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Research on Trend Investing Strategy and Hedging Strategy

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Abstract: An investment method based on traditional subjective judgments faces huge challenges, while the strategy of quantitative investment is to find the optimal alpha model to judge the best timing of selling and buying and designing the most effective investment portfolio. Therefore, compared with traditional investment methods, quantitative investment breaks through the limitations of subjective judgment with its qualitative and quantitative advantages. The futures market attracts many investors with its low transaction costs and the two-way nature of transactions. However, most of the investment strategies that are frequently used in the market have low stability and do not guarantee correlation with the general market trend. This makes the investments risky, particularly for individual investors. Therefore, this paper will explore both futures investment and risk hedging strategies, aiming to ensure that every buy and sell is the correct choice as much as possible, such that futures investment is relatively stable and has high returns. This article focuses on using the moving average cross strategy through the python programming language to achieve the judgment of buying and selling in the process of futures trading and drawing the net worth curve of the real-time futures market data and perform a correlation analysis to determine which commodity sector is the most suitable using the trend strategy. For risk hedging, the article mainly uses the correlation analysis to study the relation between the prices of different types of futures. Furthermore, the futures and options market price fluctuations are discussed in depth, and also analysed is how to use and balance hedge parameters for risk hedging.

Keywords: future options, future, portfolio investment, moving average, greek letters

1. Introduction

1.1. Background

The futures market has different attributes from the stock and bond markets, this gives investors more opportunities to adapt quantitative investment strategies to predict prices in the futures market, thereby obtaining more stable and considerable returns. Therefore, the author has designed, and improved futures trading strategies based on personal practice and investment experience, aiming to obtain considerable investment returns while maintaining relatively low investment costs and low investment risks [1,2].

DOI: 10.54254/2754-1169/22/20230322

1.2. Literature Review

1.2.1. Moving Average Crossover Strategy

The investment strategies be mainly discussed in this article is Moving Average Crossover Strategy. The Moving Average (MA) is a common tool in technical analysis [3]. As a very simple mathematical model, the moving average is widely used in the analysis of financial markets such as stocks, futures, and foreign exchange. It is simple, effective, and widely used. On the other hand, many other technical indicators are also based on moving averages, such as the famous MACD and EMA [3,4]. Therefore, moving averages occupy an important position in the field of technical analysis. First one must make an accurate mathematical description of the definition of moving average. Assuming that the closing price of the futures is P_t, and the moving average of the security for k time units is $M_t(k)$, the moving average is then defined as

$$M_t(k) = \frac{1}{k}\sum_{j=0}^{k-1} P_{t-j} \tag{1}$$

There are many trading strategies based on moving averages. This article focused on the most traditional moving average crossover strategy. When the fast-moving average (small k value) crosses the slow-moving average (large k value), the moving average crossover strategy sends a buy signal, and when the fast-moving average (small k value) crosses the slow-moving average (large k value), the moving average crossover strategy issues a sell signal.

When the two moving averages cross, let $S_t\,(k_1, k_2)$ be the signal variable, and k_1 and k_2 be the fast and slow moving average respectively, then we have [5].

$$S_t\,(k_1, k_2) = \begin{cases} 1, & M_t(k_1) \geq M_t(k_2) \\ 0, & M_t(k_1) < M_t(k_2) \end{cases} \tag{2}$$

We chose the indicators as the 5-day (k_1) and 20-day (k_2) moving averages. The 5-day moving average crossing the 20-day moving average downward is a sell signal, and the 5-day moving average crossing the 20-day moving average upward for a buy signal.

However, primarily due to inherent market volatility, the investment return of only using the 5-day moving average and the 20-day moving average is not ideal, so this paper also added the 60-day moving average indicator to make the strategy better fit the general trend of market changes and achieve better results.

1.2.2. Risk Hedging

It is significant for investor to hedge the risk when investing in futures. Using correlation analysis to calculate the correlation coefficients between futures for different kinds of commodities for a portfolio investment is a relatively effective hedging strategy. When the price correlation coefficient of two futures is negative, it means that the futures of these two categories have no correlation, and their prices will not affect each other, which means that it is suitable to combine them together for portfolio investment.

It is important to note that while correlation analysis can help reduce risk, it cannot guarantee returns or eliminate risk. A comprehensive consideration of Greek letters (hedge parameters) can better help investors resist price fluctuations and hedge risk. Furthermore, apart from only using futures to hedge the risk of futures, investors also can use future options to hedge the risk. The price of options is priced according to the Black-Scholes equation, which is directly related to these factors.

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The delta, gamma, vega, and theta indices are frequently used to hedge risk in options and futures trading. Here is a brief overview of each index and how they can be used to manage risk:

- Delta Index: The delta index measures how the option's price's changing with the underlying asset price. A high delta means that a small change in the price of the underlying asset will result in a large change in the price of the option, making it more sensitive to market movements. By using delta as a guide, traders can adjust their options positions to reduce exposure to market risk.
- Gamma Index: The gamma index measures the changing rate in an option's delta. A high gamma means that the delta is changing rapidly, which can make an option position more sensitive to market movements. Traders can use the gamma index to monitor the risk of their options positions and adjust as necessary to reduce exposure to market risk.
- Vega Index: The Vega index measures how sensitive of an option's price to changes in implied volatility. A high Vega means that a small change in implied volatility will result in a large change in the option's price, making it more sensitive to changes in the market's expectations for volatility. By using Vega as a guide, traders can adjust their options positions to reduce exposure to volatility risk.
- Theta Index: The theta index measures the sensitivity of an option's price to changes in the time to expiration. A high theta means that an option's price will decline rapidly as the expiration date approaches, making it more sensitive to time decay. By using theta as a guide, traders can adjust their future options positions to reduce exposure to time decay risk [6].

By monitoring these indices and adjusting their options positions accordingly, traders can hedge risk in their portfolios and manage their exposure to market movements, volatility, and time decay. However, it is important to keep in mind that hedging is not a guarantee of a profit and can even limit potential profits to some extent. It is significant to have a good understanding of these indices and the underlying market conditions before making any investment decisions, where further information can be found in [7] and the formulas for each from [7] is given below Table 1.

Table 1: The formulas for each hedge parameter.

Greek Letter	Call Option	Put Option
Delta	$e^{-qT}N(d_1)$	$e^{-qT}[N(d_1)-1]$
Gamma	$\frac{N'(d_1)e^{-qT}}{S_0\sigma\sqrt{T}}$	$\frac{N'(d_1)e^{-qT}}{S_0\sigma\sqrt{T}}$
Theta	$-S_0N'(d_1)\sigma e^{-qT}/(2\sqrt{T})$ $+qS_0N(d_1)e^{-qT}$ $-rKe^{-rT}N(d_2)$	$-S_0N'(d_1)\sigma e^{-qT}/(2\sqrt{T})$ $-qS_0N(-d_1)e^{-qT}$ $+rKe^{-rT}N(-d_2)$
Vega	$S_0\sqrt{T}N'(d_1)e^{-qT}$	$S_0\sqrt{T}N'(d_1)e^{-qT}$
Rho	$KTe^{-rT}N(d_2)$	$-KTe^{-rT}N(-d_2)$

1.3. Summary

This article improves the moving average crossover strategy and uses correlation analysis to research and judge which futures sector is most suitable for its strategy. In addition, this paper continues to conduct in-depth research on risk hedging strategies. This paper uses correlation analysis to analyse the price fluctuations of different types of futures, so as to select the most suitable investment portfolio, and then considers the method of using different derivatives and futures combinations to hedge risks. Finally, this paper explores the optimal hedging strategy through the analysis of different hedge parameters.

DOI: 10.54254/2754-1169/22/20230322

2. Methodology

2.1. Investment Strategy

2.1.1. Data Sources

This section described the method using python to analyse the futures categories with relatively high trading volume in each selected sector. Futures categories studied include data on agricultural commodities, metals, and chemicals. Including Zn, Sn, Ca, Rb, soybean No. 1 (non-GMO soybean), soybean No. 2 (GMO soybean and non-GMO soybean), corn, coking coal (JM.DCE), coke (J.DCE), etc. This article takes these futures varieties as examples to design a programmatic trading strategy for futures. The historical back test data used in this article is from December 30th, 2019 to January 20th, 2023 of the main futures contracts of the above-mentioned commodity categories, and the data comes from wind.

2.1.2. Methods and Steps

After the practice of only using the 5-day and 20-day moving average indicators, it was found that the return on investment is not ideal, and it is quite different from the trend of commodity futures prices. Therefore, to improve our strategy and offset market fluctuations, the 60-day moving average indicator was also used as an additional judgment condition and was compared with the closing price to form a new trading signal. Then the new signal was compared with our previous 5-day moving average 20-day signal. If the closing price is greater than the 60-day (the signal variable is 1), and the 5-day crosses the 20-day, it is a buy signal. If the closing price is lower than the 60-day (the signal variable is -1), and the 5-day crosses the 20-day moving average downward, it is a sell signal. If the closing price is greater than the 60-day, and the 5-day moving average crosses the 20-day, then only the position will be closed. Similarly, if the closing price is lower than the 60-day, and the 5-day crosses the 20-day, then only the position will be closed. Strategies are designed to follow changes in general trends more.

By drawing the net worth curve to reflect the income situation and changing trends and using correlation analysis to calculate the correlation coefficient between the closing price and capital, it can be determined whether the data or category is suitable for investment using trend strategies, so that specific commodity sectors which are more suitable for this trading strategy can be analysed. The correlation coefficient is high, and the trend of the net worth curve is generally in line with the price changing trend, which means that the commodity analogy is suitable for the trend investment strategy.

2.2. Risk Hedging

The next aim is to hedge the risk caused by price volatility. Future price volatility refers to the degree of fluctuation in the price of a futures contract over time. Volatility can have a significant impact on the performance of futures investments and can cause price changes to occur rapidly and unpredictably. High volatility can result in significant losses for investors who are unprepared or who do not have proper risk management strategies in place. There are several factors that can contribute to the volatility of futures prices, including changes in supply and demand, shifts in market sentiment, changes in economic conditions, and geopolitical events. Additionally, volatility can also be influenced by factors specific to the underlying asset, such as changes in production or changes in regulations.

Investors who are interested in futures trading should be aware of the potential for price volatility and be prepared to manage their risk through a variety of strategies, including diversification, stop-

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loss orders, and position sizing. It is also important to have a solid understanding of the underlying asset and the market conditions that may influence its price to make informed investment decisions.

First of all, different kinds of futures were joined together for investing by using correlation analysis. Correlation analysis is a statistical method used to understand the relationship between two variables. In the context of investing in futures, correlation analysis can be used to hedge risk by identifying assets that are not highly correlated. This means that if the value of one asset decreases, the value of the other asset is unlikely to decrease by a similar amount. By investing in a portfolio of uncorrelated assets, an investor can reduce the overall risk of their portfolio.

To do the analysis, firstly, the correlation coefficients between the futures was calculated. Then the futures with low correlation coefficients were chosen. This means that if the value of one future decreases, the value of the other future is unlikely to decrease by a similar amount, reducing the overall risk of the investment.

Then the investment is rebalanced periodically to maintain a desired level of risk. This may involve selling future that have become highly correlated and buying assets that have become less correlated.

To hedge risk using options, an investor could purchase a long call option for an underlying asset they own. This limits their potential losses as the price of the underlying asset decreases, as they have the right to sell at the higher strike price. An investor could also sell a short put option, which would give them the obligation to buy the underlying asset at the strike price if the price decreases, thus offsetting the potential loss. In summary, combining long and short options allows an investor to hedge their risk by offsetting the potential losses from price movements in an underlying asset [8].

Next, it is useful to analyse Greek letter to hedge risks in complicated markets. The Delta for option is the ratio of changing in the price of option to the change in the value of the underlying asset. Delta hedging refers to constructing a position with a Delta of 0 (sometimes also called a Delta neutral position) [9]. The delta value of the asset is 1.0. Therefore, for each option long position, a hedging method is to hold the amount. The delta of the option changes with time, which means that the position of the underlying asset should be adjusted frequently. Once an option position has been Delta neutral, then is useful to observe its Gamma. The Gamma value of an option is the ratio of the Delta change of the option to the change in the price of the underlying asset. This quantity is used to measure the curvature of the curve of the relationship between the option price and the price of the underlying asset. By making the option position gamma- neutral, we can reduce the effect of curvature on the delta hedging effect. If a position's Gamma value is G, then the above goals can be achieved by holding options traded on exchanges with a Gamma value of -G. Both delta and gamma hedges assume constant volatility. However, volatility changes over time. The Vega of an option or a combination of options is equal to the ratio of the change in position value to the change in volatility. Traders who wish to make their options portfolio neutral to volatility can hold a Vega neutral trading portfolio. Like constructing a Gamma-neutral state, traders can often hold offsetting trading positions to Achieve their goals. If a trader wishes to be both Gamma and Vega neutral, they must trade at least two classes of exchange-traded options [7].

Two other measures of risk in option positions are Theta and Rho. Theta is equal to the change in position value and the rate of change over time. Similarly, Rho is equal to the ratio of the change in position value to the change in interest rate, holding other variables constant.

Here is the relationship between Delta, Gamma and Theta in the Black-Scholes model from [10] [Π is portfolio value, S is the price of stock, σ is Portfolio Price Volatility, t is time]

$$\frac{\partial \Pi}{\partial t} + rS\frac{\partial \Pi}{\partial s} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 \Pi}{\partial S^2} = r\Pi \tag{3}$$

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$$\Theta = \frac{\partial \Pi}{\partial t}, \Delta = \frac{\partial \Pi}{\partial s}, \Gamma = \frac{\partial^2 \Pi}{\partial s^2} \quad (4)$$

$$\Theta + rS\Delta + \frac{1}{2}\sigma^2 S^2 \Gamma = r\Pi \quad (5)$$

In general, the Greek letters are often used in finance to describe sensitivity of options or other financial instruments to various factors. To hedge risk using the Greek letters, an investor would need to understand the significance of each Greek letter and then use financial instruments such as options or derivatives to offset their exposure to the specific risk factors described by the Greek letters.

For example, if an investor is concerned about the impact of volatility on their portfolio, they might use options to hedge against changes in implied volatility. Similarly, if an investor is concerned about changes in the price of the underlying asset, they might use delta-hedging strategies to offset their exposure to price changes. It's important to note that while the use of Greek letters can be a useful tool for managing risk, it's just one part of a comprehensive risk management strategy. Additionally, using financial instruments to hedge risk can also introduce additional risks and costs, so it's important to carefully consider the trade-offs involved [7].

2.3. Results

The following part is the results, as shown in Figures 1-8. The graphs below are the net worth curve for different futures categories. And the correlation coefficients between the closing price and capital for each commodity also be included below. The correlation coefficients for the commodities in metal sector are almost all positive and the net worth curves are also very good, which means that commodities in the metal sector are best suited for trend strategies.

After calculating the correlation coefficient of the price of different futures, it is reasonable to combine the following futures together to do the investment to hedge the risk.

e.g., the correlation coefficient of Rebar (RB.SHF) with apple (AP.CZC) is -0.312, the correlation coefficient of SN.SHF with hard rice (RR.DCE) is -0.260.

In addition, it is not enough to only consider the correlation coefficient to hedge risks, so this paper analysed the Greek letter to comprehensively hedge risk.

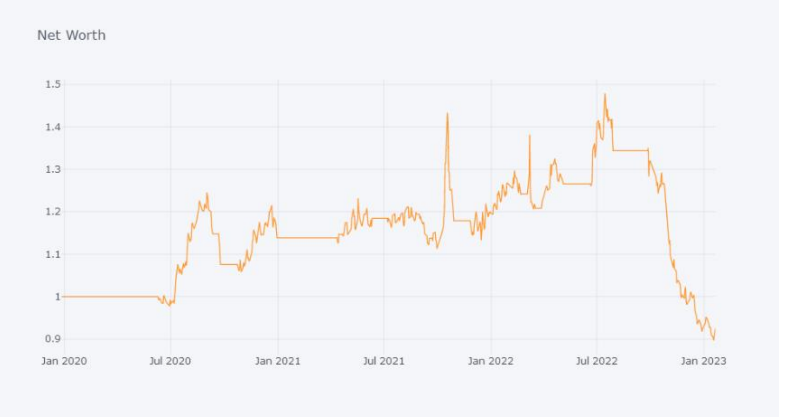

Figure 1: The net worth curve for Zn (ZN.SHF).[correlation coefficient = 0.681] (Photo credit :Original)

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Figure 2: RB.SHF. [correlation coefficient = 0.401] (Photo credit : Original)

Figure 3: SN.SHF correlation. [correlation coefficient = 0.320] (Photo credit : Original)

Figure 4: CA.SHF. [correlation coefficient = 0.525] (Photo credit : Original)

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Figure 5: Coking coal (JM.DCE). [correlation coefficient = 0.763] (Photo credit : Original)

Figure 6: Corn(C.DCE). [correlation coefficient = 0.944] (Photo credit : Original)

Figure 7: Coke (J.DCE) [correlation coefficient = 0.406] (Photo credit : Original)

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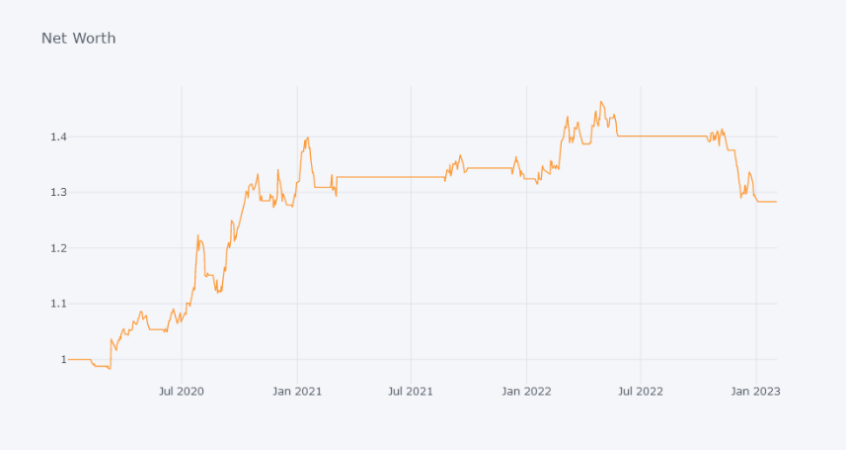

Figure 8: Palm oil (P.DCE). [correlation coefficient = 0.601] (Photo credit : Original)

3. Conclusion

In summary, the article takes the futures of commodities in Agriculture, Metal, Chemical material as the examples, designs and improves the above investment strategies, and conducts portfolio investment to hedge against the risks brought by price fluctuations. And further analysed the method of risk hedging. However, the article still has some areas for improvement.

Firstly, in the real transaction, double the detailed settings, such as slippage settings, initial capital settings, etc. This article only provides the framework of futures trading strategy and hedging strategy, but the specific details need to be added.

Furthermore, in actual application, it is difficult for all hedge parameters to reach a balanced state. The article only provides a general idea of risk hedging, but in actual operation, we still need to specifically analyse different situations.

In addition, it is difficult to accurately predict the correlation between price fluctuations of different futures categories only through data analysis. The author will continue to explore and improve these issues in subsequent papers.

The author will continue to conduct in-depth research in the follow-up to make the programmatic transaction more comprehensive and consider the details more. To a certain extent, increase the number of buy and sell so as to capture fleeting investment opportunities and reasonably control the risk of each buy and sell, try to make every decision correctly to bring a stable income.

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