AI-Fintech

An Asset Allocation System
Based on Artificial Intelligence

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Abstract

AI-Fintech is an asset-allocation project based on machine learning and data mining, emerging with the intensive research on quantitative investment research and the increasing demand for financial management by users.

Through analysis, the project obtains the user's expected return and affordable risk, and combines the expected investment period and amount to allocate the user's assets professionally and personally. Optimized through the Markowitz Model, user's assets are allocated to the stock, bond, and commodity markets to minimize risk in meeting yield needs, and models are adjusted based on changes in user's assets and market movements. The stock market adopts Multifactor Model, which dynamically calculates factors' weight based on market conditions and industry characteristics, and establishes short-term timing strategies in combination with phase indicators to select the best trading opportunities. By monitoring the Hindenburg Omen applicable to the A-Share Market and Economic Policy Uncertainty Index, the system can control risk and timely stop loss. The bond market adopts a holding maturity strategy, which uses third-party agency rating and financial statement analysis to avoid credit risk. Finally, it provides customers with personalized ranking according to the valuation data of the Shanghai Clearing House and user's risk-return preferences, and selects the best bond. Commodity market Based on Time Series Models and DCC-MIDAS model, commodity market obtains the correlation between crude oil futures and spot. Then, it uses factor timing and technical analysis to take profit and stop loss, obtaining the maximum return.

In addition to the privately-tailored asset allocation system, AI-Fintech portrays user portraits based on user preferences and Citibank's API. It uses machine learning algorithms to cluster users with the same investment preferences, and uses the LOF algorithm to eliminate off-group points and optimize clustering results to accurately recommend a portfolio for each user.

AI-Fintech also provides a depth analysis section that uses performance analysis, attribution analysis and scene analysis to quantitatively analysis users' asset allocation and market conditions, and provides professional asset returns and risk assessment analysis to make users intuitively understand product composition and revenue, volatility.

Using a series of existing frameworks and removing a series of simple repetitive operations, AI-Fintech puts the focus on the processing logic. With humanized operation, visual chart, and all-round service, AI-Fintech provides a zero threshold for ordinary investors, committed to providing users with the most profitable asset allocation, and has sufficient feasibility and broad development prospects.

It is based on the reasonable assumptions and three development goals of personalized service, automation and operability, and perfect market analysis. It grasps the economic and social feasibility brought by the financial technology boom. Supported by asset allocation and machine learning, it can

fully exert its technical superiority and team member's competence. It also takes into account the user experience, and strictly abides by laws and regulations, having a strong development momentum.

On the other hand, with the improvement of people's financial needs, team members thoroughly analyze market demand and potential customers, clarify the profit model, and explore new modes of Internet finance in the era of big data to achieve a combination of economic and social benefits. AI-Fintech has excellent prospect.

Content

1. Introduction

1.1 Background

In the 1950s, Markowitz's research on mean-variance model has formed the cornerstone of modern portfolio theory, and also became the most widely accepted method of combination construction. With the continuous development of investment practice, it has developed into two processes. First, it is too difficult for investors to build a one-step portfolio based on all securities because of its large quantity, so investors divide different securities into several asset classes. The optimal portfolio is constructed on the basis of these asset classes rather than all individual securities.

This step is often termed as asset allocation or beta allocation, and the source of excess returns on these assets is mainly market risk or beta. On the basis of the first step, investors can further select the individual securities, usually the specific securities in a certain type of assets and try to obtain excess returns through the selection of it. We usually call this excess return alpha.

The investors will face no more than 20 types of assets in assets allocation, but they may face thousands of securities when choose them in a class of asset. The mean variance model requires investors to estimate the expected return, standard deviation, and correlation between different securities to construct the portfolio. Therefore, to build an optimal portfolio requires investors to estimate the covariance of all securities using time series data, but this is a very difficult task to complete. It is this difficulty that promotes the development of the structured multi-factor risk models, which try to find out a certain number of common factors to explain the return of each security.

The Capital Asset Pricing Model takes the market as the biggest risk to construct the risk model. The Arbitrage Pricing Theory first incorporated multiple risk factors into the model to explain the security returns. Fama-French three-factor model added scale factor and value factor to the risk model as a supplement to the market risk. Carhart four-factor model added the momentum factor on the basis of the former. Although these factors were first discovered to explain market returns rather than portfolio construction, investors quickly accepted them as the basis for building a portfolio.

With the further study of these risk factors, investors find that the returns of fund products can also be explained by specific risk factors, and the returns of some investment strategies can be replicated by passive exposure to these risk factors. Fung and Hsieh proposed a seven-factor model to explain hedge fund returns. Similarly, Jensen, Yechily, and Rotenberg pointed out that hedge fund returns can be explained by purely passive strategic returns, such as momentum strategy, merger and acquisition strategy. With the deepening of the research on multi-factor risk model, the application of multi-factor risk model by investors has gradually penetrated into the performance attribution of

investment portfolio from the construction of individual portfolio of securities. Furthermore, since the return of individual securities and the return of portfolio can be explained by multi-factor risk, investors can also directly allocate the portfolio of passive exposure risk factors to construct the portfolio to achieve the purpose of investment. The combination of these passive exposure risk factors is now often referred to as "Smart Beta".

1.1.1 Present situation of Financial Market Development in China

(1) the basic environment is gradually completed, and the awareness of financial management is increasingly enhanced.

In recent years, the investment environment of users has become more and more standardized, and government departments have strengthened the management of market access and information disclosure, thus enhancing the security, stability and security of investment. At the same time, the domestic Internet penetration rate is increasing, which is helpful to the financial penetration to the public, and provide users with a variety of options for investment and financial management.

(2) The client's individual needs are poorly targeted, and it is difficult for professional financial managers to match.

The current asset allocation services in China cannot fully meet the unique needs of customers, the customer income and expenditure situation, risk tolerance and other elements of the specific inspection is lack of consideration, which results in the deepest level of customer’s demand cannot be well met.

In addition, asset allocation is very comprehensive, which requires financial advisers not only to have excellent professional knowledge, but also to be able to accurately grasp the needs of customers and have superb communication, coordination and social skills. However, the existing financial advisers in China may not be able to provide comprehensive professional services to clients with different needs.

(3) The Intellectualization of Investment financing Service and The Popularization of portfolio Investment Model.

Financial services agencies will push financial information and market information based on user subdivision, and provide recommendations on product recommendations, case descriptions, investment references and so on in combination with the actual situation of the users themselves. They maximize the benefits of the customer and thus facilitate the conclusion of the transaction by means of providing professional investment and financial management advice through financial management consultants and so on.

1.1.2 The present situation of the allocation of large classes of assets

In recent years, the scale of capital utilization of financial institutions has increased rapidly, but the structure of asset allocation and the trend of change are different. Influenced by the scale of the banks, the asset allocation structure of the whole financial institution is similar to that of the commercial bank. The proportion of securities and investment in commercial banks is different among banks with different asset scales. The proportion of securities and investment of small and medium-sized banks in China has increased rapidly in recent years, and the proportion is higher than that of large national banks in China. The share of stocks invested by securities firms has declined rapidly, while funds, bonds and other investments have grown rapidly. The investment capital of the insurance company has risen sharply, but their share of bonds has declined, stocks and securities investment funds and other investments have risen. Trust companies' allocation of financial assets has grown more slowly, even as the share of equity investment has declined, while the proportion of money invested in the physical sector has grown rapidly. Stocks and bonds accounted for slightly less of the total assets managed by fund companies, while cash and other investments rose.

Public data show that until March 31, 2018, fund management companies and their subsidiaries, securities companies, futures companies, and private equity fund managers have a total asset management business of about 54.13 trillion yuan. The total size of the fourth quarter of 2017 increased by 560 billion yuan.

With the surge in Chinese wealth management market and the need for institutional investors to allocate their assets, and the benefits that diversification can bring to investors, there is a growing demand to achieve investment goals through the allocation of large classes of assets.

1.1.3 Current situation of quantitative Investment Development

In fact, quantitative investment is a quantitative way to buy and sell in order to obtain final return through the transaction means. Quantitative investment has been developed for 30 years in western countries, and it's scale is still expanding. It is favored by more and more investors. With the rapid development of Internet technology, quantitative investment is spreading very fast in the world, and the quantitative investment is constantly improving and updating.

The development of quantitative investment in China can be divided into five stages. From 2010 to 2012, quantitative investment took root in China. Quantitative funds mainly through short-term quantitative futures trends and arbitrage strategy to gain income. And then, in 2012 and 2016, the alpha strategy for highly leveraged fundamental stocks became widespread. From 2016 to 2017, full-frequency quantitative futures trends and arbitrage strategies, especially those for commodity futures, provide a new way of thinking for the QF, from 2017 to 2018, and beyond 2018,

Alpha strategy and multi-strategy macro-rotation allocation strategy have become the mainstream of domestic quantitative investment. Overall, Chinese quantitative investment is entering the era of multi-strategy macro-dynamic allocation, and this strategy will better reflect the robustness of quantitative investment.

Until the end of 2017, the quantified hedge funds worldwide has reached $438 billion. In this background, Chinese quantifiable investment industry, which is still small, has plenty of room for growth in the future.

1.2 Advantages

1.2.1 Multiple asset allocation

This system will go through two steps when choosing a suitable portfolio for investors: general asset allocation and the specific optimization for each market.

The Markowitz model is used in general asset allocation to find the minimum risk under the condition of satisfying the investors' demand for return. In this way, the initial allocation of investors' assets has given an advantage to the investment strategy. In the specific optimization, the system will further seek the optimal solution of the investment results in each market according to the results of general asset allocation, so that the final portfolio performance will be better. At the same time, according to the different characteristics of different kinds of assets, the system adopts different schemes for different markets in order to ensure the accuracy and reliability of the results.

1.2.2 Risk Control based on Quantification timing

The stock market adopts the multi-factor model to carry on the analysis. On this basis, the project chooses the effective factor dynamically according to the industry, and adopts the modified conditional expectation factor timing (Modified HKQ model), and adjusts the factors' weight dynamically according to the exogenous variable, in order to make the model more suitable for the market state.

Meanwhile, this project uses phase index to establish timing model, makes short-term prediction through past data, generates buy or sell signals, and determines the opening or closing time. The traditional multi-factor model uses timing to adjust the position, which is in the condition of full position every moment, and can not choose the time for enter or leave, and the performance in the bear market is poor.

In addition, the commodity market has also formulated an effective timing strategy: under the guidance of technical surface analysis, combining the prediction of time series model and the

determination of definite demand, futures' price and the time of return is compared, and the dynamic adjustment is carried out. The system meets the needs of the customer, and achieves the expected goals as well, if unexpected, can also stop in time.

1.2.3 Machine learning for prediction(LSTM)

Commodity markets need to forecast the return of futures and spot goods for the next day.

In this market, we predict the yield of the futures and spot goods, combine the volatility and the correlation coefficient of the spot market and future market based on DCC-MIDAS model, and finally get the asset ratio of the two markets.

Here, we adopt LSTM time series (Long short-term memory neural network) model. LSTM model is a special case of RNN model, which solves the problem of gradient disappearance during long sequence training. Therefore, it is more suitable for long time series data. Although the time series data of finance are random, there is a certain autocorrelation, especially in the crude oil futures market in China. Such a market is not very mature, so that our time series model has a very good performance.

1.2.4 Data Mining Based on Citi API

Intelligent recommendation system is composed of API data mining module and cluster recommendation module.

API data mining module is a precursor module of cluster recommendation module.

Citibank provides APIs for users, where we finally get users' investment preferences through data mining combined with effective information from external markets. Citibank provides eight categories, namely, account, authorization, card, management, transfer, bonus, function and customer, with a total of thousands of modules. As for the first part, we conducted a screening of the API provided by Citibank according to the "management method for investors in securities and futures". In the end, we get four categories of liability account, asset account, stock investment and fund investment, with a total of 15 indicators.

We will select the indicators that can be used to measure users' investment tendency according to the "securities and futures investor appropriateness management method", and finally make three indicators according to specific rules: asset-liability ratio, stock investment risk preference index and fund investment risk preference index.

For the ratio of assets to liabilities, all the data comes from the user deposit and Citibank's API. However, for the stock investment risk preference index and the fund investment risk preference index, the yield and risk in the index are one of our evaluation of this stock, which comes from the

external sources. Some metrics can be called directly to the data interface of Wind or other websites. Because of the global market involved, we have adopted a web crawler scheme for indicators that do not have access to data interfaces.

1.2.5 Intelligent Recommendation Based on Clustering Algorithm

The logic of intelligent recommendation is to first cluster according to the API. Then the fuzzy requirements were selected according to the questionnaire. Finally, Sharpe ratio is sorted and the top three asset allocation schemes are recommended. Users in the use of the process of our asset management platform sometimes do not know your current investment inclination, or the current market does not make a good judgment. Thus we introduced the intelligent recommendation system, in the tendency of some very accord with the user's investment in the asset allocation plan, refer to the user to fill in the questionnaire of indicators, intelligent, recommend some excellent market performance portfolio to the user.

1.2.6 Application of DCC-MIDAS model

The DCC-MIDAS model is used to estimate the dynamic correlation between crude oil futures and spot in commodity market. The volatility component in the GARCH model is used to replace the fixed component in the traditional DCC model, and the long-term correlation is added to the data sample of mixing frequency through the GARCH-MIDAS model. The DCC-MIDAS model can dynamically depict the correlation between two markets and improve the effectiveness of the estimation and eliminate the bias of the estimation. At the same time, the empirical study of DCC-MIDAS model combining the characteristics of dynamic conditions and mixed frequency data is in the initial stage in China, and this project is a pioneer in the market.

2. Strategy

2.1 Investment Demand Confirmation

2.1.1 Fuzzy requirements

We obtain the fuzzy requirements of users through questionnaires.

We comprehensively consider the needs of users from four aspects: income demand, liquid demand, actual risk tolerance and mental risk tolerance through the aspects of age, income, economic composition, consumption concept, investment philosophy, investment experience, investment

period and knowledge reserve. In the questionnaire, five options are set for each topic, corresponding to five different types of investors, which are conservative, stable, balanced, growing, and aggressive.

By weighting the expected return and expected volatility of different types of investors according to different market average returns, CPI index and other indicators and combining the answers of different options selected by users in the questionnaire, the unique expected return and expected volatility of each user can be calculated, and then through the follow-up model. The allocation of assets is scientific, effective, concise and direct.

In addition, for our recommended expected volatility and expected rate of return, users can also re-test according to their own needs, so that the system can be better met the user's needs.

2.1.2 Clear requirements

Considering that users are ordinary investors, in order to maintain the zero threshold of software, what the users need to fill in should be simple, easy to understand, and in a small number. Therefore, the project believes that the data required by users should be controlled within five.

For investment, the amount of investment is an indispensable item. At the same time, it is necessary for users to know the estimated investment time in order to close position in time and not hinder the liquidity of the user's assets.

In order to describe user's investment preference from return and risk, the project selects two indicators of expected rate of return and volatility, and calculates recommended return and fluctuations for users according to the "investment preference and risk assessment form" that the user has previously filled in which can be the user's reference.

2.2 Asset Allocation

2.2.1 An introduction of Assets Allocation

I. How to classify assets?

After the classification of assets is completed, they should have the following characteristics:

(1) All the Assets of the same class should have things in common;

(2) Different types of assets must have significantly different characters of investment;

(3) The same asset cannot be attributed to multiple major asset classes;

(4) After classification, the total value of all the major assets should cover most of the world's investable assets;

(5) Any investor's large allocation to any one of these assets will not cause the liquidity of such assets to dry up.

Generally, the major assets are divided into four major categories: stocks, debts, commodities, and cash.

II. What is assets allocation?

Asset allocation is an investment decision-making system that combines quantitative and qualitative knowledge. Whether theoretically or practically speaking, asset allocation needs to use the knowledge of statistics, finance and economics.

Specifically, asset allocations focus on how to invest in a certain type of asset, rather than a particular investment choice. Therefore, in our system, the meaning of studying assets allocation is to help investors to determine how to allocate their funds on different kinds of assets after they determine the total amount of funds they can use for investment, and their requirements for risks, benefits and the expected investment period. In other words, determine the proportion of investment in various types of assets. After assets allocation, we continue to optimize the selection in each market and finally provide a specific investment portfolio.

Generally speaking, asset allocation is a systematic process that includes five main procedures: setting investment objectives, strategic asset allocation (SAA), tactical asset allocation (TAA), rebalancing, and performance review and adjustment:

(1) Setting the investment target is the beginning of assets allocation, which includes the income target and the risk target;

(2) Achieving investment objectives requires following certain investment strategies strictly, including strategic asset allocation (SAA) and tactical asset allocation (TAA). The strategic asset allocation determines the target allocation ratio of different type of assets in the long-term (usually more than 5 years). Once the SAA ratio is determined, it will not be adjusted in the short term;

(3) Tactical asset allocation focuses on capturing short-term investment opportunities in the market (ranging from a few months to a year). The adjust the allocation ratio according to the tactical asset allocation can facilitate seizing the short-term investment opportunities in time;

(4) Rebalancing is a very important part of assets allocation, which can help to achieve the seemingly impossible effect that reducing the volatility of portfolios and increasing the combined rate of return simultaneously;

(5) The final step in asset allocation is the performance review and adjustment.

III. Characteristics of asset allocation

Asset allocation helps to find the portfolio having the minimum risk with the same desired return rate, which is achieved mainly through “decentralization” and “rebalancing”. Decentralization is the core of asset allocation, which may need to sacrifice revenue to reduce risk. Meanwhile,

rebalancing operations may greatly reduce risks without sacrificing revenue, and even increase risk while reducing risks, just like “free lunch”.

(1) Asset allocation helps to get a better Sharpe ratio.

We choose the simplest 60/40 model as the representative to illustrate this characteristic of asset allocation. In this model, only two types of assets are taken into consideration: stocks and bonds, in which we use the Shanghai-Shenzhen 300 Index and the China Treasury Total Wealth (Total Value) Index to reflect the performance of stock and bonds respectively.

Investors invest 60% of their funds to bonds and 40% to stocks. Considering volatility and yields are generally higher for stocks, we can seek a better return at an acceptable risk in this way. A lot of literature shows that this simple strategy has a better result than just invest in a single type of asset. It increases the Sharpe ratio significantly, because of diversification of risk.

(2) Decentralization is the core of asset allocation, but it is often need to sacrifice revenue to reduce risk.

Decentralization is the core of asset allocation. In the process of large-scale asset allocation, the SAA process is used to obtain a more decentralized configuration ratio. In SAA process, the adopted models and SAA configuration ratio may vary according to the input parameters, but the core remains the same—to achieve dispersion in some extent. If the dispersion cannot be achieved, the risk will be excessively concentrated on a certain type of asset. Once the asset has a large loss, the yield of the entire portfolio will be greatly adversely affected. The reason that decentralization can reduce risk is that the correlation ratio among different categories of assets is relatively low. If the correlation ratio among different categories of assets is high, this dispersion is of little significance.

Decentralization tends to reduce risk at the expense of some benefits. Stocks have the highest yields but great risks; bonds have low risk, but yields are also low, so decentralized portfolios (without rebalancing) have return and risk characteristics between stocks and bonds.

Also taking the 60/40 model of stock and debt as an example, when compared with the single portfolio of stock, the compound annualized return rate is 5.36%, which has been reduced by about 1 percentage point; however, the volatility of the investment portfolio is 19%, which is greatly reduced. The percentage of the largest retracement of the portfolio is 60%, and it is reduced by 12 percentage points. It can be concluded from these data that a simple decentralized investment may bring the expense of a small portion of the benefits, but it can significantly reduce the risk.

(3) Rebalancing reduces risk while increasing revenue.

Rebalancing operations can significantly reduce risk without sacrificing revenue, and can even increase revenue while reducing risk. In general, revenue is directly proportional to risk, but rebalancing may increase risk while reducing risk.

Still taking the 60/40 model of stock and bond as an example, the portfolio which is re-balanced every 6 months has the annual returning rate of 7.48%, compared with the portfolio without rebalance operation, there is an increase of 2 percentage points; The volatility index of it is 17%, showing a decrease of 2 percentage points compared with the portfolio without rebalance operation; the maximum retracement was 47%, which represents a decrease of 13 percentage points when compared with the portfolio without rebalance operation. In conclusion, the return and risk characteristics of the portfolio that performs the rebalancing operation are both better than the portfolios' performance without the rebalance operation.

When it comes to the comparison of the performance of a single asset and rebalanced portfolio, we here take the portfolio that only includes stocks to explain our point. The portfolio rebalanced in every 6 months has a yield that is even more than one percentage point higher than the stock yield, and the risk is also significantly reduced, which means that the return and risk characteristics of the portfolio for rebalancing operations is more preferable than just focus on the stock market. The same case holds for bonds.

2.2.2 The scope of asset allocation

When determining the scope of asset allocation, we further analyze the four markets divided in 2.1.1 to determine the broad category of assets considered in our system. For the stock market, it can be subdivided into A-shares (that is, stocks that are generally investable in the Mainland China), US stocks and Hong Kong stocks.

As the way of trading of US stocks and Hong Kong stocks are still not very convenient, it is difficult for ordinary investors to invest in these markets. So only the A-share market is considered as the investable market in our system. For the bond market, it can also be subdivided into overseas bonds and domestic bonds. For reasons similar to stocks, our system only takes domestic bonds into consideration.

Investment in commodity markets is mainly through the futures market. As the production cost gets lower when the material price is lower, the profitability of enterprise will increase, so there is a high probability of the stock price rises. Hence, the correlation between the futures market and the stock market and the bond market is quite weak, so the investment in the futures market can play a good hedging role. Considering that futures are related to different kinds of physical assets, and the price movements of various physical assets are affected by their own nature, if we consider the futures all together, the subsequent analysis may not be sufficiently targeted. To make our further analyses more significant, we focus on the crude oil futures, which is an important part in the futures market. As for cash assets, since the amount of fund investors input into our system is the amount that they intend to use for investment, this type of asset is no longer considered.

2.2.3 The logic of asset allocation

When investors using our system, they will get the opportunity to describe their own investment target rate of return and the maximum risk rate they can tolerate at the very beginning. When performing asset allocation, we first extract the expected return rate and the expected risks of stocks, bonds and commodities from their historical performance data. By combining the subjective requirements given by the users and the objective prediction information together, we can plan the amount of investment on each kind of asset. To complete this step, we mainly use the Markowitz model as the main frame. The reasons for adopting this model are explained as following:

(1) The Markowitz model is more quantitative than the series of models mentioned above, such as 60/40, risk parity, etc., and its guidance for asset allocation given to investors is more concrete and feasible;

(2) The Markowitz model comprehensively considers the risk and return, and the correlation between these major categories of assets. It can play the role of minimizing the risk while achieving given return, or maximizing the return while not exceeding the given risk.

(3) The Markowitz model has strong flexibility and can adjust its investment ratio in various major assets according to the needs of different investors, based on their requirements for the return rate, risk and investment years.

When using this model, we first find the expected rate of return and volatility in each market based on the historical data of representative assets in these markets. The Shanghai and Shenzhen 300 Index is used to represent the stock market. The NYMEX crude oil price index is selected for the crude oil futures. The bond market is divided into two subsets: corporate bonds and government bonds, represented by the CSI Corporate Bond Index and the CSI Credit Portfolio Index respectively.

Let w denotes the total investment amount, the investment amount invested in various assets is ω_1, ω_2..., and the expected return rate of these assets is $r_1, r_2 \cdots$, $r_i = \frac{1}{T}\sum_{t=1}^{T} u_{it}$, where u_{it} is the yield of the i-th asset in the t-year, derived from historical data. Then the overall expected rate of return $E(r) = \frac{\sum_{i=1}^{n} r_i \omega_i}{\omega}$. Correspondingly, the risk is represented by the covariance between different assets, which can be calculated by $\sigma_{ij} = \frac{1}{T-1}\sum_{t=1}^{T} (u_{it} - r_i)(u_{jt} - r_j)$, $\forall 1 \le i \le n, 1 \le t \le T$.

The expected rate of return entered by the investor is expressed in μ, so the model can be explained as the following statements:

$$Min\ \sigma_p^2 = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\omega_i\omega_j\sigma_{ij}}{\omega^2}$$

$$s.t.\ \begin{cases} \sum_{i=1}^{n}\frac{\omega_i r_i}{\omega} \geq \mu, \\ \sum_{i=1}^{n}\omega_i = \omega, \end{cases}$$

$$\omega_i \geq 0,\ i=1,2,\ldots n$$

Using computer to solve this problem and we get the result of asset allocation.

However, when the problem was solved, there may be cases where the expected rate of return of the investor cannot match the risk the investor can tolerate. In other words, to obtain the expected returning rate of the investor, the minimum risk predicted by our model based on historical data will exceed the tolerance of the investor. When this kind of situation occurs, the system will give the investor a reminder to let the investor choose whether to continue or not. If the investor chose to continue, then we carry out subsequent optimization procedure in each market based on the determined best asset allocation, in order to further optimize the final results to meet the investor's demand. Otherwise, investors are given an opportunity to adjust their target rate of return and risk rate.

2.2.4 Adjustment to asset allocation

After deciding the long-term strategy of asset allocation by the steps above, we must be aware of that there are lots of things that will change as time goes by. For instance, the amount of funds investors can use to invest, the investment ideas of these investors, or the performance of each market. Without doubt, these changes are likely influence the results of asset allocation, so that the pre-determined asset allocation scheme may no longer be the best solution under the current situation. Therefore, in some cases, we need to make some adjustments to the asset allocation plan. The main considerations are as follows:

I. Changes in investor's disposable funds

Investors are likely to change the amount of funds they can spend on investment in the process. For example, its partial investment target in a certain market expires (which brings new disposable funds to the investor), changes in the investor's personal financial status, and so on. In this case, it may be necessary to adjust the configuration of the asset class.

Adjustments are still based on the Markowitz model. We add parameters (a_i) to the model to represent the investment that already exists in a certain market, where a represents the total amount that has been used for investment before, so the model used for adjustment is expressed as following:

$$\min \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{(\omega_i + a_i)(\omega_j + a_j)}{(\omega + a)^2} \sigma_{ij},$$

$$s.t. \sum_{i=1}^{n} \frac{(\omega_i + a_i)}{\omega + a} r_i \geq \mu,$$

$$\sum_{i=1}^{n} \omega_i = \omega,$$

$$\omega_i \geq 0, \forall 1 \leq i \leq n$$

II. Changes in market conditions

According to changes in the market, strategic adjustments should also be made in due course. We mainly consider three situations that need our adjustment:

(1) Market trend monitoring. The rate of return and risk in each market certainly will change due to the differences in time, risk, public preferences, and so on. In order to provide investors with a more suitable investment strategy, the system will adjust the asset allocation strategy with the latest data at the end of each month, so that investors will not miss the possible investment opportunities.

(2) If a great risk predicted in a certain market, all funds will be withdrawn from that market. The specific approach is to set a risk or rate of interest warning line in each market, once the warning line is reached, we no longer suggest investing in the market.

(3) Policy changes may have an impact on market performance. This is mainly reflected in the consideration of EPU (Economic Policy Uncertainty), which will be further explained latter.

2.3 Stock Market Asset Allocation

2.3.1 Introduction to Multi-Factor Model

According to Barra's definition, style factors can be divided into nine categories: beta, momentum, size, earning yield, volatility, growth, value, leverage, and liquidity.

The basic principle of factor analysis is to think that factors and rates of return are related. For example, when a group of investors think that high X factor stocks are good investment targets, they will buy stocks with high X factors, resulting in the price of these stocks rising, and the effectiveness

of the X factor will also be reflected. Through the correlation test, the relationship between the factor and the rate of return can be analyzed, and the factors related to the rate of return can be obtained. On this basis, a multiple-factor model (MFM) is established to quantitatively characterize the linear relationship between the expected return on stocks and the factor payload (risk exposure) of stocks on each factor, as well as the factor yield of per unit factor payload (risk exposure). The Multi-Factor Model is a complete risk model based on the idea of the APT model.

General expression for Multi-Factor Model:

$$r_i = \sum_{k=1}^{K} X_{ik} * f_k + \mu_i:$$

In this formula,

X_{ik}: Factor i exposure on factor k,

f_k : The factor benefit of the factor k,

μ_i : Residual yield of stock i.

The advantage of the Multi-Factor Model is that it can synthesize multiple pieces of information (which are usually represented as factors), get the result of a stock pick, and be relatively stable and portable. The project is based on a Multi-Factor Model and combines quantitative timing to analyze the stock market.

2.3.2 Factor Processing

I. Outlier Processing

Before we can standardize data, we need to deal with outliers first. These values differ greatly from other data, and are likely to affect the correlation estimation results between factors and returns, and interfere with the correlation test. Because this project adopts regression method to build multi-factor model, outliers will also seriously affect the calculation of regression equation. Therefore, removing these outliers can eliminate the interference and enhance the accuracy of data analysis and the robustness of the model.

The outlier handling method used in this project is the MAD method. The Median Absolute Deviation (MAD), is a method to detect outliers by calculating the sum of distances between all the factors and the average. The processing logic is as follows:

The first step is to find out the median X_{median} of all factors.

The second step is to calculate the absolute deviation value $X_i - X_{median}$ of each factor and the median, so as to obtain the median σ of the absolute deviation value.

Finally, the parameter n is determined to determine the reasonable range $[X_{median} - n\sigma\ ,\ X_{median} + n\sigma]$, and the following adjustments are made for factor values outside the reasonable range:

$$X_I^{'} = \begin{cases} X_{median} + nMAD & if\ X_i > X_{median} + nMAD \\ X_{median} - nMAD & if\ X_i < X_{median} - nMAD \\ X_I\ if\ X_{median} - nMAD < X_i < X_{median} + nMAD \end{cases}$$

II. Data Standardization

Due to the different dimensions between different factors, the data difference is large, which will affect the reliability of the regression. In order to enable different indicators to be compared and regressed, the data needs to be standardized, and the z-score method is generally used to transform the data from dimensioned to dimensionless.

The specific treatment method is: z=(x-μ)/σ. In it, x is a specific fraction, μ is the mean, σ is the standard deviation, the original factor value is normalized, and more factor distribution information is retained.

III. Neutralization

When multi-factor weighting, there may be strong correlation between factors. If the correlation of factors is not treated, the combination may have repeated exposure to certain factors, thus affecting the long-term performance of the combination. When using these factors for stock selection, sometimes the selected stocks have some bias that we do not want to see because of the influence of other factors. For example, the P/B ratio will have a high correlation with the market value. If we use the P/B ratio that is not market-neutral, the results of the stock selection will be more concentrated. Therefore, before using these factors, neutralization is required to eliminate bias and unwanted effects in the factors.

The main method is to use regression to obtain a factor that is linearly independent of the risk factor, that is, by establishing a linear regression, the residual is extracted as a new factor after neutralization. The correlation between the neutralization factor and the risk factor after such treatment is strictly zero.

IV. Factor Orthogonal

In order to better deal with the correlation of factors, the ideal situation is that the performance of the combination remains basically unchanged when a factor with high correlation with existing factors is added.

In this project, the factor orthogonal method is used to linearly transform the factors to obtain a set of new factors. These new factors contain the characteristics of the original factors and have no

correlation with each other, that is, a set of mutually orthogonal factors. The essence is to rotate the original factor (through a series of linear transformations), and then obtain a set of new factors that are orthogonal to each other. The correlation between them is zero and the degree of interpretation of the benefit (i.e. the overall variance) is maintained. constant.

This project adopts symmetric orthogonality, and its advantages are:

(1) There is no need to provide an order of orthogonal factors, which is equal for each factor;

(2) It is only necessary to calculate the value of the factor on the cross section, and it is not necessary to rely on other historical data to determine the order of the factors orthogonal, nor the monthly yield data of the stock;

(3) In all orthogonal modes, the similarity between the matrix after symmetric orthogonality and the original matrix is the largest;

(4) The calculation efficiency is high, and the calculation time is also short when the number of factors is large.

2.3.3 Validity Test

Considering that the factors that are effective in different industries may be different; the values of the same stock are different in the different stock pools after the factor exposure; the same factor may have different stock picking ability in different industries, tthe system will test the effectiveness of the factor by industry. After that, the expected return of stocks will be calculated.

This project uses a sorting method to test the stock selection effectiveness of candidate factors. Specifically, for any one of the candidate factors and any industry, the size of the factor for each normal trading stock in the market is calculated at the beginning of the first month of the model formation period, and the stocks in the industry are sorted in ascending order. And divided into five groups, which are held until the end of the month. At the beginning of next month, the five groups are reconstructed in the same way and held until the end of the month. This is repeated every month until the end of the model formation.

After the combination is constructed, calculate the annualized compound income of the five combinations, the excess return relative to the performance benchmark, the probability of the high-yield combination outperform benchmark and the low-yield combination underperformed in different market conditions. To determine the validity of the stock selection factor, the following criteria were established:

(1) The annualized composite income of the combination of ordinal numbers from 1 to n should satisfy a certain ordering relationship, that is, the size of the combination factor should have a large correlation with the income. From a statistical point of view, the factor can significantly affect the expected income of the combination. Assuming that the annualized composite income of the

combination of the ordinal number i is x_i, then the absolute value of the correlation Abs(Corr(x_i,i)) between x_i and i should satisfy the following relationship:

Abs(Corr(x_i,i))≥Min Corr

In it, MinCorr is the minimum correlation threshold of the income and ordinal set by the model.

(2) The excess returns of the two extreme combinations with the ordinal number of 1 and n relative to the benchmark are AR_1 and AR_n, respectively. If $AR_1 > AR_n$ (the hypothesis indicates that the smaller the factor, the larger the benefit), then the two should meet the following condition:

AR_1>MinAR_{top}>0 and AR_n<MinAR_{bottom}<0

Conversely, if $AR_1 < AR_n$ (this assumption indicates the larger the factor, the smaller the benefit), then similar to the above inequality, the two should satisfy:

AR_n>MinAR_{top}>0 和AR_1<MinAR_{bottom}<0

Min and Min are the minimum excess return thresholds of the two extreme combinations respectively. Among the two combinations of the maximum and minimum guaranteed factors, one is the winner combination that clearly outperforms the market, and the other is the loser combination that clearly underperforms the market.

(3) In the two extreme combinations of the rise and fall or the whole model formation period, the ordinal number is 1 and 5, the combination of higher returns should be able to outperform the market with a higher probability, and the combination of lower returns can underperform the market with a high probability.

A factor that meets the above three conditions at least indicates that it has a better stock picking ability in the past period and can be used as an effective stock selection factor for further screening.

2.3.4 Factor Timing

By factoring the time, that is, the dynamic adjustment factor weighting weight, it can better adapt to the market changes and obtain better performance than the static weighted multi-factor combination. Therefore, after the factor yield vector is obtained by regressing the value of the effective factor of the t period of each industry and the stock return rate of the t+1 period, the project will adopt the factor timing based on the modified conditional expectation (Modified HKQ Model), and adopt the specific adjustment of factor yield. The HKQ model considers that there is a correlation between

factor returns and exogenous variables. When given the value of exogenous variables, the conditional expectation of factor returns can be solved.

The project selected a number of market trading variables (such as the price rise and fall of the Shanghai Stock Exchange 50 in past 20 trading days) and macro variables (such as CPI, PPI, etc.) as selected exogenous variables. Similar to the processing of factor data, the values of exogenous variables also require outlier processing and standardization.

Because in actual investment, it is impossible for investors to add all exogenous variables to the model. Adding too many exogenous variables does not necessarily lead to better results, and it will produce over-fitting in the sample. Therefore, this project screens exogenous variables based on the AICc method (corrected AIC), which encourages the goodness of data fitting and avoids large over-fitting when the sample window length T is small.

$$AICc = T \bullet \log[|\sum_{|V}|] + 2N \bullet K + \frac{2K \bullet (K+1)}{T-K-1}$$

T is the sample window length, N is the number of factors, K is the number of exogenous variables, $\sum_{|v}$ is the covariance matrix of factor returns.

$\sum_{|v} = \sum_{RR} - \sum_{\Delta\Delta}$, $\sum_{\Delta\Delta} = \sum_{RV} \bullet \sum_{VV}^{-1} \bullet \sum_{VR}$ is the correction for the covariance matrix.

Based on the AIC_C calculation formula, we can filter the external variables at the end of each month by the following steps:

(1) At initialization, the optimal exogenous variable set S_0 is empty, and the initial AIC_C value is $AIC_C = T \bullet \log[|\sum_{RR}|]$;

(2) For each exogenous variable k, calculate the AIC_C value after adding it to S_i;

(3) If the lowest AIC_C in step (2) is lower than the existing $AICc_i$, jump to step (4); otherwise, the step ends, and the current optimal exogenous variable set S_i is the screening result;

(4) Add the exogenous variable k with the lowest AIC_C to S_i, ie $S_{i+1} = S_i \cup \{k\}$, update $AICc_{i+1}$ to the AIC_C value after using the S_{i+1} model;

(5) Continue to perform step (2).

It is assumed that the factor returns and the exogenous variables satisfy the joint normal distribution. On this basis, the conditional expectation of the factor returns can be calculated according to the value v of the current exogenous variable:

$$R_{|V} = \overline{R} + \Delta R$$

In it, $\Delta R = \sum_{RV} \bullet \sum_{VV}^{-1} \bullet (v - \overline{V})$ is the correction for the income,

The conditional expected mean value after screening by AIC_C is used as the factor weight to obtain the comprehensive ranking of the stock market.

2.3.5 Adjust Asset Allocation Model according to EPU

As the A-share market is highly disruptive to the policy, the project introduces an Economic Policy Uncertainty (EPU) index to simulate policy factors to correct the model. TThe EPU index is based mainly on ten authoritative national newspapers and monthly statistics of articles containing three terms related to "economy", "uncertainty" and "policy" (e.g. deficit, constitution, etc.). Since the length of an article varies with newspaper or time, the number of articles in the same newspaper in a month is used as a statistic. The statistic is then standardized using the standard deviation from 1985 to 2018, and ten newspapers were averaged on a monthly basis. Finally, the resulting data is normalized so that the mean for 1985-2018 is 100. The specific operations are as follows:

(1) The construction variable X_{it} is used as the EPU frequency of the newspaper i (i = 1, 2, ..., 10) in the t-th month. And select two time ranges T_1 and T_2, respectively representing the time range of standardized calculation and normalized calculation;

(2) Calculating the standard deviation σ_i of each newspaper i in the time range T_1;

(3) Let $Y_{it} = X_{it} / \sigma_i$ denote a standardized EPU index;

(4) Averaging the monthly Y_{it} to obtain the monthly average Z_t of 10 newspapers;

(5) Calculating the mean value M of Z_t in the time range T_2;

(6) Multiply Z_t by $(100/M)$ to get the normalized EPU index.

Studies have shown that the sensitivity of EPU is different, that is, the volatility of stocks in some industries is susceptible to EPU, and EPU does not have a significant correlation with stock returns.

Through the MIDAS regression model, the industry and its sensitivity that are susceptible to the EPU index are obtained. In the model of each period, the expected earnings of stocks in these industries will be adjusted based on the current EPU index. The specific adjustment strategy is: in the rise, according to the EPU index and sensitivity to the EPU to improve the stock expectations; in the fall, according to the EPU index and sensitivity to the EPU to reduce the stock expectations.

2.3.6 Short-Line Timing Based on Phase Indicators

The phase indicator is a short-term timing indicator. Based on the synchronization indicator, a leading indicator is constructed to judge the short-term fluctuations. Determine the bull and bear signal by judging whether this leading indicator has entered the inflection point. The phase indicator can well establish a short-term timing model. Combined with the multi-factor model, we can actively choose the time of buying and selling, and buy at the low price as much as possible, rather than passively in a fixed point of time to adjust positions, may cause certain losses. Through backtesting, the prediction accuracy rate of the phase index is more than 60%, which is more accurate and can obtain a stable income.

Because the multi-factor model has been used to predict the long-term trend, the phase index will be further controlled to reduce unwanted transactions, reduce transaction costs, but also can control the loss caused by prediction errors.

The daily closing price time series of each stock is modeled, and the modeling process of the phase index is mainly divided into seven steps:

(1) Initial data is denoised, resulting in a relatively smooth set of exponential time series.

(2) Remove long-term trends and retain the short-term fluctuation time series required for the study.

(3) Construct an in-phase orthogonal space by Hilbert transform.

(4) Calculate and process the instantaneous period of each moment.

(5) Fourier transform calculates the dynamic phase angle.

(6) Estimate the optimal phase delay within the sample.

(7) Determine the bull and bear signal according to the phase indicator.

2.3.7 Building an Asset Allocation Model

This project combines multi-factor model with short-term timing based on phase indicators. First, at some time during the running period of the model, for example, at the beginning of each month, the expected returns of all the stocks are obtained according to the multi-factor model described above, and the stocks are sorted accordingly, and the stocks with the highest probability of rising trend are

selected. In the cycle of a multi-factor model, combined with the phase indicators, these "quality stocks" are monitored, and bought at long-positions and sold at short-positions.

The combination of the two avoids the unpredictable volatility of the multi-factor model in the short-term market, and minimizes the losses caused by the inappropriate entry and exit timing. Moreover, since the stock selected by the multi-factor model has a high probability of rising trend in the long term, the loss caused by the prediction error of the phase index can be reduced.

2.3.8 Market Anomaly

Hindenburg Omen is one of the important methods used in the technical analysis of the stock market to predict that the trend will weaken or plummet. It believes that after the market is divided, it may fall sharply, and its applicability in the US stock market has been confirmed. Since A shares and US stocks have non-negligible differences, we now modify the judgment criteria of Hindenburg Omen by using the relevant degree of individual stocks relative to the market index to represent the market differentiation index of the US stocks.

Standard 1: The average of the 30-day trading rate of all stocks relative to the average $\overline{r^2}$ of the market index's return rate r^2 is used as an indicator to measure market convergence. The lower the value, the lower the convergence and the higher the differentiation.

Standard 2: Use the 50-day moving average of the market index as an indicator of whether the market is going well in the medium term.

Standard 3: Use the short-term 10-day moving average to determine whether the short-term market is in short-position.

When it is tested that there is an abnormality in the market, the investment in the stock market will be cleared, and the stock will not be invested in a short period of time to reduce losses, and the stock will be re-stocked after the market returns to normal.

2.4 Bond Market Asset Allocation

2.4.1 Investment Strategy

The system adopts the buy-and-hold strategy for the investment allocation of the bond market, that is, it purchases bonds whose maturity date is earlier than the end date of the client's investment and keeps them until the maturity and payment date to obtain bond interest income and principal for the following reasons:

(1) The return brought by this strategy is fixed, which is not affected by the changes in market conditions and effectively avoids price risks. It can be used as the fixed income part of the whole system to improve the stability of the whole system income.

(2) Selecting bonds through reasonable credit evaluation system and investment value system, and purchasing bonds with higher investment value can guarantee better investment effect.

(3) This investment strategy is simple to operate and is more suitable for bonds, which have less volatility and less liquidity. And because there is no buying and selling, the transaction costs and fees are low.

2.4.2 Credit Evaluation System

According to the classification of bonds, bonds can be divided into interest rate bonds and credit bonds. Interest rate bonds specifically refer to government bonds, local government bonds, government support agency bonds, etc. Credit debt refers to other types of bonds other than interest rate debt, including corporate bonds, corporate bonds, convertible bonds and so on. The main risk of different types of bonds is different. The main risk of interest rate bonds is the risk caused by interest rate changes. In addition to the risk brought by interest rate fluctuations, credit bonds are also faced with the credit risk of the issuer's credit deterioration and the inability to repay the bonds. Credit risk is the main risk of credit bonds. Therefore, for the investment of credit bonds, it is necessary to establish a reasonable credit evaluation system to avoid risks. This system establishes a risk evaluation model by combining the following representative indicators with the client's risk return preference.

(1) External credit rating:

At the time of transaction, the rating of the bond and the subject reflects to some extent the issuer's repayment ability, default risk level, financing risk level and other information. A higher rating reflects the issuer's advantages in terms of solvency, bond guarantee mechanism and bond liquidity.

Standard: divide the user into three levels according to the expected risk of the customer

Expected risk <=1%: select the latest triple-AAA rated bonds and join the investment bank.

1%< expected risk <5%: select debt rated AA+ and AAA and join the investment pool.

Expected risk >=5%: select the AA, AA+ and AAA bonds and join the investment bank.

(2) Corporate asset-liability ratio:

Balance of the debt to total debt issuers is the future, including short-term liabilities and long-term liabilities, such as bank loans and debt issuance of bonds and other way, reflects the company's capital credit and real credit situation, this system by asset-liability ratio as an index to measure enterprise debt balance, eliminate excessive debt bonds issued by the company.

Criteria: users are divided into two levels according to the expected risk of the customer

Expected risk >=5%: select asset-liability ratio <70% and join the investment bank

Expected risk <5%: select asset-liability ratio <65% and join the investment bank

(3) Enterprise cash flow ratio

Cash flow ratio = operating activities cash flows/current liabilities, said the current cash flow of business activities can meet the future maturing debt level within a year. If the ratio is less than 1 indicates that the current business activities generated cash flow is not enough to pay current debts, which needs further analysis enterprise's capital structure and analyzes the presence of excessive credit. This model uses the enterprise's cash flow ratio to measure the enterprise the management situation and debt solvency.

Criteria: select bonds with a cash flow ratio greater than 1 and add them to the database.

2.4.3 Investment Value System Model

When bonds enter the investment pool, we need to establish a model to evaluate the investment value of bonds, so as to select the most worthwhile bonds for allocation. In secondary trading market, independent and objective third-party bond valuation is not only conducive to enhancing bond liquidity, improving bond market stability, improving financial regulation accuracy and avoiding the black box of transactions, but also an important reference basis for the transaction price of each trader's bonds. In China's secondary trading market, according to the differences in the bond custodian and trading place, the current market mainly exists in the bond valuation, China securities valuation, Shanghai clearing house valuation, etc., all of which are important basis indicators for investment. Therefore, this model uses the valuation yield and valuation correction duration data of Shanghai clearing house, combining with the risk return preference of customers, grades and ranks the bonds in the investment database according to the weight, and selects the bonds with the best performance in interest rate bonds and credit bonds respectively for investment.

2.5 Commodity Market Asset Allocation

2.5.1 Configuration Ideas

The commodity market is all-encompassing, including futures, options, gold, infrastructure, etc. This project selects the combination of crude oil futures and crude oil spot of Shanghai International Energy Trading Center in March 2018. Although considering the method of arbitrage, this combination risk is small and easy to operate, the following methods can be applied to any futures spot portfolio, more universal and more relevant to the market. There are four steps in total.

In the first step, the expected yields of the crude oil spot market and the futures market are obtained based on the time series model.

In the second step, the correlation coefficient between the crude oil futures market and the crude oil spot market is calculated by the DCC-MIDAS model.

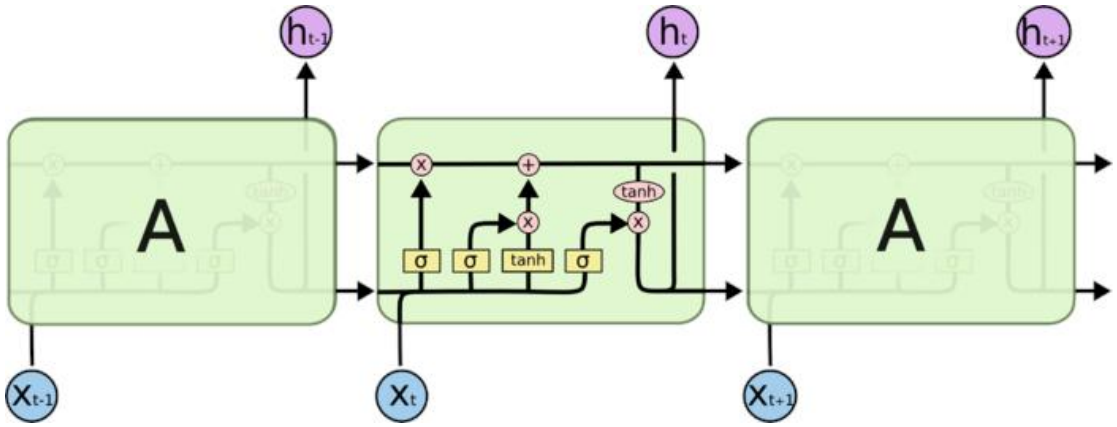
In the third step, according to the results of the large-scale asset allocation, the Markowitz model uses the historical volatility data to obtain the futures spot combination ratio with the lowest volatility.

The fourth step is to adjust the position according to the expected income, and to close the position in special circumstances.

At the same time, due to the high threshold of the futures market, this is the operation carried out in the case that the commodity market funds meet the entry threshold.

2.5.2 Forecast the rate of return using a time series model

This project uses the LSTM time series model to predict the price of spot and futures in commodity market. LSTM is a special variant RNN, while RNN is a neural network with repetitive chain modules. In RNN standard, this repeated structural module is just some neurons that record a single value, while in LSTM it is a structure consisting of input gates, forgetting gates, output gates, and so on.



Our model is a multi-layer LSTM, which is a superposition of LSTM. The advantage is that it can express features more abstractly at higher levels and reduce the number of neurons, increase recognition accuracy and reduce training time.

For the forecast of stocks, oil futures, spot, etc., we use the data of the past N days as the training set, and use the sliding window which is k days long and read the N-k+1 training data. For each training data of length k days, we treat the last day of the data as the prediction target, that is, the data of the kth day is predicted by using the previous k-1 days' data. Iterative training won't be ended until the model converges or reaches a certain number of rounds to obtain a predictive model.

In the forecast, we enter the first k-1 days of data into the model, and the model will output the price of the next kth day.

2.5.3 Introduction to DCC-MIDAS Model

Using DCC-MIDAS model to calculate the correlation coefficient between crude oil futures market and crude oil spot market, it is divided into two steps: model construction and parameter estimation. First build the model: Assume that the yield of the crude oil market spot (futures) on the i-th day of the t-month is $r_{i,t} = \mu + \sqrt{\tau_t \bullet g_i \xi_{i,t}}$, $\xi_{i,t} | \Phi_{i-1,t}$, $t \sim N(0,1)$.

In it, Φ is the set of all historical information of the day, and μ is the yield $r_{i,t}$= 100 · (log $P_{i,t}$ − log$P_{i,t-1}$) through the formula, P is the closing price, and the predicted value of the yield r under the previous t-1 day conditions. $g_{i,t}$ is the short-term part of the conditional variance, m is the long-term part, assuming g meets the GARCH(1,1) process, i.e. $g_{i,t} = (1 - \alpha - \beta) + \alpha \frac{(r_{i,t}-\mu)^2}{\tau_t}$;

α and β are constants, satisfying α+β<1, the value of Γ is fixed, and the MIDAS process description of the fluctuation is realized by a smooth curve, i.e. $\tau_t = m + \theta \sum_{k=1}^{K} \varphi_k(\omega) RV_{t-k}$, $RV_t = \sum_{j=1}^{N_t} r_{i,j}^2$;

Nt is the number of trading days in the t-th month, and θ is the parameter. X is an exogenous macro variable. The EPU index is brought into, so θ cannot be zero.

The weight function form is $\varphi_k(\omega_i) = \frac{(1-k/K_v)^{\omega_i - 1}}{\sum_{l=1}^{K_v}(1-l/K_v)^{\omega_i - 1}}$, $k = 1,2,\cdots,K_v$.

In it, K is the number of trading days in the smooth interval, which is 36.

Because log(m)=m+ $\theta \sum_{k=1}^{K_v} \varphi_k(\omega_i) X_{\tau-k}$ is an exogenous macroscopic variable, and the EPU index is brought into, so θ cannot be 0 .

The total conditional variance is $\sigma_{i,t}^2 = \tau_t \bullet g_{i,t}$.

The previous formula constructed the GARCH-MIDAS model, combined with the classic DCC model, to construct the DCC-MIDAS model as follows:

ε is the standard residual of the GARCH-MIDAS model, and the variance is represented by the ARMA model, taking GARCH(1,1):

$$\sigma_t = \alpha_0 + \varepsilon_{t-1}^2 \alpha_1 + \sigma_{t-1} \beta_1$$

$$q_{i,j,t} = \overline{\rho}_{i,j,t}(1-a-b) + a\xi_{i,t-1}\xi_{j,t-1} + bq_{i,j,t-1}$$

$$\overline{\rho}_{i,j,t} = \sum_{k=1}^{K_c^{ij}} \varphi_k(\omega_r^{ij})\, c_{i,j,t-1}$$

$$c_{i,j,t} = \frac{\sum_{k=t-N_c^{i,j}}^{t} \xi_{i,k}\xi_{j,k}}{\sqrt{\sum_{k=t-N_c^{i,j}}^{t} \xi_{i,k}^2}\sqrt{\sum_{k=t-N_c^{i,j}}^{t} \xi_{j,k}^2}}$$

K_c^{ij} is the lag order of historical correlation (time series), i corresponds to spot, and j corresponds to futures. $q_{i,j,t}$ is the short-term correlation between futures and spot, $\overline{\rho}_{i,j,t}$ is a long-term correlation component. a, b are parameters.

The answer is q.

For the parameters in the model, the univariate conditional wave model and the conditional correlation parameter are respectively listed as two vectors according to the historical data. The parameters in the GARCH-MIDAS are calculated first, and then the parameters in the DCC-MIDAS are calculated.

2.5.4 Closing Strategy

In financial futures trading, only a very small number of contracts expired for physical delivery, and most futures contracts are closed by doing opposite trading. Here, the relevance of the spot market is used, so the two markets trade at the same time, and the spot is sold at the same time as the futures are sold. The EPU index is used in the DCC-MIDAS model, and the uncertainty of economic policy is also considered, which makes the investment of this project safer. There are two situations that trigger a closing strategy: one is stop profit, the expected profit is reached, or the price reaches the target point. In the case of profit, the four situations will stop profit. (1) The current price fell below 95% of the previous high point. (2) The current price fell below the 10-day closing price average, which is below the average cost price. (3) In the case of already 10% yield, the trading volume of the day fell below the 10-day volume average. These three methods are technically analyzed and have a downward trend. (4) The price rises by 30% within ten days. On this basis, if there is still a certain degree of loss due to market abnormalities, etc., the stop loss strategy will be triggered. This is an extreme situation. Here, two methods of closing the stop price are considered. It is a capital stop loss and the other is a technical stop loss. The main consideration of the capital stop loss is to describe the customer's risk tolerance with the expected volatility obtained from the clear demand. The loss rate is greater than the expected volatility, and in order to ensure the safety of

funds, the liquidation will be closed. Technical stop loss is a technical analysis: if the futures price falls below the 10-day moving average, or if it has fallen below 5% (the settlement price fluctuation limit), the volume falls below the 10-day volume average, there is a jump empty trend, will stop loss.

2.6 In-depth Analysis

In-depth analysis is not only the view of the stock markets, bond markets and commodity markets, but also the view of the performance of the asset allocation. By displaying the market quotation our system, it shows the insights of various industries, as well as the comparison between the overall market prices and the performances of our asset allocation to achieve a degree of understanding of the market conditions. Through quantitative analysis of various types of investments, we diversify the portfolio and control the risk within the acceptable range to achieve the expected goal that getting stable capital gains. This system can also help the customers understand the dynamic real-time situation of the investment portfolio with the comparison under different market conditions and periods perfectly and the trend of data change conveniently. The comparison between our product and market details is offered, making it easy to understand and operate, helping customers observe the allocations and revenues. At the same time, this system helps to monitor the competitiveness of our product in the market and realize real-time optimization of the allocations.

2.6.1 Depth Analysis of Stock Market

The purpose of this module is to make users have a better understanding of the specific performances and characteristics of the stock part of the strategy which can be regarded as a fund through intuitive and clear charts. This module is divided into three parts: performance analysis, attribution analysis and scenario analysis. Seven types of charts are selected to describe the performance and characteristics of the fund in the past two years (2016-9-1 to 2018-6-1) making references for investments.

In the part of performance analysis, we use the Excessive Dynamic Retracement And Excessive Return chart to reflect, through this chart, users can clearly view the excessive return trend of the fund comparing with the benchmark, and the situation of the excessive return. This table compares the excessive cumulative rate of return, the monthly winning rate, the excessive maximum withdrawal rate with the benchmark hs300 index. Thus users can observe the excessive return and risk withdrawal of the fund.

In the attribution analysis section, we mainly analyze style attributions including Large-cap Growth, Large-cap Value, Mid-cap Growth, Mid-cap Value, Small-cap Growth and Small-cap Value and industry attributions which contain Periodic Upstream Index, Periodic Midstream Index,

Periodic Downstream Index, Major Financial Index, Consumer Index and TMT Index. We conducted a cluster of 28 Shenwan-1 Industry indexes and selected the above six categories of industries. In this section, we present three types of charts: Allocation-capability chart, Exposure-explanation chart, Preference-contribution chart.

In Allocation-capability chart, we use Industry Style Benchmark Income minus Market Benchmark Income to represent the contribution of Market timing which can be used to judge the income situation of the funds' industries, the income contribution of the funds' main industries. In order to measure the alpha in stock selection we use the fund return minus the style (industry) benchmark return to represent the selection-stock contribution. Cumulative Excessive Return is used to describe the cumulative effect of timing contribution of style (industry). It intuitively shows the trend of the dynamic style (industry) benchmark of the fund. The Cumulative Excessive return of the fund shows the cumulative effect of the style (industry) stock selection contribution and reflects the alpha's cumulative income of the stock. The Allocation- capability table also shows the winning rate and annualized return of timing and stock selection contribution.

The exposure chart is used mainly for classifying the Fund Style (Fund Industry), showing the exposure of the Fund Style (Fund Industry) in the past two years and judging the characteristics of the Fund Style (Fund Industry). The explanation table shows the stock holdings fitness of the Fund Style. Here we show it by adjusting R2.

Through Preference-contribution chart, users can learn about the preference of the Fund Style (Fund Industry) as well as the relative market overmatch / low match benefits in each style (industry).

In the scene analysis section, the classification of the style scene chart, the factor sensitivity analysis of volatility and the special scene analysis are presented.

The classification of the style scene chart can help users understand the risk-return index and main sources of fund returns under different conditions. The style scenes are divided into four conditions: stock market rising & large-cap rising, stock market rising & small-cap rising, stock market falling & large-cap rising and stock market falling & small-cap rising.

Special scene analysis focuses on the fund sensitivity towards volatility.

Special scene analysis shows the fund's income performance and risk control ability in each special situation. Here we have selected seven special periods, RMB joins SDR (2016/10/01-2016/11/30), chairman Liu's criticism of the phenomenon Hostile Takeover (2016/12/03-2016/12/30), the crash in GEM (2016/12/12-2017/01/17), 19 quotes (2017/05/05-2017/06/12), the release of the New Asset Management Regulation Draft (2017/11/17-2017/12/25), global financial turmoil and U.S. stocks slumping (2018/01/29-2018/02/09) and the trade war (2018/03/20-2018/04/09).

2.6.2 In-depth analysis of bond market

The in-depth analysis of the bond market is mainly divided into three parts. The form of chart enables users to have a deeper comprehension of the bond part of the generation strategy which can be regarded as a fund:

In the first part, the dynamic retracement and absolute return of the bonds are displayed to facilitate users to view the trend of absolute return and the retracement. The table compares the excessive cumulative rate of return, monthly winning rate and maximum excessive retracement rate of the fund with the hs300 to make users understand and observe the excessive rate of return compared with benchmark and risk retracement control of the fund intuitively.

The second part shows the risk exposure and duration measurement of the bonds. The table lists six indexes of the fund, including Credit Rating, Asset-liability Ratio, Cash Flow Ratio, Yield and Duration, Long-term Interest Rate and Short-term Interest Rate. It also measures the risk of the product with a distinctive perspective.

The third part is the special scene analysis table which divides the time of the product since its establishment into different periods according to special situations of the market. The list shows the income performance and withdrawal of the product in each special situation which reflects the historical risk control ability of the product. The special scenes selected in this part are: Black swan event in bond market (2016/11/04-2016/12/26), Brexit (2016/06/04), (2016/04/01-2016/06/03), Credit debts default (2016/04/01-2016/06/03), 811 Exchange rate reform (2015/08/11-2015/08/18), 19 quotes (2017/05/05-2017/06/12〉, the release of the New Asset Management Regulation Draft (2017/11/17-2017/12/25), global financial turmoil and U.S. stocks slumping (2018/01/29-2018/02/09) and the trade war (2018/03/20-2018/04/09).

2.6.3 In-depth Analysis of Commodity Market

This module helps users to have a more intuitive comprehension of the commodity market part of the strategy through the presentation of some charts.

The module of dynamic retracement and absolute income can help users observe the income of the portfolio through the display of relatively intuitive straight line graph. Meanwhile, it is compared with the benchmark (NHCI is adopted as the benchmark of commodities futures market, and the Southern Crude Oil Index is adopted as the benchmark of the international crude oil futures market).

In the part of scenario analysis, time is divided into four parts: strong trend fluctuation is weak, weak trend fluctuation is weak, strong trend fluctuation is strong and weak trend fluctuation is strong. The indexes of these four parts including Cycles, Range of weekly return rate, Volatility, Sharpe

ratio and Maximum Retracement Rate are shown in the form of table to help users understand multiple indexes of different periods and have a more comprehensive control of the information.

In the part of factor sensitivity analysis, the combination yield rate is used as the ordinate and volatility is used as the abscissa. Through linear fitting and curve fitting, the broken line graph is formed for display, so as to analyze the sensitivity of commodity portfolio to volatility.

The part of residual analysis shows the time sequence diagram of residual of return, the distribution diagram of residual of return, the skewness and kurtosis so that users can have a better understanding of the risks and benefits of the commodity portfolio.

The special scenario analysis table shows the income performance and risk control ability of the commodity in each special situation. We selected some special scenes after the launch of crude oil futures including The standard warehouse receipt transactions of the previous periods was officially launched (2018.5.28-2018.6.1), The unstable situation in the Middle East (2018.4.10-2018.4.20), China puts tariffs on American goods (2018.4.4-2018.4.11), The United States started the trade war again (2018.6.15-2018.6.30) and tariffs increase (2018.8.3-2018.8.10) for comparative analysis.

2.7 Intelligent Recommendation

2.7.1 API Data Mining Module

The intelligent recommendation system is composed of an API data mining module and a cluster recommendation module.

The API data mining module is a precursor module of the cluster recommendation module.

Citibank provides API for users. We use data mining in the API, combined with effective information from external markets, to ultimately get the user's investment preferences. Citibank provides eight categories which are accounts, authorizations, cards, management, transfers, points, functions, and customers, totaling thousands of modules. First, we will filter API provided by Citibank according to the “Administrative Measures for the Appropriateness of Securities and Futures Investors”. Finally, there are four categories of debt account categories, asset account categories, stock investment categories, and fund investment categories, for a total of 15 indicators.

Parameter	Category	Index	Variable
x_1	liability	loan account balance	Outstanding balance
x_2		credit card account summary	Outstanding balance
x_3		ready credit card accounting su	Outstanding balance

		mmary	
y_1	Asset	Call deposit account summary	Current balance
y_2		Time deposit account summary	Current balance
y_3		Original principle account	Current balance
y_4		Mutual fund account summary	Current balance
y_5		Securities brokerage account summary	Current balance
s_1	Security investment preference	Security	Stock Market Code
s_2		Security	Stock Code
s_3		Security	Investment Amount
s_4		Security	Average Unit Cost
t_1	Fund investment preference	MutualFund	Product Code
t_2		MutualFund	Net Asset Value Amount
t_3		MutualFund	Latest Price

According to the “Measures for the Appropriateness of Securities and Futures Investors”, we will filter the indicators that can be used to measure the user's investment propensity. According to the specific rules, we will finally make three indicators: asset-liability ratio, preference index of stock investment risk and preference index of fund investment risk .

$$\text{BalanceSheetRatios} = \sum_{i=1}^{3} x_i \Big/ \sum_{i=1}^{5} y_i$$

$$\text{StockRiskPreference} = \left(\sum_{i=1}^{n} r_i \big/ \sigma_i * q_i\right) \Big/ \sum_{i=1}^{n} q_i$$

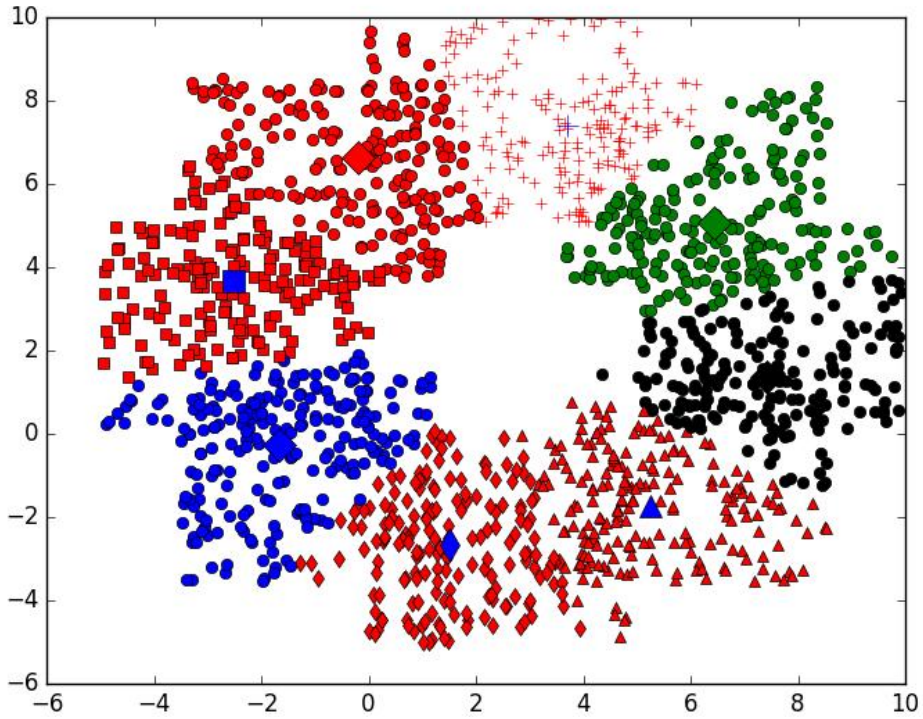
$$\text{MutualFundRiskPreference} = \left(\sum_{i=1}^{N} R_i \big/ \zeta_i * Q_i\right) \Big/ \sum_{i=1}^{N} Q_i$$

For the asset-liability ratio, its data all comes from the user's deposit in Citibank's API. However, for the preference index of stock investment risk and the preference index of fund investment risk , the rate of return and risk are our evaluations of this stock, which comes from the outside. Some indicators can directly call the data interface of Wind or other websites. As for the global market, we have adopted a web crawler for those indicators that cannot call the data interface.

2.7.2 Clustering recommendation module

First, each user is generated by the API as a data point in space. The LOF (Local Outlier Factor) algorithm is used to detect outliers (ie, outliers), and the special user data is eliminated to reduce the influence of outliers and isolated points on the clustering effect. Finally, the user is clustered using the improved Kmeans algorithm. The initial clustering center of the Kmeans algorithm is initialized by the Kmeans++ algorithm, that is, the points farther away are selected as the cluster centers.

The large icons in each group point in the figure below are the center points of each type, and the Kmeans algorithm optimizes the center point by iteration.



When making initial point selection, If n initial cluster centers have been selected (0 < n < K), then the point farther away from the current n cluster centers will have a higher probability of being selected as the N + 1th cluster centers. When selecting the first cluster center (n=1), the same method is adopted.

When optimizing, calculate which center point c belongs to each sample i

$$c^{(i)} := \arg\min_{j} \|x^{(i)} - \mu_j\|^2$$

Recalculate the center point for each class:

$$\mu_j := \frac{\sum_{i=1}^{m} 1\{c^{(i)} = j\} x^{(i)}}{\sum_{i=1}^{m} 1\{c^{(i)} = j\}}$$

This iteration to convergence.

Kmeans is a classic algorithm for solving clustering problems. The ultimate goal is to classify similar users into one class, so that in the final asset recommendation, those asset allocation schemes that differ greatly from the user's risk-reward preferences are not recommended. In the analysis of customer segmentation, the specific value of the data does not have much practical significance, and more importantly, the relative position.

As the number of users continues to increase, the center of the cluster will adjust accordingly. In other words, the Kmean++ model is constantly self-optimizing during use. In the end, people with the same risk appetite are divided into one category. In addition, the Kmeans algorithm is based on adequate consideration. On the one hand, it can converge faster; on the other hand, the Kmeans algorithm can be used for distributed computing. This highlight is crucial for commercial use.

3. Description of software technology

3.1. Technical detail

3.1.1 Summary

The system adopts the structure of separation of front and back, each of which runs independently and communicates through RESTful API. This is conducive to the parallel development of the front and back, which can improve efficiency and develop the web front-end while using PWA (Progressive Web App), a progressive web application completing the development of the mobile side.

3.1.2 Typescript、Python（programming language）

TypeScript is a free and open source programming language developed by Microsoft. It is a superset of JavaScript which essentially adds optional static types and class-based object-oriented programming to the language. TypeScript extends the syntax of JavaScript, so any existing JavaScript program that works under TypeScript without change is designed for the development of large applications. At compile time, it generates JavaScript to ensure compatibility. TypeScript

supports header files that add type information to existing JavaScript libraries, extending its benefits to popular libraries such as jQuery,MongoDB,Node.js and D3.js.

Python is an object-oriented interpreted computer programming language. Python is pure free software and the source code and interpreter CPython follow the GPL (GNU General Public License) protocol. Python syntax is clear, one of the features is the mandatory use of the whitespace (white space) as a statement indent. Python has a rich and powerful library, The ability to easily connect modules in other languages (especially C / C) into version 3.0 of Python, often called Python 3000, or Py3k. for short This is a big upgrade compared to earlier versions of Python. Python 3.0 was not designed to be down-compatible in order not to bring too much overhead.

3.1.3 Visual Studio Code、WebStorm、PyCharm（Integrated development environment IDE）

Visual Studio Code is a cross-platform source code editor for writing modern Web and cloud applications that runs on top of Mac OS Windows and Linux. Visual Studio Code provides developers with built-in support for multiple programming languages. These languages will also be provided with rich code completion and navigation capabilities. JavaScript type Node.js and ASP.NET 5 developers will also receive additional toolsets. The editor also integrates all the features that a modern editor should have, including syntax highlighting (syntax hight lighting), customizable hotkey bindings, (customizable keyboard bindings), braces matching (bracket matching), and code snippet collection (snippets).

WebStorm is a powerful HTML5/JavaScript Web front-end development tool owned by jetbrains. At present, JS developers in China have been praised as "Web front-end developer artifact", "the most powerful HTML5 editor", "the most intelligent JavaScript IDE" and so on. Homologous to IntelliJ IDEA, it inherits the functionality of the powerful JS part of IntelliJ IDEA.

PyCharm is a Python IDE, with a set of tools that can help users improve their efficiency when using the Python language, such as debugging, syntax highlighting Project management, code jumping, intelligent prompts, automatic completion, unit testing, version control. In addition, the IDE provides advanced features to support professional Web development under the flask framework.

3.1.4 React（Front-end view framework）

React is a JavaScript library for building user interfaces. Mainly used to build UI, with high performance, the code logic is very simple .React takes declarative paradigm, which can easily describe applications; through the simulation of DOM, the interaction with DOM is minimized; and it can work well with known libraries or frameworks. Using React to build components, the code can

be reused more easily, and it can be well applied in the development of large projects. The data stream of one-way response can be realized by .React, thus reducing the duplication of code.

3.1.5 SQLite、SQLAlchemy（database）

SQLite is a small, open source, embeddable, program driven, no data type, support for ACID transactions, efficient relational database. It is contained in a relatively small C library and is a public domain project established by D.RichardHipp. It supports mainstream operating systems such as Windows/Linux/Unix, and can be combined with many programming languages, such as Tcl,C#,PHP,Java and so on, and the ODBC interface. SQLite is an in-process library that is self-sufficient, serverless, zero configurable. Transactional SQL Database engine. It is a zero-configuration database and does not need to be configured in the system. The SQLite engine is not a separate process and can connect statically or dynamically to its storage files as required by the application.

SQLAlchemy is an open source software under the Python programming language. SQL toolkit and object-relational mapping (ORM) tool are provided. The MIT license is used to distribute .SQLAlchemy in a simple Python language, which is designed for efficient and high performance database access. The idea of implementing a complete enterprise persistence model. SQLAlchemy is that the order of magnitude and performance of SQL database is more important than object set, and the abstraction of object set is important to table and row. Therefore, SQL Alchmey adopts a data mapping model similar to Hibernate in Java, rather than the Active Record model used in other ORM frameworks. However, optional plug-ins such as Elixir and declarative allow users to use declarative syntax.

3.1.6 Swagger（Front and rear interface documentation tool）

Swagger is a canonical and complete framework for generating, describing, invoking, and visualizing RESTful-style Web services. The overall goal is to update the client and file system as servers at the same rate. File methods, parameters and models are tightly integrated into server-side code, allowing API to remain synchronized all the time. Swagger is a generic, programming language-independent API specification that runs through the entire API ecosystem, such as designing API, Writing API documentation, testing and deploying.

3.1.7 Git（Version control tool）

Git is an open source distributed version control system, which can effectively and quickly process from very small to very large project version management. Git is an open source version control software developed by Linus Torvalds to help manage the development of Linux kernel.

3.1.8 PWA（Progressive web application）

PWA (Progressive Web Apps, Progressive Web Application, launched by Google in 2015, has three main features: Reliable-even in an unstable network environment-dedicated to achieving a similar native app experience through web app. Also can load and display instantly; Fast-quick response and smooth animation; Engaging- can be added to the userundefineds home screen and don’t need to download apps to provide similar APP experience, and can also push notifications.

3.1.9 Technical summary

Web fore-end	
React	Front-end view framework
MobX	Web state management tool
Ant Design	UI component Library and Design language Foundation
TypeScript	programming language
Visual Studio Code/WebStorm	Integrated development environment (IDE)
NPM	Node package Management tool
Webpack	Front-end resource packaging and engineering management
Moving front end	
PWA	Progressive web application
After end	
Python 3	programming language
Flask	Web server program
SQLite	data base
SQLAlchemy	Integrating database and server programs
PyCharm	Integrated development environment (IDE)
Pip	Python package Management tool
Other tools	
Git	Multiplayer collaboration, version control tool
JWT	Authentication technology
Swagger	Front and rear interface documentation tool

3.2 Architecture Design

3.2.1 Case View

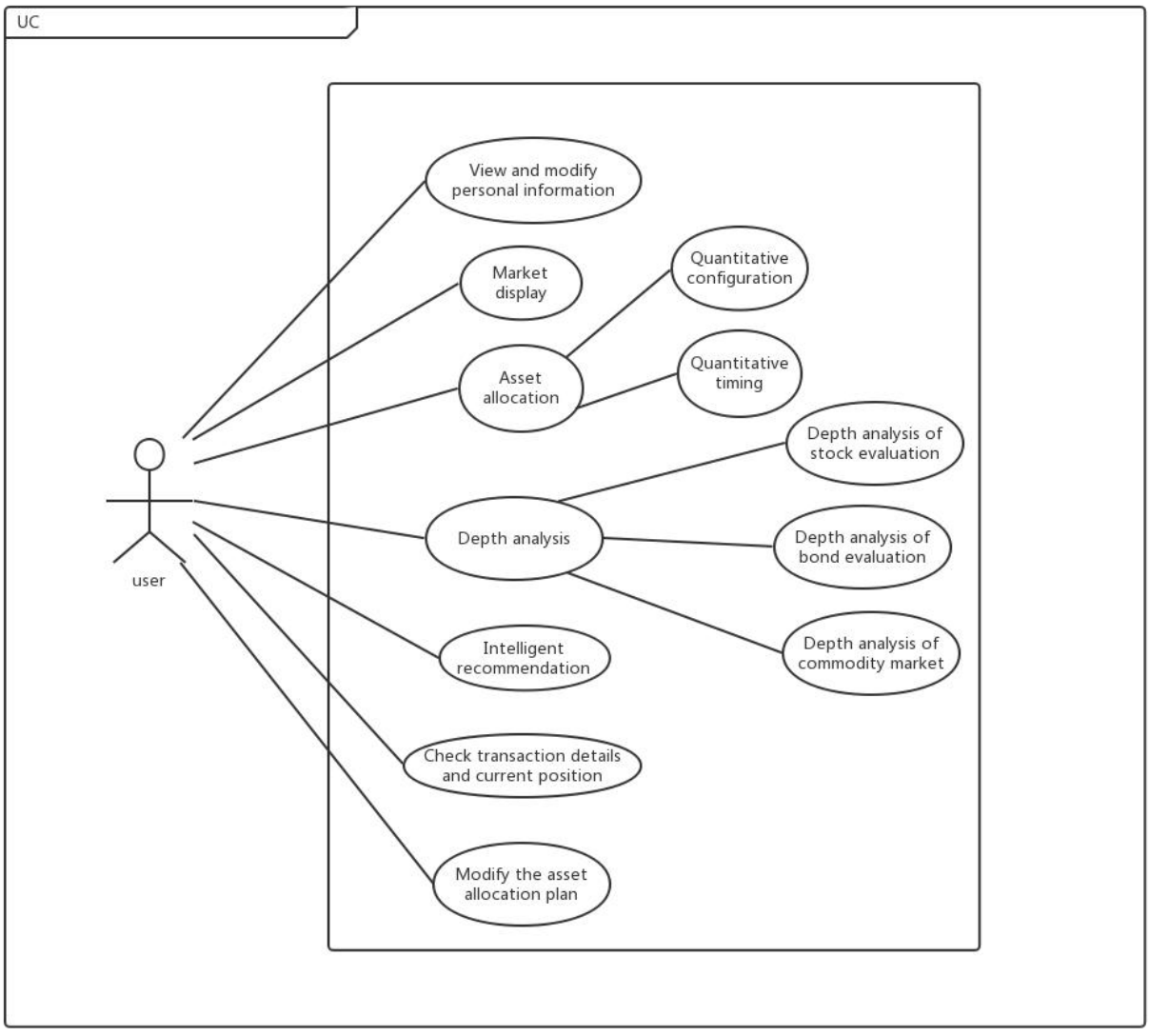


Figure 3.2.1-1 Case view

3.2.2 Logical View

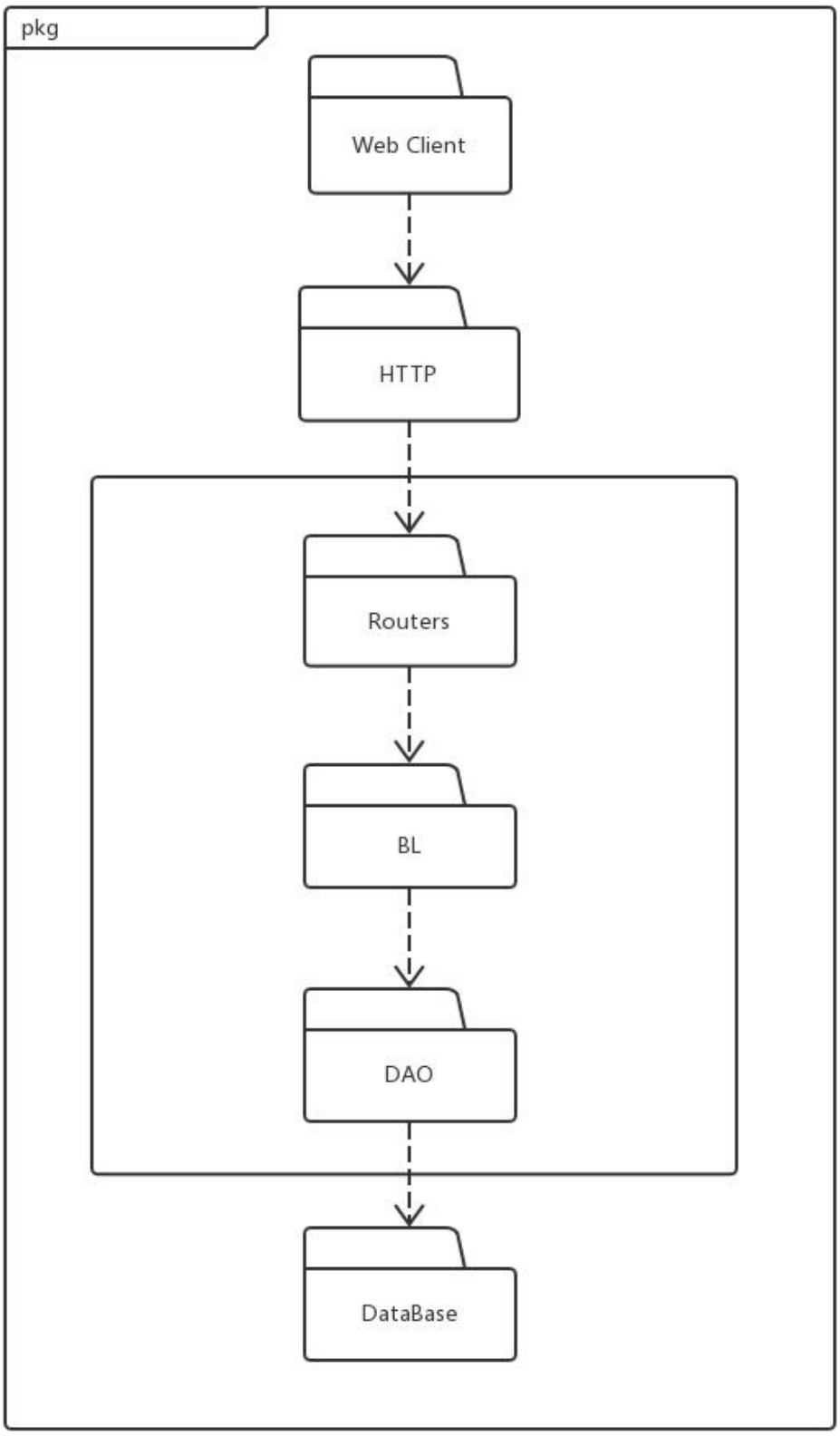


Figure 3.2.2-1 Logical view

3.2.3 Development View

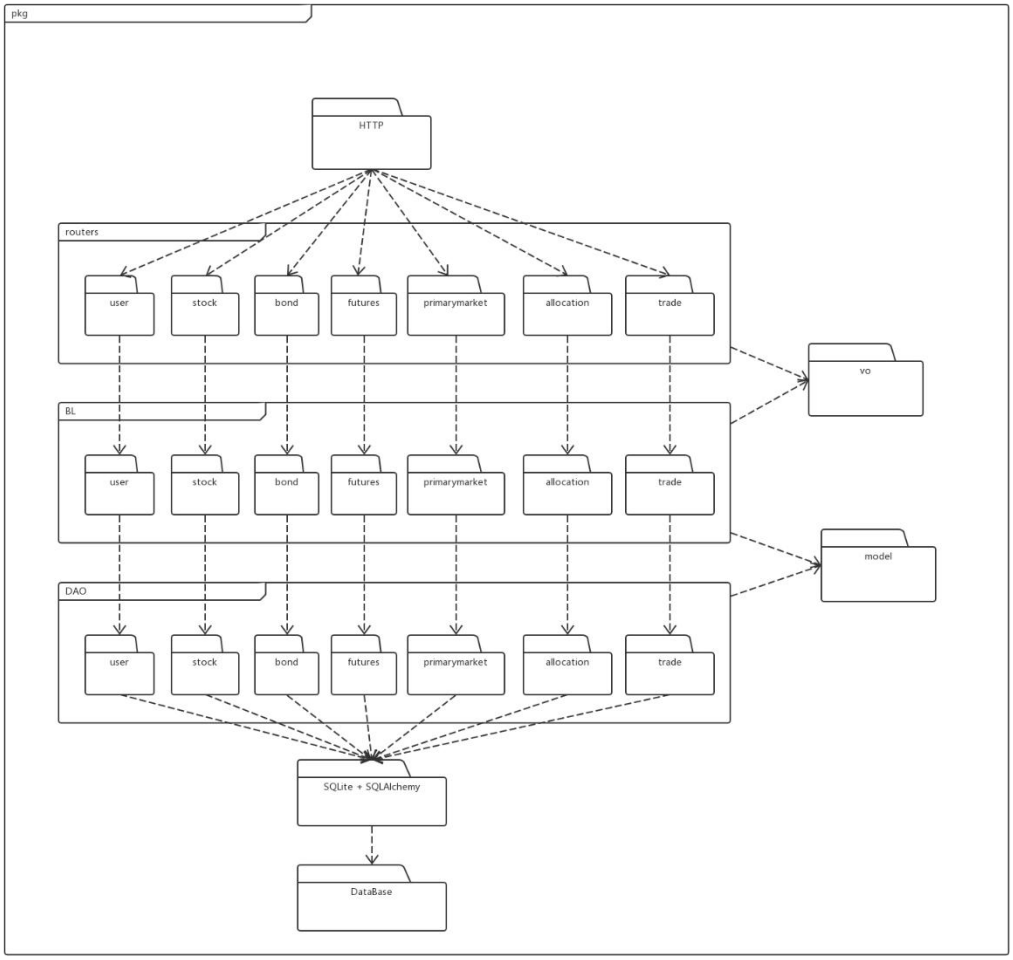


Figure 3.2.3-1 Development view

3.2.4 Process View

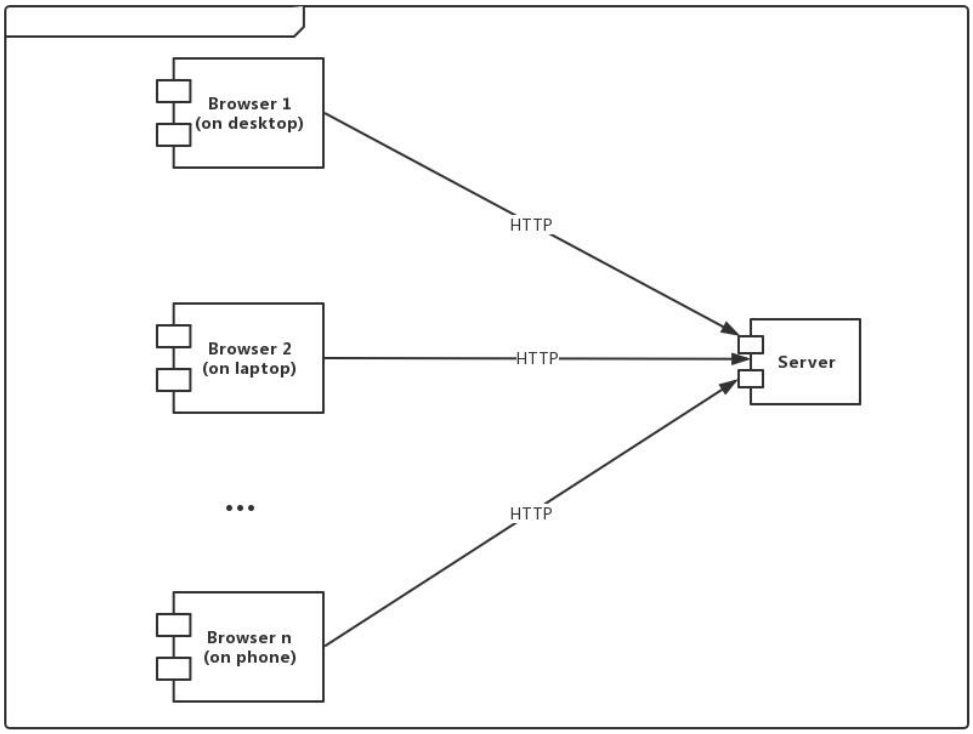


Figure 3.2.4-1 Process view

3.2.5 Deployment View

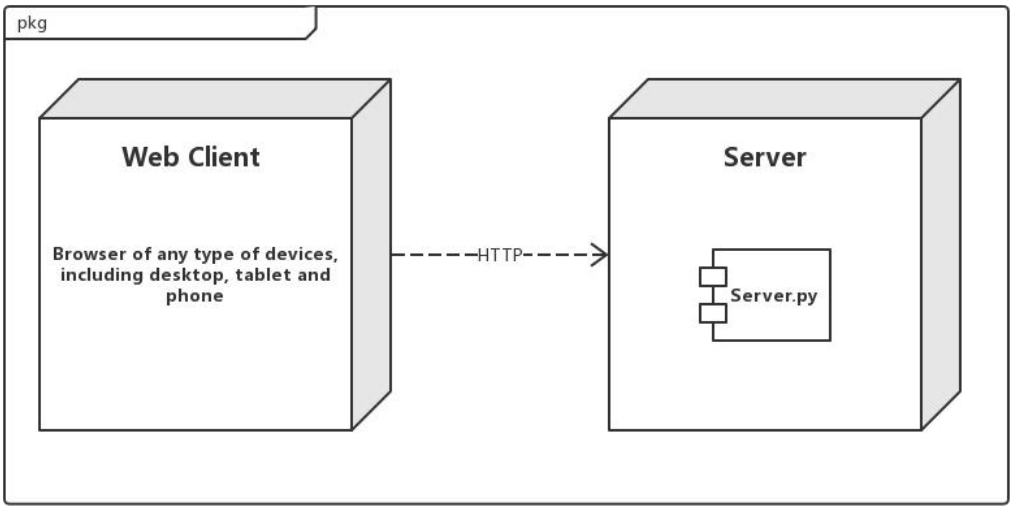


Figure 3.2.5-1 Deployment view

4. Product Introduction

4.1 Interface Display

AI-Fintech – An asset allocation system based on artificial intelligence is developed for ordinary investors. The goal of development is to provide investors with a comprehensive evaluation of the allocation of various assets, and provide portfolio and risk management based on investor preferences, aiming to obtain the maximum benefit from a multi-factor comprehensive consideration.

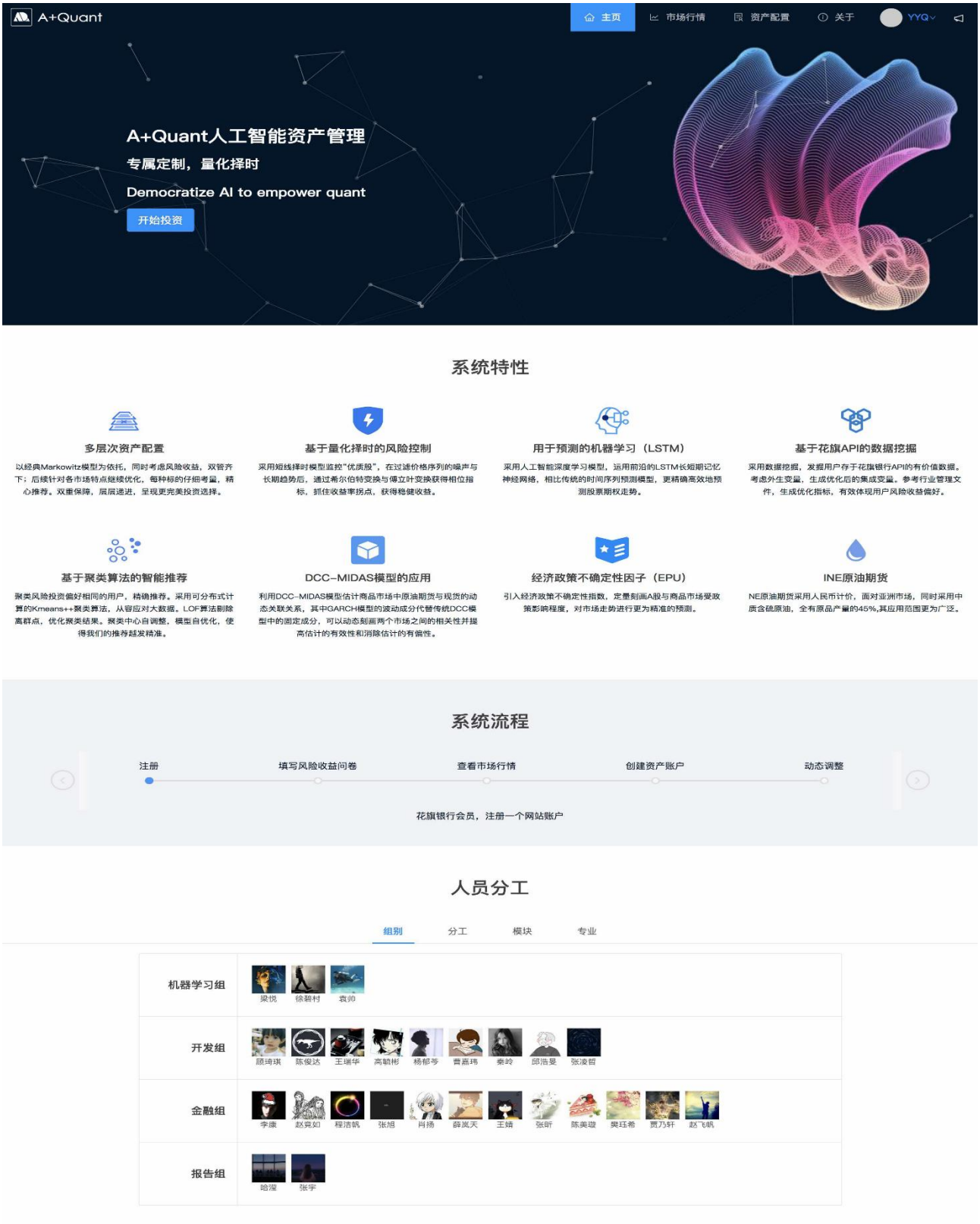
4.1.1 Register

Enter the required information in the text box on the right and follow the prompts to register to create an account.

4.1.2 Login

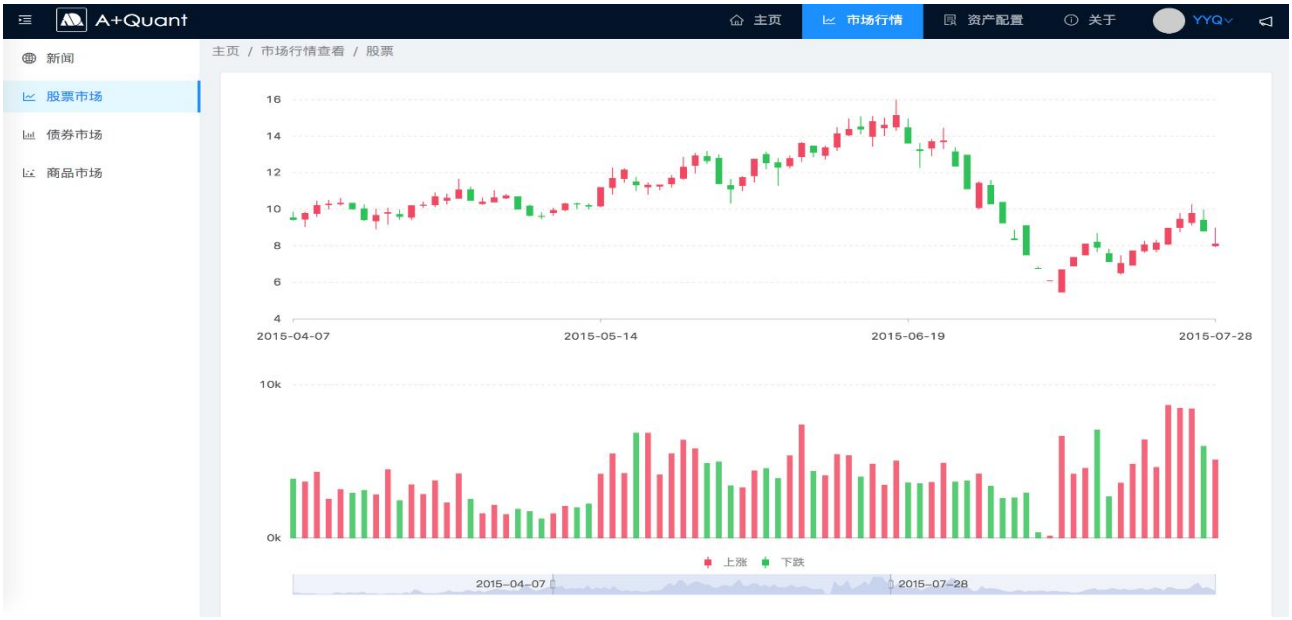
Log in using the account and password registered in 4.1.1.

4.1.3 Home



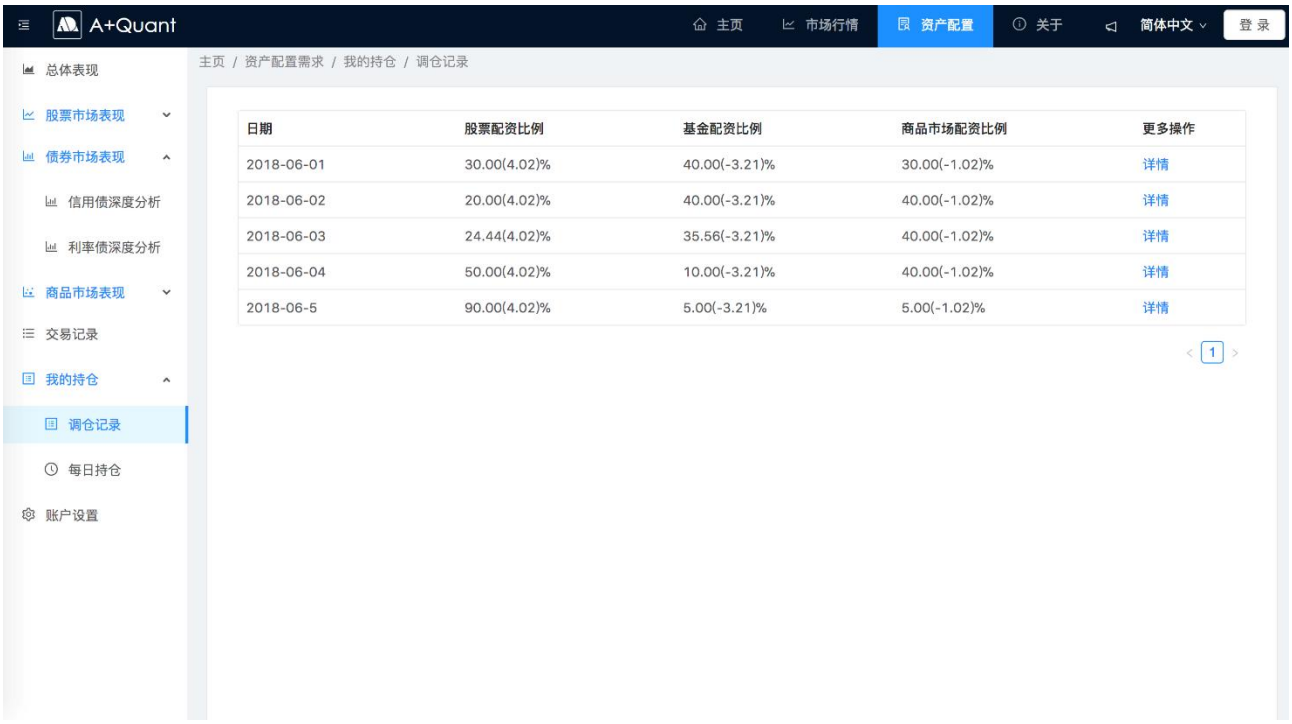
This page is the home page of the project, which mainly reflects the project advantages, project overview and the team management.

4.1.4 Analysis of Market



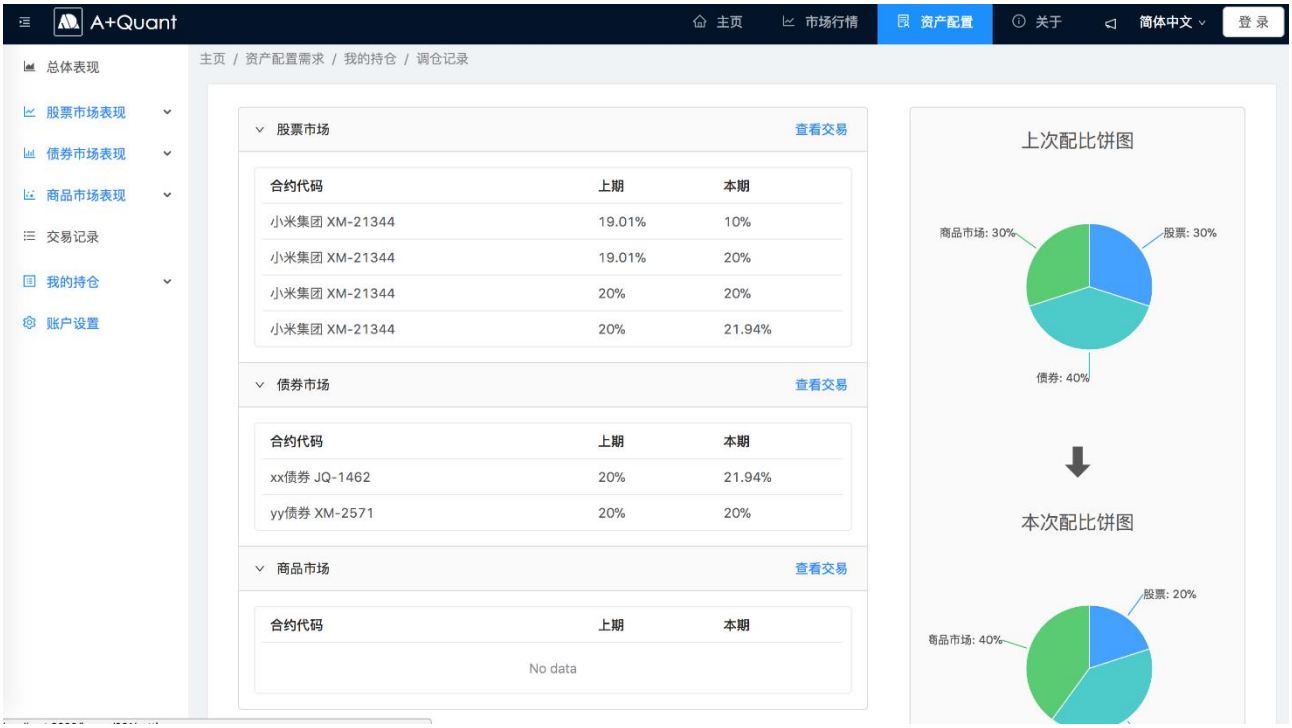
Users can use this module to deepen their understanding of the market before starting to allocate their assets (in the stock market, for example).

4.1.5 Position Record



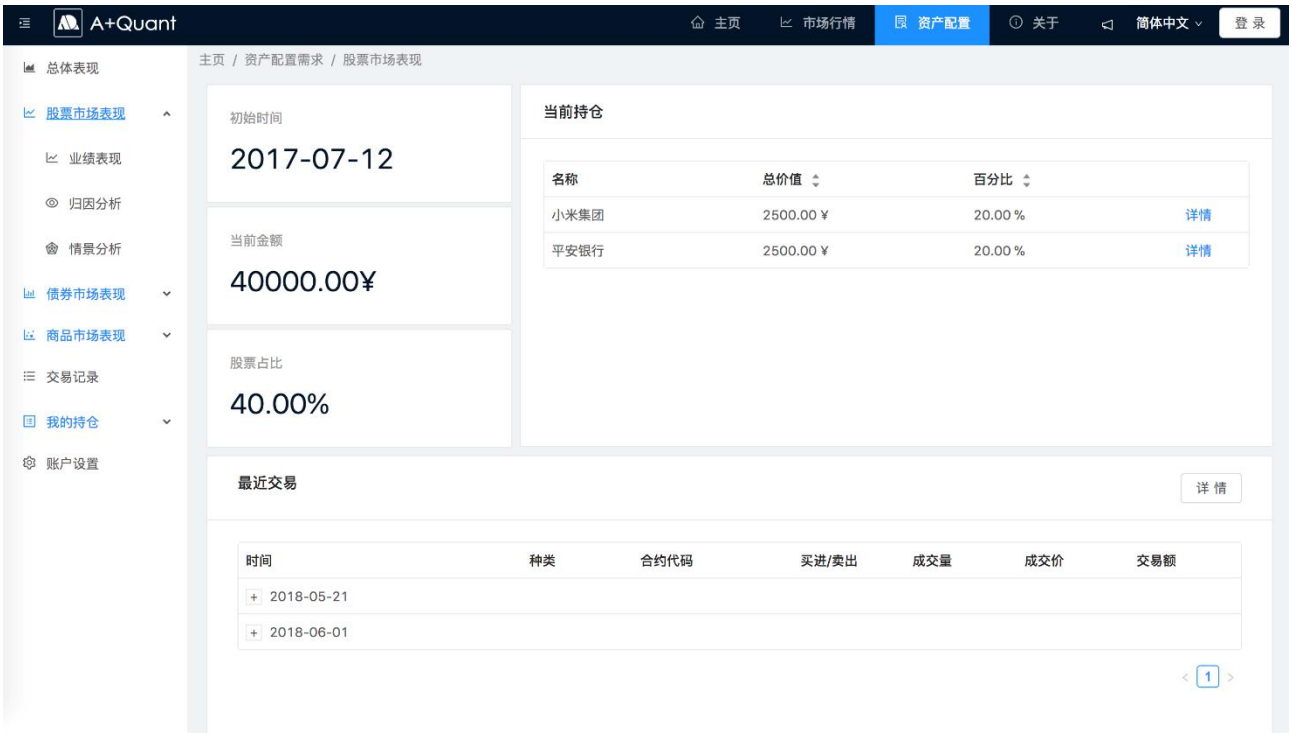
Users can enter the Home / Asset Allocation / My Position / Position Record to query all the position records for comparison, and click the details button at the far right of each item to view the details of the position record, which is shown in 4.1.10.

4.1.6 Position Comparison



Users can enter the Home / Asset Allocation / My Position / Position Record / Details to view the current and previous period positions (including detailed investment objectives and proportions) for comparison, and on the right there is a matching pie chart to assist visual comparison.

4.1.7 Stock Performance

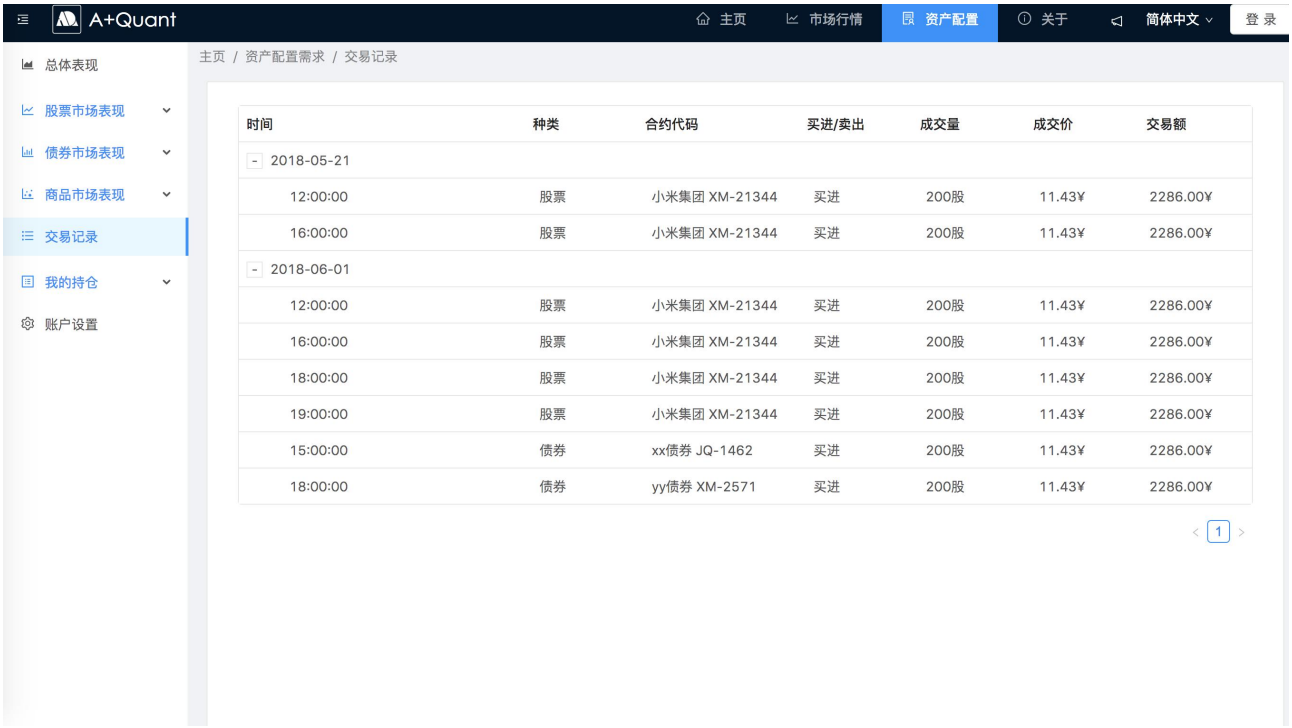


Users can enter the Home / Asset Allocation Requirement s/ Stock Market Performance to view detailed information about the investment in the stock market, such as the time of starting the investment, the current amount, the proportion of all investments, positions, and transaction records.

4.1.8 Stock Depth Analysis

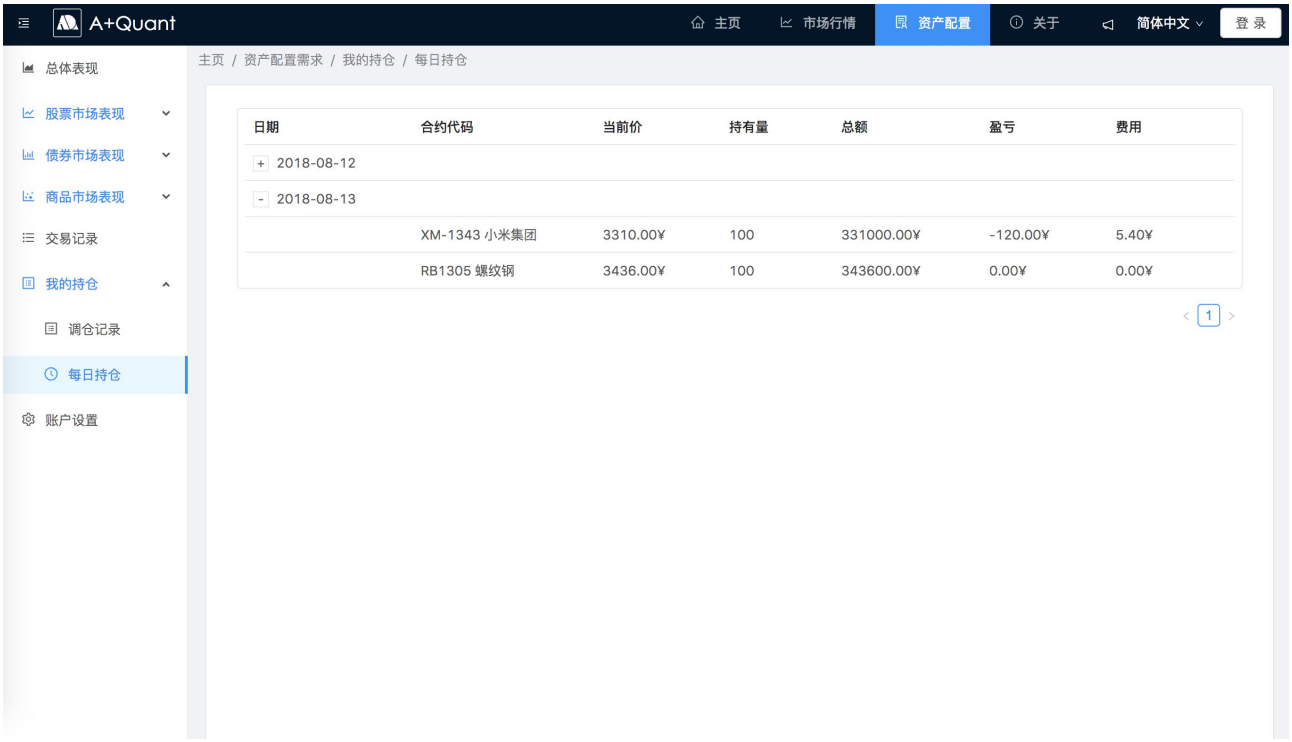
Access to the home page / asset allocation demand / stock market performance / performance analysis page allows you to view key information of all stocks invested in this asset account such as the name, number of cycles, cumulative rate of return, monthly winning rate, excess maximum withdrawal rate, etc. Above this, there is a visual chart for detailed comparison.

4.1.9 Transaction Record



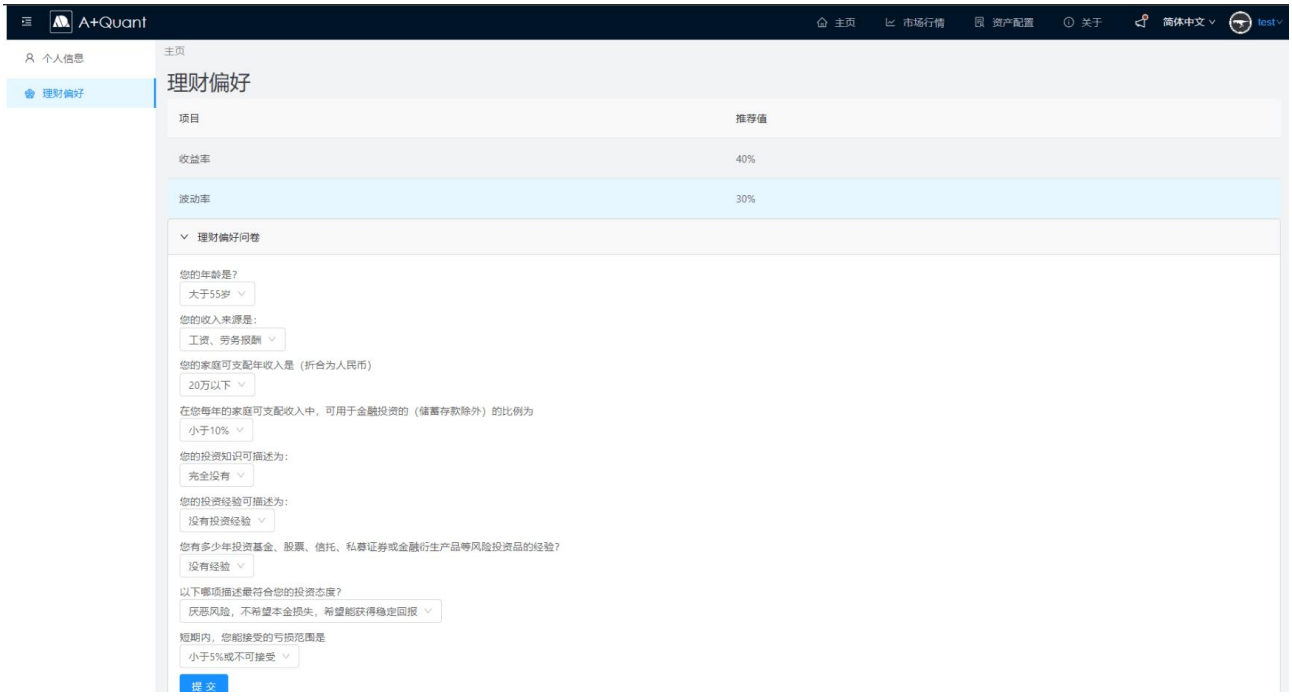
Access to the home page / asset allocation requirements / transaction records page allows users to view all records of investments in this asset account.

4.1.10 Daily Position



The user can view the position details of the asset account per day in the home page / asset allocation requirements / daily position page.

4.1.11 Fill out the Questionnaire to Get the Investment Demand



Users can go to the home page to find financial preferences and fill out a financial preference questionnaire to help the system correctly according to the personality of the user to determine the appropriate proportion of investment.

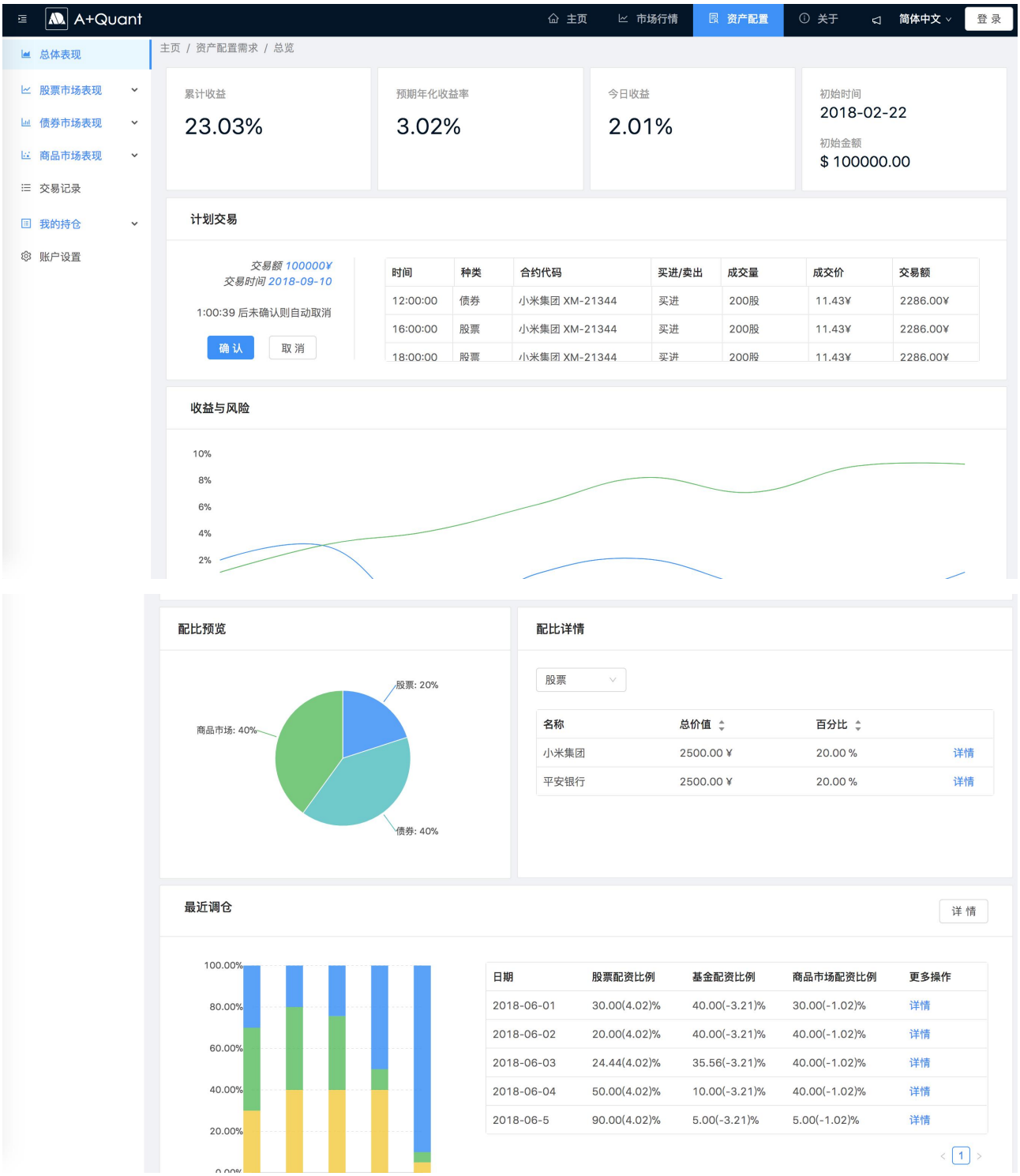
4.1.12 Bond Depth Analysis

Users can view quarterly information about credit debt on the home page / asset allocation requirements / credit debt depth analysis page, including stock price correction duration, asset-liability ratio, cash flow ratio, credit rating, And above there is a visual chart for detailed comparison.

4.1.13 Account Setting

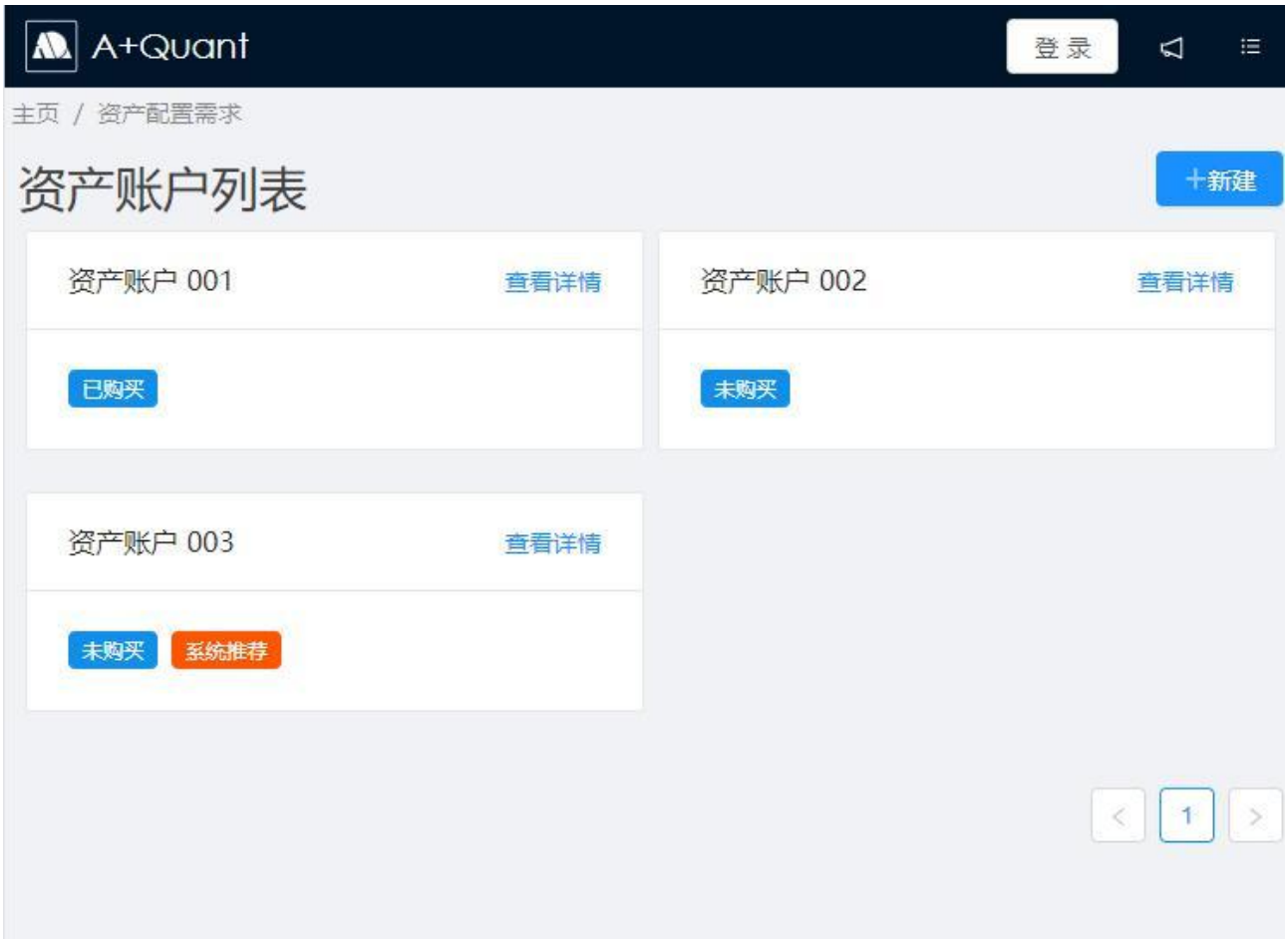
Access to the home page / asset allocation requirements / account setup interface allows users to modify the default operation for transactions, including default operations and alarm quotas when asset allocation will change.

4.1.14 Overall Performance



Access to the home page / asset allocation requirements / overview interface allows users to view their own resource allocation scenarios as well as earnings trends with other consolidated reports.

4.1.15 Assets Account



Users can create a new account here and view their own asset accounts. You can also configure new asset accounts here according to system recommendations. Users can first allocate good assets according to their own needs, but not necessarily buy on-the-spot which shows whether an asset account has been purchased.

4.1.16 Notification Center

The notification center displays the notifications sent by the system, which includes, for example, carrying out investment preference tests, adjusting positions, confirming to buy assets and recommending asset allocation. An integrated notification center will be more indirect and more user-friendly.

4.2 Risk Management

In the course of the operation of this platform, there may be systemic risks posed by unstable external factors that cannot be eliminated by diversified investment, and specific non-systemic risks associated with factors unrelated to financial market fluctuations, which can be mitigated by diversification. In systemic risk, we mainly discuss cyclical fluctuation risk of economy, exchange rate risk, political policy risk, purchasing power risk; in non-systematic risk, we mainly discuss default risk, moral hazard, product technology risk.

4.2.1 Systemic Risk

(1) Cyclical Fluctuation Risk of Economy

The market always keeps cyclical fluctuations, the overall economic situation is showing a certain volatility, and the profitability of various financial products also follows this cyclical fluctuation law. Although this is a circular movement and the project has made emergency plans for extreme cases, it is still difficult to understand the regularity of accuracy to a certain point. Our platform analyzes and confirms the asset allocation scheme based on large asset allocation, and it is inevitable to face the risk of cyclical economic fluctuations through factor timing.

(2) Exchange Rate Risk

Changes in exchange rates and interest rates both have impacts on prices. Interest rates are often used as an auxiliary tool for valuing financial products, that is, to discount future cash flows through interest rates. If interest rates change, bond prices then change. However, investment activities involving foreign markets generally need to use foreign currency to trade, and the change of exchange rate will inevitably bring about the change of portfolio income. Therefore, the exchange rate and interest rate have a great influence on the price and income of the portfolio. This project will effectively control this risk through a variety of dispersion methods.

(3) Purchasing Power Risk

The purchasing power factor is closely related to the interest rate factor. During the implementation of the investment scheme provided by the platform for users, the economic situation of inflation may be faced with, which makes the real income level of currency depreciation lower than expected. Inflation factors are inextricably tied up with the overall economic phenomenon and specific interest rate changes. We will enhance vigilance, improve the platform mechanism and properly deal with a series of systemic risks.

(4) Political Policy Risk

Because the large asset allocation covers many aspects of the financial field in China, it involves the supervision of different industries in the financial field of our country. However,

against this background, asset allocation business faces the difficulty of following different rules and regulations applied by different industries. Therefore, in the actual operation process, the legally permissible boundaries of the project may be difficult to define, and we may face certain legal risks. In order to avoid this risk, our team will consult professional legal practitioners, develop programs according to the corresponding national standard policies, avoid conflicts with national policies and related laws and regulations, and make full use of existing supportive laws to promote our own development.

At the same time, with the progress of the times, our country will often improve the policy. Therefore, for the team, there is a risk that future laws will make the previous treatment inappropriate. To avoid this risk, we will consult with legal counsel in related fields or seek professional advice from law firms.

4.2.1 Non-systemic Risk

(1) Default Risk

Default risk (i. e. credit risk) is asymmetric, cumulative, systemic, endogenous, and debt service is an important guarantee of investment income. However, the situation that bond issuers are not even able to repay their debt or repay it on time still exists, so we may be at risk of default, unable to take advantage of the good investment opportunities that we should have. In order to avoid this risk effectively, in the design process of the model, we pay close attention to the credit condition of the issuer, enrich the credit evaluation system, take the external credit rating, the enterprise asset-liability ratio, several representative indicators of cash flow ratio and customer preference to establish risk analysis model.

(2) Moral Hazard

In any market, the information content and information richness of buyers and sellers are not equal. For the sake of self-interest, the party with more information is likely to take advantage of the surplus information held for its own benefit and take some actions against others. This risk is related to someone's own moral accomplishment which is difficult to be precisely controlled. In addition to relying on the relevant national laws and industry norms, the project will also enhance its own risk awareness, and improve the platform risk mechanism, in order to better deal with the moral hazard caused by the information asymmetry.

(3) Product Technology Risk

Although both our platforms and technologies have great advantages and characteristics in the field of asset allocation, they have not yet passed the test of the market and haven't gained popularity in the market. Many investors may be skeptical about our platforms and technologies, exposing the project to product and technological risks. In order to enhance investors' understanding of the project

and enhance the trust about our system, we will make a concise and clear introduction to the platform in the process of publicity, which will bring our users a pleasant experience.

At the same time, in order to avoid the risk in technical level, which is the system failure in technical level, leading that the platform cannot run normally, and users cannot use the system, or the failure of configuration of hardware equipment on capacity, for example, which cause economic, spiritual and other losses to customer, as well as economic and reputation losses to the team. We will firstly keep learning in both theory and technology. Secondly, in the context of the continuous upgrading of the technological level of the whole society, we will also pay attention to updating the hardware and software so that the models, capacity, quantity, operation condition and handling capacity of the hardware equipment can adapt to the normal market transmission, transaction transfer needs, etc. It can deal with unexpected events effectively and timely, so that the efficiency of software operation, the speed and precision of market transmission and service processing can meet the needs of business.

5. Market Analysis

5.1 Market Environment Analysis

5.1.1 political environment

In March 2015, the Securities Regulatory Commission issued the account Management Business rules (draft for comments). It made detailed rules on business qualifications, business norms, internal control management, self-discipline management, and so on, which strengthened investors undefined confidence in standardizing the market and helped the capital management business releasing the positive signal to the popularity.

As an innovative asset allocation system, AI-Fintech provides users with individualized and scientific asset allocation scheme, which meets the requirements of regulatory authorities and conforms to the current trend. The project is based on personalized service, automation and maneuverability, perfect market analysis, three development objectives and reasonable hypothetical conditions, grasp economic feasibility, fully understand market demand and deeply analyze potential customers and competitive products. Based on the system support of large asset allocation and multi-factor analysis, it is feasible to give full play to the technical advantages and the ability of team members giving consideration to the user experience and to strictly abide by the legal norms.

5.1.2 Economic environment

In China in the past few years the interest rate market has seen a downward trend and the return rate of wealth management products is also getting lower and lower. At present, retail investors are in great need of relatively professional asset allocation services.

Because the A-share market is affected by the economy and the policy is interfered, we introduce the EPU index of economic policy uncertainty to simulate the policy factors to modify the model. In our country, we mean the news index. Specifically, selected large newspapers in China, through the search keywords to screen out the economic policy uncertainty related articles, after statistical and standardized processing to get the index. The research shows that the sensitivity of EPU is different, that is, the volatility of stocks in some industries is vulnerable to the influence of EPU, but EPU has no obvious correlation with stock yield.

In the model of stock market, the product will adjust the volatility of EPU index according to the expected return of the more sensitive industry stock by multi-factor model. In the commodity market, the EPU index is brought into the exogenous macro variable in the DCC-MIDAS model, and then the expected income target will be better realized.

5.1.3 Social environment

With the development of the Internet environment, the characteristics of traditional wealth management investment products with high cost and high investment starting point are no longer able to meet the investment needs of most users. In addition, the domestic credit risk exposure is accelerating, the asset shortage continues, and the single class of assets is increasingly difficult to meet the needs of many investors "medium and high returns, medium and low risk". At the same time, due to the general promotion of public financial investment awareness and knowledge, the individual investors of high net worth have gradually become mature and rational, with no longer blindly pursuing high returns, and gradually realized the importance of the allocation of large types of assets. In the current market environment, the real economy is under increased pressure, the return on various types of assets is declining, and the allocation of investors undefined assets is more difficult. The development of intelligent financial management can reduce the choice cost of investors, reduce investment risks, enrich investor fund choice at the same time and gradually train market medium and long-term investment strength.

The intelligent recommendation provided by this product can also greatly meet the personalized needs of today undefined consumers, clustering according to the characteristics of different users and then careful screening according to the users undefined own fuzzy needs. Finally, by calculating different ratio indexes to make a certain number of recommendations for users, ensure that the

recommended asset allocation scheme is optimal meeting the needs of investors and in line with the trend of the market.

5.1.4 Science and technology environment

It is difficult for traditional offline channels to integrate and analyze the geometric growth data. Through big data, cloud computing, in-depth learning in the field of digital asset allocation, it helps smart asset allocation products predict the behavior of users and make a figure in the financial market by handling the market and user information data.

This product is analyzed by multi-factor model. On this basis, the project chooses the effective factor dynamically according to the industry, and adopts the modified conditional expectation factor timing (Modified HKQ model), adjusts the factor weight dynamically according to the exogenous variable, in order to make the model more suitable for the market state.

At the same time, the traditional multi-factor model uses timing to adjust the position, which is in the condition of full position every time, and cannot choose when to enter, leave the market time. The performance in bear market is poor, but this project adopts phase index. According to the past market data to judge the future market state, establish the timing model and then decide when to close or open the position, which solves this problem very well and conforms to the evolution and demand of the scientific and technological environment.

5.2 Market entry Feasibility Analysis

5.2.1 Consumer demand

China's growing middle class has accumulated wealth that breeds huge demand for investment and asset management. The total number of middle classes in China was just 164 million in 2015, according to a report by Zhiyan Consulting. By 2030, that number is expected to double to 350 million. In addition, China current per capita GDP has crossed the important threshold of $8000, and there is a growing demand for investment management.

Young and middle-aged users, as the main force of investment finance, need to be solved urgently. According to Analysys 2017, the proportion of users aged 31 to 35 is the highest among all users, accounting for nearly half of the total number of users, accounting for 46% of the total number of users.

Therefore, among the individual investors in the financial management investment market in China, the investors who were born in the 1980s and 1990s have occupied a very large market in the middle income level of the society. These two groups have a high interest in and acceptance of

Internet financing, which coincides with the target users of AI-Fintech and their characteristics as an Internet financing platform.

The development trend of Internet financing in China is swift. The 42nd China Internet Network Development Statistics report released by the China Internet Network Information Center (CNNIC) shows that up to June 2018, the number of Internet users buying Internet financial products in China has reached 169 million. Compared with the end of 2017 growth of 30.9%, a high growth trend is shown. The usage rate of Internet users is 21.0 percent, with 4.3 percentage points higher than at the end of 2017.

At the same time, according to another report published by iResearch, "the White Paper on Internet financing after 8090 in 2018", nearly 80% of post-80s and post-90s users are the first wealth management products purchased through the Internet; Among these, 64.6 percent are still engaged in online wealth management, while 39.0 percent have the highest amount of money invested online. The breadth and height of the Internet wealth management products rank first, indicating their popularity among 80-and 90-year users. This also shows that the concept of online consulting and asset allocation scheme design conforms to the overall market trend and has a good market prospects.

According to the survey report on the status of individual investors issued by Shenzhen Stock Exchange and the survey report on the investment of individual fund investors issued by China Securities Investment Fund Industry Association, the main characteristics of the newly-entered individual investors in China financial management market in recent years are as follows:

(1) The basic situation of individual investors has remained stable as a whole. The majority of small and medium-sized investors, mostly men, aged 30 to 40, with bachelor degree or above and annual income below 150,000 yuan after tax, are still young and middle-aged.

(2) Most of the individual investors with financial assets ranging from 100,000 yuan to 500,000 Yuan account for less than 50% of the annual household income.

(3) While pursuing higher returns than bank deposits, attention should be paid to diversification of investment risks and pension savings, which focused on relatively stable investment.

(4) Internet is the most important source of investment information for investors. Personal computers are still the main medium of transactions, while mobile phones and other mobile terminals are becoming increasingly popular.

(5) Acknowledges the Internet financial products as a whole and holds the point that the Internet financial products should be easy to use, providing good user experience, many choices, high yield and low cost.

AI-Fintech's main target customer population is this kind of newly entered the financial management market who has the high net worth potential user and the demand for the risk dispersal. Intelligent asset allocation is still in the ascendant stage in China, although it has been developed for many years abroad. With the rapid development of information technology, the cost of financial services has been reduced accordingly. Because of the level of economic development, rising demand for investment and financial management at all levels increasing and other reasons, the target consumer market has great potential for the future. As emerging financial products widely accepted, AI-Fintech access to the market is highly feasible.

In addition, according to the "Research Report on Life Attitudes and Internet Financial Safety Behaviors of the New Middle Class in 2018" published by iResearch, simplicity and convenience are the primary reasons for attracting new users --- mainly the new middle class, whose support rate exceeds 72%. Secondly, more than half of the users choose the reason of high income and low threshold. AI-Fintech also conforms to this market trend and establishes a simple, easy-to-operate, easy-to-understand, high-quality, cost-effective asset allocation system to meet consumer needs.

5.3 Market Competition Analysis

5.3.1 Market Competition Environment Analysis

In analyzing the market competition environment A + Quant faces, we use Michael Porter's Five Forces Model to analyze the market competition it faces.

(1) Bargaining power of suppliers

For A + Quant, suppliers are mainly industry data acquisition organizations and cloud service companies that provide industry data and basic computing platforms. For the former, financial products, industry public opinion and other major data are mostly open to the public. For the latter, the development of cloud computing is rapid, and the number of market participants is large. In combination with the two, the bargaining power of suppliers is weak.

(2) Bargaining power of buyers

The users of our system include individual investors and institutional users. Individual investors have a high demand for this kind of platform, and the system will gradually gain the trust of individual investors. Such individual investors have weak bargaining power. Institutional users compete with each other, which brings them the middle position of bargaining power. AI-Fintech's unique integrity and innovation will further weaken the bargaining power of buyers.

(3) The threat of new entrants

Among the entrants, the original data and customer resources of financial institutions, the strong mesh capital chain of Internet companies, and the new financial platform similar to the system business brought about by technological advancement are likely to increase market competition pressure.

(4) Threat of substitutes

The advantage of A + Quant lies in the integrity of its system design and its scientific evaluation. It is highly forward-looking and has low threat of substitutes.

(5) Rivalry among existing competitors

At present, there are no strong institutions or platforms in the market of intelligent financial management software. Most of the intelligent financial products are managed by their own platforms, and their corresponding software or technical level needs to be verified. There are some mature softwares in China, such as MachineGene Investment of China Merchants Bank. Intelligent financial management tool of Harvest Fund and third-party software "Financial Cube", etc.. Each kind of these softwares is difficult to fully meet the user's personalized and diversified needs, but we does not rule out these softwares to develop in this direction. Fewer competitors participate in this market now, but we should be vigilant about the future development of the market.

5.3.2 Competition Analysis

The core of this project is the idea of asset allocation, which is comparable with the domestic robo-advisor system in asset allocation. At present, three main types of enterprises lay out robo-adviser market in China.

(1) Traditional financial institutions such as commercial banks, securities firms, fund companies, etc.

(2) Internet companies such as Alibaba, Jingdong, Tencent etc.

(3) Internet start-ups.

Contrastive competition	Strategy	Recent earnings	Advantages	Weaknesses
Machine Gene Investment (A+H share listed company)	According to the user's risk tolerance, join the investment time limit dimension and perform the combined configuration.	As of June 2018, the average yield since the beginning of this year was 2.98%.	(1) Add consideration of the investment time limit in the portfolio strategy; (2) The scale of purchase is broken by 10 billion yuan; (3) The first smart investment in the domestic banking	(1) The minimum investment amount is relatively high; (2) Take the black box strategy, the user does not know the system tuning logic; (3) Poor risk control.
Financial magic cube (Start-up company)	Match the portfolio around the basic principles of combined risk control and user risk customization.	As of June 2018, the average yield since this year was 2.60%.	(1) Adopt a semi-white box strategy, the user knows the triggering rules and characteristics of the trading strategy; (2) Have a complete asset tracking function; (3) Focus on fund optimization and portfolio risk control; (4) Have exclusive consultants and investment reports.	(1) The threshold of investment is relatively high; (2) For some users, the alert of transferring warehouse is too frequent.
Xuanji Robo-Advisor (Start-up company)	Considering market changes, effective frontiers, transaction costs and user risk preferences, provide a global asset allocation scheme.	As of June 2018, the average rate of return this year has been 3.50%.	(1) Have a dedicated investment advisor; (2) Focus on the allocation of domestic assets; (3) The risk matching questionnaire filled in at the beginning of the user's use is of high quality.	(1) It is easy to miss the profit opportunity when the market pulls back.

5.3.3 Product Competitiveness Analysis

This product has the following core advantages:

(1) Allocating assets according to the user's investment preferences, personalized asset portfolio recommendation.

Users choose the investment preference independently, and the system displays all the information of the asset allocation recommended according to the user's investment demand (expected income/risk). The system lists each asset (including cash assets), future expected income and risk estimation (the system gives specific information such as stocks and bonds to be invested in tabular form) by category. Also, this project provides the function of modifying the asset allocation combination, by which users can change their investment preferences and system-recommended asset allocation to achieve personalized allocation.

(2) Perfect multi-factor evaluation system, professional asset income and risk assessment.

This project selects multiple factors that affect the rate of return to constructs ATP multi-factor pricing model while it selects and evaluates factors through effectiveness test, time series model, data analysis and machine learning. According to the multi-factor model and factor theory, this system allocates various assets including stocks, bonds, commodities, and funds. The tracking of the portfolio and the real-time presentation of the data will help the user to understand the income situation at any time, as well as present the asset return situation and risk status in real time, helping the user to make professional judgments and choices.

(3) A variety of asset allocation combinations are available for selection, and factor timing is used to adjust asset allocation in real time.

The project will provide an investment system that allocates assets according to user needs, which uses factor strategies for market forecasting and asset allocation. On the basis of the processed factors, the appropriate factors are selected through the validity test, and the investment portfolio is configured through the multi-factor model, the investment strategy is formulated, and various asset allocation combinations are recommended according to the user's investment preference.

There are multiple channels for a portfolio or a parent fund to generate revenue. One way is finding factors or sub-strategies with higher average returns and making them as low-correlation as possible. Another possible way is using appropriate "factor timing" choose the appropriate factor to build the model according to macroeconomics and market conditions, and constantly adjust the weight of the factors, in order to make the model more suitable for the current market and to obtain revenue. The system uses the factor timing to adjust the recommended asset configuration in real time, bringing a more satisfactory asset allocation plan for the user.

(4) More comprehensive service and more user-friendly experience.

From market display to in-depth analysis, from user-defined investment preferences to system-recommended asset allocation portfolios, from real-time adjustment of asset allocation to future expected returns and risk estimates, this project provides customers with all the service functions that a financial advisory system should has. The system is simple to operate and easy to understand, providing customers with the best experience.

At the same time we use SWOT analysis to determine our strategy:

Internal ability / **External ability**	**Strengths**	**Weaknesses**
	a) Product integrity. b) Meet the needs of investors. c) Product design and market conditions are closely combined. d) Excellent R&D consultants and team members.	a) No market base, high barriers to entry. b) Limited R&D funding. c) Traditional financial institutions disperse some target customers. d) Small initial diffusion range.
Opportunities	**S-O Strategy**	**W-O Strategy**
a) Domestic "asset shortage" situation. b) National policies regulate industry conditions, guide, support, encourage innovation. c) Intelligent financial management is gradually accepted by investors. d) Citi Financial Innovation	✓ We should use our superior resources to publicize. ✓ Fight for venture capital fund. ✓ During the Citi cup, we will strive for financing through various exhibitions.	✓ Cooperate with some institutional enterprises to reduce entry barriers with their resources. ✓ Expand other user markets through cooperation. ✓ Take advantage of venture capital to further develop the market.

Application Competition Support.		
Threats	**S-T Strategy**	**W-T Strategy**
a) The team has no financial market entrepreneurial experience. b) More new competitors and fierce competition.	✓ During the R & D period, the members communicate with the consultant teachers to ensure the smooth solution of the problem. ✓ Design system based on market demand to improve product competitiveness.	✓ Borrow mentors and school resources to develop the market. ✓ Cooperate with many parties.

6. Financial Analysis

6.1 Profit Model

Target customers are individuals, organizations and institutions with asset allocation requirements.

The profit model for target customers is a free trial in the first three months, followed by a fixed service fee of $10 per month.

6.2 Estimation of Financial Position

According to the historical data of the industry and the statistical data of the relevant authoritative organizations in the past ten years, we make relevant financial estimates combined with mathematical methods such as statistics and practical experience.

In order to promote operation and collect user data, we adopt a free trial in the first three months, and then charge 10 yuan per month, which is conducive to better access to the market.

Revenue (Unit: Yuan)

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
From new users	250000	300000	400000	600000	800000
From old users	0	540000	1134000	1884600	2992140
Revenue	250000	840000	1534000	2484600	3792740

Note: The retention rate of old users is calculated according to 90%/year. Assuming that the probabilities of new users are the same and the conversion rate reaches 90% in each month, the growth rate of users will increase year by year, and there will be no Extra-Business income.

Cost of Sales (Unit: Yuan)

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
Raw Materials	100000	100000	100000	100000	100000
Service Costs	200000	220000	240000	260000	280000

Cost of Sales	300000	320000	340000	360000	380000

Note: in order to save costs, the salaries of start-up members remain at a low level.

The project requires a 2-core 4GB server and 10M bandwidth to transmit a large amount of data by renting a cloud server from a domestic giant. The cost of the server is 579 yuan a month, which means 6948 yuan a year, plus the cost of the Enterprise Edition data interface. Therefore, the raw material budget is 100000 yuan a year.

Sales Tax (calculated in 5% of the financial and insurance industry operating income)

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
Tax	12500	42000	76700	124230	189637

Selling & Distribution Expense

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
Salary	100000	110000	120000	130000	140000
Entertainment Expense	50000	50000	50000	50000	50000
Advertisement Expense	50000	50000	50000	50000	50000
Selling&Distribution Expense	200000	210000	220000	230000	240000

G&A Expense

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
Salary	200000	230000	260000	290000	320000
Employee Welfare	28000	32200	36400	40600	44800
Office Fee	10000	10000	10000	10000	10000
Travel Expense	20000	20000	20000	20000	20000
Depreciation	5000	5000	5000	5000	5000
Management costs	263000	297200	331400	365600	399800

Note: With the enlargement of the scale, the requirement for managers increases accordingly, so the salary of managers increases year by year. The initial fixed assets total value is 100,000 yuan with a 10-year service life, and the net residual value is 50,000 yuan. If the depreciation is calculated using the straight-line method, the annual depreciation is: (100000-50000)/10=5000 yuan.

6.3 Expected profit statement

Based on the above estimates, the profits and losses of the company in the next 5 years are as follows:

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
1.Revenue	250000	840000	1534000	2484600	3792740
Less: Cost of Sales	300000	320000	340000	360000	380000
Sales Tax	12500	42000	76700	124230	189637
2.Gross Profit	-62500	478000	1117300	2000370	3223103
Add: Other Operating Income	0	0	0	0	0
Less: Selling & Distribution Expense	200000	210000	220000	230000	240000

G&A Expense	263000	297200	331400	365600	399800
Finance Expense	0	0	0	0	0
3.Profit From Operation	-525500	-29200	565900	1404770	2583303
Add: Investment Income	0	0	0	0	0
Subsidy Income	0	0	0	0	0
Non-operating Income	0	0	0	0	0
Less: Non-operating Expense	0	0	0	0	0
4.Profit Before Tax	-525500	-29200	565900	1404770	2583303
Less: Income Tax	0	0	141475	351192.5	645825.75
5.Net Profit	0	0	424425	1053577.5	1937477.3

Note: The financial expenses are assumed to be 0, the income tax rate is 25%, and there are no non-operating income and expenses, no investment income and no subsidized income.

6.4 Cash flow estimation

The cash flow generated by the company's operating activities in the next five years is expected to be as follows:

	The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year
Cash from selling commodities or offering labor	250000	840000	1534000	2484600	3792740
Refund of tax and fee received	0	0	0	0	0

Other cash received related to operating activities	0	0	0	0	0
Cash Inflow Subtotal	250000	840000	1534000	2484600	3792740
Cash paid for commodities or labor	0	0	0	0	0
Cash paid to and for employees	428000	482200	536400	590600	644800
Taxes and fees paid	12500	42000	218175	475422.5	835462.8
Other cash paid related to operating activities	235000	235000	235000	235000	235000
Cash Outflow Subtotal	675500	759200	989575	1301022.5	1715262.8
Net Cash flow generated from operating activitie	-425500	80800	544425	1183577.5	2077477.3

6.5 Net present value of investment

Calculated based on the previous five-year cash flow situation:

$$\text{NPV} = \sum_{t=1}^{n} \frac{NFC}{(1+K)^t} - C, n = 5, k = 10\%$$

After calculation, NPV =2,406,076.77, greater than 0, so that the investment project is feasible (in the case of normal expected industry income).

6.6 Financial risk control

In order to control the risk, we assume that the income is reduced to x (percentage) of normal income while the related expenses and taxes are unchanged, the expected cash flow statement is as follows:

The 1st year	The 2nd year	The 3rd year	The 4th year	The 5th year

Cash from selling commodities or offering labor	250000x	840000x	1534000x	2484600x	3792740x
Refund of tax and fee received	0	0	0	0	0
Other cash received related to operating activities	0	0	0	0	0
Cash Inflow Subtotal	250000	840000	1534000	2484600	3792740
Cash paid for commodities or labor	0	0	0	0	0
Cash paid to and for employees	428000	482200	536400	590600	644800
Taxes and fees paid	12500	42000	218175	42001	835462.8
Other cash paid related to operating activities	235000	235000	235000	235000	235000
Cash Outflow Subtotal	675500	759200	989575	867601	1715262.8
Cash flow generated from operating	250000x-675500	840000x-759200	1534000x-989575	2484600x-867601	3792740x-1715262.8

activities

Net Amount

The net present value of investment is calculated on the basis of the cash flow situation in the past 5 years.

$$\text{NPV} = \sum_{t=1}^{n} \frac{NFC}{(1+K)^t} - C, n = 5, k = 10\%$$

Let NPV = 0 and solve x = 0.6429, which means, as long as the actual income can reach the expected income (industry normal income) of 64.29%, the NPV of the project is greater than 0, so the project can be implemented. In reality, it is not difficult to achieve this goal, so we confirm the feasibility of the project.