# Analysis of vegetable planting portfolio based on risk-benefit optimization

Junwei Huang[a,b*], Limin Wang[b,c]

[a]College of Computer Engineering, College of Shangqiu, Shangqiu 476000, China;
[b]Department of Computer Science and Technology, College of Computer and Information Engineering, Henan Normal University, Xinxiang 453007, China;
[c]College of Information Engineering, Xuchang Vocational and Technical College, Xuchang 461000, China

* Junwei Huang(huangjunwei2006@126.com)

**Abstract.** The traditional mean variance combination strategy takes into account the volatility of vegetable prices and fails to fully consider the proportion of planting combinations. Based on the theoretical analysis of portfolio management, this paper uses risk parity portfolio strategies and asset allocation algorithms to calculate the risks and returns of portfolio investments, overcoming the shortcomings of traditional mean-variance model research, and proposes a multi-objective optimization method based on risk returns. This method takes the investment goal of farmers as the optimization goal to obtain the vegetable planting portfolio with the maximum income and minimum risk. The experimental results show that the maximum yield is 0.93, which proves the feasibility and effectiveness of our idea.

**Keywords:** Vegetable planting, risk assessment, investment portfolio, maximum return

## 1 Introduction

China's vegetable market price fluctuation, market size, supply-demand relationship, agricultural input and other factors. The price fluctuation of vegetable market in China is formed by the joint action of many factors [1-5]. First of all, China's vegetable market is very large and the demand is huge. Due to China's large population, the demand for vegetables has also increased correspondingly. Secondly, the instability of supply is also an important reason for price fluctuations. The growth cycle of vegetables is relatively short, and the supply is affected by natural factors such as season and climate, which is prone to the imbalance between supply and demand. In addition, the lack of agricultural input is also one of the reasons for the fluctuation of vegetable prices. Farmers are under great cost pressure. If the input is insufficient, the output will decline, which will affect the supply and price of vegetables in the market. Therefore, in view of this problem, many scholars have studied vegetable prices.


Y. Jiao et al. (eds.), *Proceedings of the 3rd International Conference on Internet Finance and Digital Economy (ICIFDE 2023)*, Atlantis Highlights in Economics, Business and Management 1,
https://doi.org/10.2991/978-94-6463-270-5_5

(1) Structural analysis of vegetable prices. Liu Yike et al. focused on the structural characteristics of vegetable prices, discussed the factors affecting prices, and conducted in-depth research on the changing laws of vegetable prices [6-7]. The structural analysis of vegetable prices needs to consider many factors, including variety, origin, season, market and supply and demand. By analyzing these factors, we can better understand the formation mechanism of vegetable prices and provide reference for consumers and decision makers. There are many kinds of vegetables, and the price difference is large. The price of high-grade vegetables is high, and the price of low-grade vegetables is low. The prices of vegetables in different regions also vary greatly. The closer the origin is to the consumption place, the lower the price is. The prices of vegetables in different seasons also vary greatly. The prices in the season with sufficient supply are lower, and the prices in the season with short supply are higher. The relationship between supply and demand is an important factor that determines the price of vegetables. If supply exceeds demand, the price will fall; If the supply is insufficient, the price will rise.

(2) Volatility analysis of vegetable prices. Xing Kongwen and others discussed the volatility of vegetable prices, analyzed the factors affecting the volatility of vegetable prices, and the impact of vegetable price fluctuations on vegetable supply and demand [8]. The price fluctuation analysis refers to the analysis of the trend, range and cycle of the market price fluctuation to reveal the reasons and laws behind the price fluctuation and help farmers formulate investment strategies.

The price fluctuation analysis is usually carried out from the following aspects: trend analysis, amplitude analysis and periodic analysis. Trend is one of the basic forms of price fluctuation. Through the drawing of trend line and the judgment of trend, the rising, falling or fluctuating trend of price can be determined to help farmers grasp the trend of the market. Amplitude is the amplitude of price fluctuation. Through the calculation and analysis of the amplitude, the intensity and range of price fluctuation can be determined to help farmers develop trading strategies. Cycle is one of the important characteristics of price fluctuations. By analyzing the periodicity of price fluctuations, we can determine the rhythm and cycle of price fluctuations, and help farmers grasp the rhythm and trend of the market. The price pattern is another manifestation of price fluctuation. Through the analysis and judgment of the price pattern, we can determine the rising, falling or fluctuating trend of the price, and help farmers develop trading strategies. The price fluctuation analysis can be carried out by combining technical analysis with basic analysis. Technical analysis mainly focuses on the price trend and fluctuation rules, while basic analysis focuses on the economic, political and social factors behind the price fluctuation. By using these two methods comprehensively, we can analyze the causes and laws of market price fluctuations more comprehensively and help farmers formulate more effective investment strategies.

(3) Research on the market mechanism of vegetable price. Xing Kongwen and others discussed the market mechanism of vegetable prices, such as the formation mechanism of vegetable prices, the adjustment mechanism of vegetable prices and the transmission mechanism of vegetable prices [8]. The research on market mechanism of vegetable price mainly involves supply and demand relationship, price formation

mechanism, market transaction and policy regulation. The first thing to consider in the study of the market mechanism of vegetable prices is the relationship between supply and demand. The relationship between supply and demand refers to the relationship between the supply and demand of vegetables in the market. When the supply is sufficient, the price of vegetables will fall, and vice versa, the price of vegetables will rise. Understanding the production, sales, consumption and other conditions of vegetables, as well as the supply-demand relationship of each link, is of great significance to predict the change trend of vegetable prices. The research on the market mechanism of vegetable prices also needs to consider the price formation mechanism. The research on the market mechanism of vegetable prices also needs to consider market transactions. Market transactions refer to the vegetable trading activities conducted by both parties in the market. Different market trading methods have different effects on vegetable prices. The government intervenes in vegetable prices through price regulation, market supervision and other means to maintain market order and consumer interests. In a word, the research on the market mechanism of vegetable prices needs to be analyzed from supply and demand relationship, price formation mechanism, market transaction and policy regulation, so as to better predict and control the fluctuation of vegetable prices.

(4) Policy research on vegetable prices. The researchers focused on the government's policies on vegetable prices, such as the government's price control policies, support policies, and the impact of policies on vegetable prices [9]. Vegetable prices are an important factor affecting people's daily life. For the government, stabilizing vegetable prices is an important task to maintain social stability. Therefore, the government needs to formulate a series of policies to study and control vegetable prices. Macroeconomic control policy refers to the change trend and price level of vegetable prices through macroeconomic control measures. The price supervision policy refers to the protection of consumers' rights and interests, as well as the interests of production enterprises, through the supervision of market prices to prevent prices from being inflated or lower than costs. The government can strengthen price monitoring and supervision by formulating price regulation regulations and standards, punish price violations, and maintain market price order. Subsidy policy means that the government provides certain financial support to support vegetable production and sales. The government can encourage farmers to increase vegetable planting and sales and reduce vegetable prices by providing production subsidies and sales subsidies. Trade policy means that the government regulates vegetable prices through trade means. The government can adjust the quantity and price of imported and exported vegetables through tax and other means, thus affecting the domestic vegetable price. In short, the government needs to take various policy measures to study and control vegetable prices and balance the interests of all parties.

Based on the risk grade assessment of farmers, combined with the risk assessment portfolio strategy and asset allocation algorithm, this paper takes the investment goal of farmers as the optimization goal, in order to obtain the maximum income and minimum risk vegetable planting portfolio. This paper proposes a new method: vegetable planting portfolio method based on risk-benefit optimization. The research results of

this paper will help to provide better decision-making reference for vegetable farmers to improve the efficiency and efficiency of vegetable planting.

## 2 Vegetable planting portfolio method based on risk-benefit optimization

The mean-variance combination strategy takes into account the volatility of vegetable prices and fails to fully consider the proportion of planting combinations; The risk parity portfolio strategy takes into account the proportion of the planting portfolio, and fails to reflect the impact of vegetable price fluctuations on the vegetable planting portfolio; The vegetable planting portfolio algorithm based on risk-return optimization not only takes into account the impact of vegetable price fluctuation on the vegetable planting portfolio, but also takes into account the proportion of various vegetable planting portfolios. According to the investment strategy of farmers, the optimal asset portfolio is selected to effectively avoid risks and improve the return on investment. The steps of the algorithm are shown in Table 1.

**Table 1.** Vegetable planting portfolio algorithm based on risk-benefit optimization

| Step | Work |
|---|---|
| Step-1 | Analyze investment strategy |
| Step-2 | Choose the type of vegetables to invest |
| Step-3 | Estimated return on investment of assets |
| Step-4 | Calculate risk |
| Step-5 | Optimize asset allocation |

First, according to the investment strategy and financial situation of farmers, collect their effective investment strategies, including farmers' risk preference, investment period, maximum investment amount, etc. Then, according to the investment strategy of farmers, select the type of vegetables to match it. The assets can be high-grade vegetables, greenhouse vegetables, and general vegetables. The return on investment of various assets is roughly estimated by referring to the historical return on investment. According to the risk preference of farmers, calculate the risk in the asset portfolio and select the portfolio of investment assets to achieve the risk preference of farmers. According to the expected return on investment, risk level and investment period of farmers, optimize the investment portfolio and use Monte Carlo simulation to find the best asset allocation ratio [10]. According to the optimal asset allocation ratio, the purchase and sale of investment assets are automatically carried out to complete the allocation.

## 3 Experiment

In this section, we have carried out various analyses on the data of six vegetables, including logarithmic rate of return, portfolio rate of return and Sharp rate. The specific experimental results are as follows

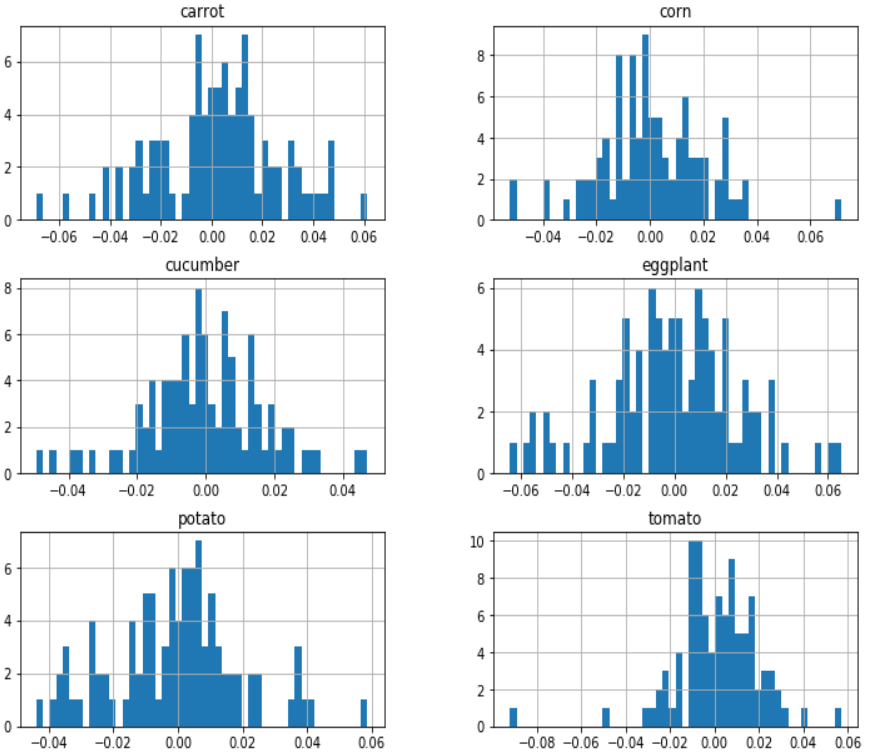
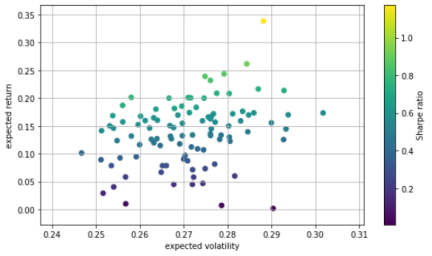
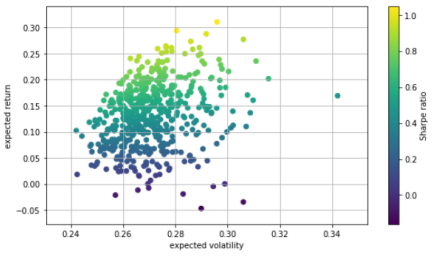


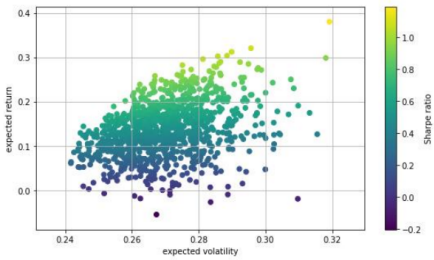

**Fig. 1.** Logarithmic rate of return of six vegetables



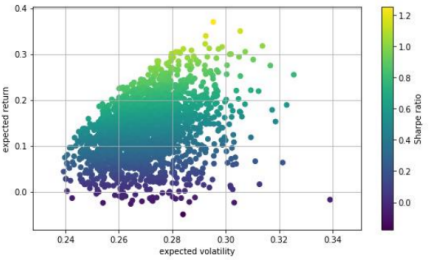

(a) Scatter number=100



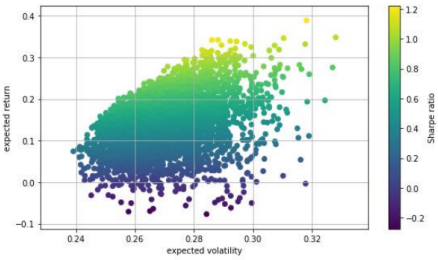

(b) Scatter number =500



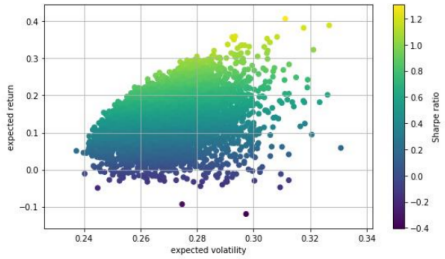

(c) Scatter number =1000




(d) Scatter number =3000




(e) Scatter number =4000




(f) Scatter number =5000

**Fig. 2.** Scatter chart of portfolio yield, volatility and Sharp rate

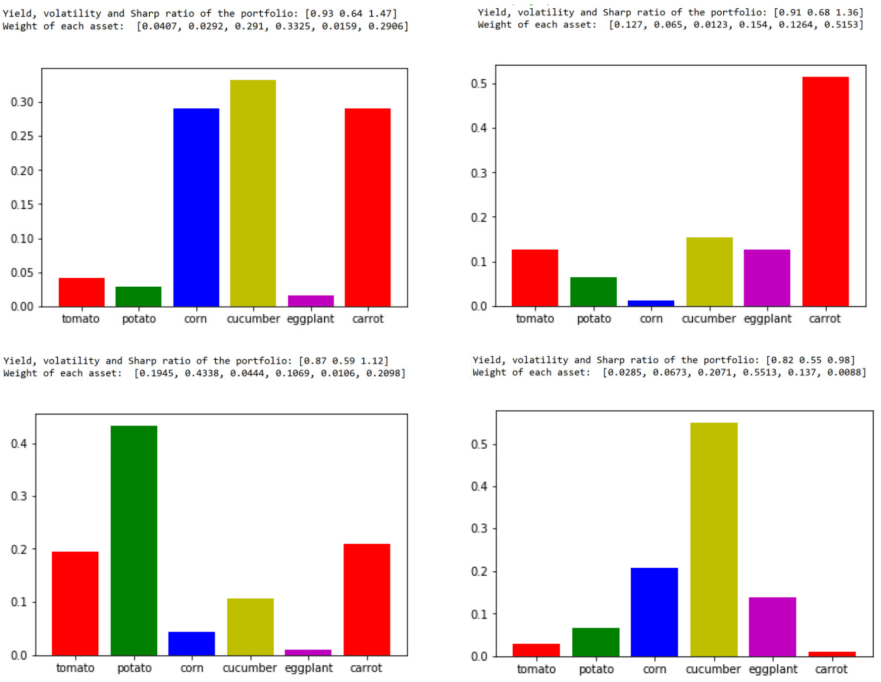



**Fig. 3.** Vegetable portfolio

As can be seen from Figure 1, the distribution shape of each vegetable is similar to the normal distribution, but the normality is weak. As can be seen from Figure 2, with the increase of scatter points, the higher the Sharp rate is, the better the weight distribution of vegetable combinations is. We analyzed four groups of data in Figure 3. From Figure 3, we can see that when the Sharp rate reaches 1.47, the highest yield is 0.93, and the proportion of six vegetables is 0.0407, 0.0292, 0.291, 0.3325, 0.0159, and 0.2906.

## 4 Conclusion

Through in-depth mining of vegetable data, an algorithm model of vegetable planting portfolio based on risk-benefit optimization is proposed. The algorithm combines the user risk evaluation level, risk parity portfolio strategy and asset allocation algorithm, and takes the investment goal of farmers as the optimization goal, in order to obtain the maximum income and minimum risk vegetable planting portfolio. The vegetable planting portfolio algorithm based on risk-return optimization considers not only the impact of vegetable price fluctuation on vegetable planting portfolio, but also the proportion of various vegetable planting portfolios. The research results will help to better understand the effectiveness of the vegetable planting type selection model, provide decision-making reference for vegetable farmers, and improve the efficiency and efficiency of vegetable planting.

## Reference

1. Zhoutao Wang, Guilong Lu, Qibin Wu, et al. Isolating QTL controlling sugarcane leaf blight resistance using a two-way pseudo-testcross strategy[J]. 2022,10(4):1131-1140. DOI: 10.1016/j.cj.2021.11.009.
2. Yang Lan The current situation, hotspot and evolution trend of food security research in China in recent years -- based on citespace bibliometric analysis [J] Heilongjiang Grain, 2022 (10): 66-68. DOI: 10.3969/j.issn.1671-6019.2022.10.024
3. Peng Yuling, Li Kaixi, Xu Xuexian, etc Analysis of the development trend of global food security research from 2001 to 2020 [J] China Food and Nutrition, 2022,28 (8): 13-20 DOI:10.19870/j.cnki.11-3716/ts.2022.08.004.
4. Luo Meng, Liu Ziyu, Mu Yueying Research progress on food security in China -- a review based on CSSCI literature measurement [J] China Food and Nutrition, 2021,27 (1): 8-13 DOI:10.3969/j.issn.1006-9577.2021.01.002.
5. Guo Fugui Accelerate the certification of "three products and one standard" and promote the targeted poverty alleviation of poor households [J] Agricultural Development and Equipment, 2018 (2): 71,96 DOI:10.3969/j.issn.1673-9205.2018.02.056.
6. Liu Yike Research on China's agricultural product price fluctuation and its control countermeasures [D] Inner Mongolia University of Finance and Economics, 2022.
7. Liu Yike Research on the price change of agricultural products in Inner Mongolia and its countermeasures [J] Journal of Inner Mongolia University of Finance and Economics, 2022,20 (1): 71-74 DOI:10.3969/j.issn.2095-5871.2022.01.016.
8. Xing Kongwen. Analysis of agricultural product price changes and market strategies based on western economic principles [J]. Rural Science and Technology, 2019 (33): 14-15. DOI: 10.19345/j.cnki.1674-7909.2019.33.006.
9. Yun Lu, Cui Xiaomin, Xiao Lisheng, etc. Analysis framework of international commodity supply and demand: global perspective and China's role [J] International Economic Review, 2022 (3): 68-88.
10. Liu Yingxia, GERARD B. M. HEUVELINK, Zhanguo Bai, et al. Statistical analysis of nitrogen use efficiency in Northeast China using multiple linear regression and Random Forest[J]. Journal of Agricultural Sciences, 2022,21 (12): 3637-3657. DOI: 10.1016/j.jia.2022.08.054.