment idea. Including the ability to withstand risks, the expected return on the asset allocation, etc.

2) *Stock selection*

According to the weight value of the indicators in Table 1 and the scores of the indicators in Table 3, we calculate

the total score of each company ranking, as shown in table 3.And then we draw the conclusion according to the ranking.

**Table 3. Company's score sheet**

Company	Goal	Ranking
Lukang pharmaceutical	81.7445	3
Green holdings	83.725	1
Zhengzhou coal machine	76.156	5
ZTE	79.503	4
Phecda technology	81.883	2

**4. Application**

Select 2014 stock volume as validation, as shown in Table 4.The results are consistent with the conclusions drawn from the analytic hierarchy process model.

**Table 4. The results are consistent with the conclusions drawn from the analytic hierarchy process model**

	Lukang	Green holdings	Zhengzhou coal machine	ZTE	Phecda technology
C11	80	80	80	80	80
C12	85	80	85	80	80
C13	85	90	80	75	75
C14	80	80	75	85	90
C15	80	85	80	80	80
C21	80	85	80	80	85
C22	80	85	80	80	80
C23	80	80	80	80	85
C31	85	80	75	80	80
C32	80	85	75	80	85
C33	80	80	80	80	80
C41	85	85	80	80	80
C42	85	80	80	80	85
C51	80	85	70	80	80
C52	80	80	80	80	80

C53	85	85	80	75	85
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## 5. Conclusion

It is not difficult to see from the principle, steps and application of analytic hierarchy process that it has the advantages such as systematic, practical, simple and so on. From the analysis of this paper, we can see that the analytic hierarchy process provides an effective tool for the evaluation and decision of stock selection, and the analysis result is a very valuable reference for investors.

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