

Optimal Transaction Model Based on Venture Capital

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Abstract: Market is full of volatile assets, making traders dazzling when investing and forming portfolios. Surely, even the most intelligent one can fall head over heels when facing rug-pull. However, the goal to maximize total return is possible if a best strategy is made. Instead of invest blindly and behave impulsively and help the trader to achieve his goal, we preprocess the prices of gold and bitcoin, build three models to achieve the best balance between risk and return. With the help of MA calculations and through rotating test, we come to our conclusion that Bitcoin is not strongly correlated with gold and can be hedged against risk and is more volatile and suitable for short-term holdings while gold should be made into long-term investment and avoid frequent trading. With the help of optimal portfolio theory, we build our model and test the best proportion of gold and bitcoin when selling and buying.

Keywords: Quantitative Trading; Asset Portfolio; Filtering Optimization; Maximum Benefits

1. Introduction

Bigger return is always accompanied by higher risk. The volatile trading market is capricious, full of uncertainties, making losses a commonplace. Moreover, most of the participants want to be lucky investors instead of speculators or gamblers. The harsh reality is that the way most people trade indeed is gambling. They constantly make short-swing trading in the market and only care about the probability of making a fortune. Therefore, instead of making decisions based on blind judgment, a scientific prediction about future prices and a reasonable allotment of the entire portfolio are efficient for pursuing higher yields. One important thing to be added is that the advantage of quantitative transaction is not absolute, indicating there is no one hundred percent accurate of prediction, but exists a relatively larger probability advantage goal.

2. Model overview

The problem requires us to develop a model targeting the trading portfolio consists of gold and bitcoin. Our goal is to pursue the largest return and to find out the best time to purchase and sell additionally. Based on the price of gold and bitcoin from 9/11/2016 to 9/10/2021, we preprocess the data given and visualize it. By comparing the opening price (we assume it as yesterday's closing price) and the closing price every day, we can learn the up-down bar. The color of the bar shows whether the trader get profits or losses. Red represents losses whereas green means profits. After data preparation, we utilize a mixture of CTA (Commodity Trading Advisor) strategy and optimal portfolio, applying several theories to our model mentioned as the upcoming example shows: 1) Double moving average strategy helps to standardize the buying and selling point. 2) Optimal portfolio proposed by Markovitz indicates how to allot assets. We keep going through loop operation by adjusting the parameters with the help of Python and compare our result with another method to test whether it can earn more. We calculate price elasticity and finally know the sensitivity that how transaction costs affect strategy and results.

3. Double moving average strategy

Before we start modeling, we need to perform preliminary processing of the relevant price data for gold and bitcoin provided in this question to facilitate our subsequent analysis. original_flavor to obtain the K-line charts of gold and bitcoin respectively. The charts will be used in the subsequent analysis and an example is shown in Figure 1.



Figure 1: The K-line chart of gold

We use the algorithm to average the prices of gold and bitcoin separately over a period of time, and then connect the averages over time to obtain an arithmetic moving average. The Figure 2 below shows the graph of the arithmetic moving averages we obtained, where the orange curve represents the short-term moving average and the green curve represents the long-term moving average. This chart will be used in the subsequent analysis.



Figure 2: The arithmetic moving average

3.1. Theoretical framework

Traditional double moving average strategy captures trends by crossing fast-moving average lines and slow-moving average lines. Here they represent MA5 and MA20 respectively. MA means moving average, an arithmetic average of the last n days of closing prices, and are always used in technical analysis as an indicator for financial markets such as stocks, forex, cryptocurrencies, etc. When MA5 crosses upward MA20, there is a buy signal, indicating a wave of uptrend. When the former crosses underneath the latter, a sell signal appears, indicating a downtrend.

Strategy 1: Buy when the golden cross appears and sell when meeting dead cross, the so-called golden cross and dead cross are illustrated in Figure 3. Golden cross and dead cross are two crossover points.

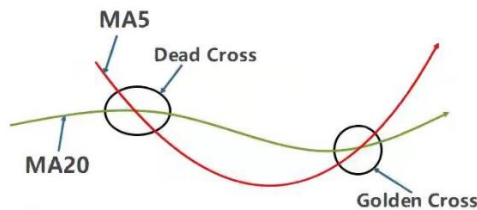


Figure 3: An example of golden cross and dead cross

Reason: As MA5 means short-term trend and MA20 acts as long-term trade, MA5 is more sensitive to the price than MA20. When short-term trend breakthrough long-term trend, the upward trend will continue, then investor should buy and harvest the upward phase. On the contrary, investor sell when the trend has effectively changed to down phase, especially when the price is down below expectation, sell immediately is a correct solution.

3.2. Properties of two assets

Because gold has commodity and monetary properties^[1], the time when its investment value becomes prominent may occur during a phase of economic overheating or even when economic crisis arises. The former is because investors invest in gold to avoid the risk of inflation, while the latter exists when they invest in order to avoid financial or economic risks.

The economy is cyclical and is very closely associated to the fluctuation of gold price. A complete economic cycle goes from one trough to the next, or from one peak to the next. At different points in the economic cycle, the allocation and flow of capital have different characteristics and effects on the price fluctuations. The stable international economic situation and the well-developed economic fields are full of chances to invest, stimulating the flow of capital to securities markets in real economy or virtual economy with higher returns, causing the capital flowing into the gold market declines and the price tends to fall. On the contrary, international economic instability or crisis is expected to reduce investment opportunities in economic field, stimulating capital from the real economy or virtual economy securities market outflow, then the capital into the gold market increases and price tends to rise.

3.3. Properties of bitcoin

Bitcoin is a new type of electronic currency designed by software developer Satoshi Nakamoto in 2009. Bitcoin is decentralized and not controlled by any entity such as a central bank. Users can use computers to verify or facilitate bitcoin transactions to generate new bitcoin, which is the process known as “mining”. Bitcoin is a high-risk alternative investment. Nevertheless, it will become a digital gold in the future because of the limited supply and its deflationary properties.

The current volatility of bitcoin is very high, with its average daily rate of increase or decrease higher than the S&P 500, gold, etc., so it has a very high volatility risk. Cryptocurrency investments are still niche compared to traditional stock and bond investments. Bitcoin has high risk and return, with a low correlation coefficient with the other major asset classes (such as gold and stocks). For high-net worth individuals or institutional investors, adding bitcoin to the asset pool can optimize asset allocation.

3.4. Model operation and results

As to the gold, the general economic cycle changes are relatively long, so the effect of the changing average gold price is very significant. According to 5 years of historical data statistics, we calculate MA. MA is completely represented by MA (n), where n is the period of MA.

We use the following formula:

$$MA(n) = \sum_{1}^{n} (\text{closing price})/n$$

From calculation, we also get the following data showing below:

- (1) The average intra-day increase is 0.024%.
- (2) The average annual increase is 6.048%.
- (3) The maximum single-day increase or decrease in only about 5.13%.
- (4) More than 75% of the single-day increase or decrease of no more than 0.6%.
- (5) The transaction fee of gold when buying and selling it is 1% of the transaction amount, which accounts for one-third of the average annual return.

Through the data above, we can come into conclusion:

- 1) Buy gold to hedge against inflation when the economy is overheated.

- 2) When there exists a huge economic crisis or financial risk, buy gold to avoid the risk.
- 3) Gold should be made into long-term investment and avoid frequent trading.

Based on the above conclusions, we can adjust the arithmetic moving average indicator of the double mean channel taking into account the economic cycle factor. Gold can be traded only during working days, so there are 20 trading days in January and 120 trading days in half a year. So using the monthly moving average MA20 and semi-annual moving average MA120 formed by golden and dead crosses as a reference to buy and sell signals and therefore reduce the number of transactions and lower trading costs as well.

Through testing the MA5 and MA20 indicators in the trading system, the system sent out 38 buy signals and 37 sell signals for a 5-year return of 17.84% without commissions. Calculating all the transaction costs, the final 5-year return is -18.65%, which shows the impact of trading frequency on the final return.

As to the bitcoin, we repeat the procedure and get the following data: The average intra-day increase is 0.236%.

- (1) The average annual increase is 86.18%.
- (2) The maximum single-day increase or decrease is 19.78%.
- (3) The maximum decrease is 49.66%.
- (4) The single transaction cost of bitcoin is 2% of the transaction amount, which is only 2.32% of the average annual return.

So the following are our conclusions:

- 1) Bitcoin is not strongly correlated with gold and can be hedged against risk
- 2) Bitcoin is more volatile and suitable for short-term holdings.

Based on the above conclusions, we can trade short term for the high volatility of bitcoin. Bitcoin can be traded every day, so there are 7 trading days in a week and 30 trading days in a month. Therefore, we adjust the arithmetic moving average indicator of the double mean channel, and use the weekly moving average MA7, and the monthly moving average MA30 to form a golden cross and a dead cross as a reference to buy and sell signals.

4. Optimal Portfolio

What kinds of assets should be included in the portfolio and how should the various assets be proportioned in order to minimize the total risk but maximize the return? This is the central question of modern portfolio theory. This theory includes two important elements: the mean-variance analysis and the efficient frontier model of the portfolio.

4.1. The Establishment of Mean-Variance Analysis

Modern portfolio theory uses mean and variance to portray the two key factors of return and risk. The mean, which refers to the portfolio's expected return, is a weighted average of the expected returns of individual securities, weighted by the corresponding percentage of the investment. The variance, on the other hand, refers to the variance of the portfolio's return, which measures the deviation of the actual return from the mean and portrays the portfolio's risk.

To calculate the variance of a portfolio you need to know the covariance between two of all the assets, the covariance is a measure of the change in the return of two assets. If the return on gold rises while the return on bitcoin rises, then the covariance between the two is positive; if the return on bitcoin falls while the return on gold rises, the covariance is negative. The larger the value of the covariance, the greater the degree to which the two are changing in the same direction (or in the opposite direction).

The generalized formula for calculating the expected return of the portfolio is now given as follows:

$$E(R_P) = E\left(\sum_{i=1}^N w_i R_i\right) = [w_1, w_2, \dots, w_N][E(R_1), E(R_2), \dots, E(R_N)]^T$$

In calculating the return on gold and bitcoin, the expression for the return on the "I"th asset on the

"t"th trading day can be changed to the rate of return with continuous compounding as follows:

$$R_{it} = \ln \frac{P_{it}}{P_{it-1}}$$

Before calculating the volatility of a portfolio, the covariance and correlation coefficients between the returns of two assets need to be calculated. The specific expression for the volatility of the return of a portfolio consisting of two assets is as follows:

$$\begin{aligned} \sigma_p^2 &= w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2 \\ w &= [w_1, w_2, \dots, w_N] \\ \Sigma &= \begin{bmatrix} \sigma_1^2 & \dots & \sigma_{1N} \\ \vdots & \ddots & \vdots \\ \sigma_{N1} & \dots & \sigma_N^2 \end{bmatrix}, \sigma_{ij} = Cov(R_i R_j) \\ \sigma_p &= \sqrt{w \Sigma w^T} \end{aligned}$$

$$Annual\ Volatility = \sqrt{252} \times Daily\ Volatility$$

4.2. The Establishment of Effective Frontier

The efficient frontier is also known as the "efficient frontier".^[2] A rational investor is generally averse to risk and prefers return, and will choose the portfolio that offers the greatest return for the same level of risk, and the portfolio that offers the least risk for the same expected return. A portfolio that satisfies both of these conditions is the efficient frontier. In summary, the efficient frontier is to solve this optimal equation as follows:

$$\min \sigma_p = \min \sqrt{\sum_{i=1}^N \sum_{j=1}^N w_i w_j Cov(R_i, R_j)}$$

The constraints are:

$$\begin{aligned} \sum_{i=1}^N w_i &= 1, w_i > 0 \\ E(R_p) &= E\left(\sum_{i=1}^N w_i R_i\right) = \text{Given constant} \end{aligned}$$

4.3. The Solution of the model

With the mean-variance model, we determine the expressions for the investment return and the corresponding risk. The mean represents the return of the portfolio, and the variance of the portfolio return measures the deviation of the actual return from the mean, portraying the risk of the portfolio. Rational consumers tend to maximize return and minimize risk through portfolio selection. The scenario we choose is to maximize the portfolio return for a given maximum risk condition, which is solved by targeting the optimal portfolio solution through a mathematical planning model.

Base on the solution of the optimal portfolio solution, we further calculate the relationship between the given return and risk to obtain its efficient frontier:

$$\bar{\sigma}_p = \sqrt{w \Sigma w}$$

On the efficient frontier, we can find the global maximum yield portfolio ^[3].

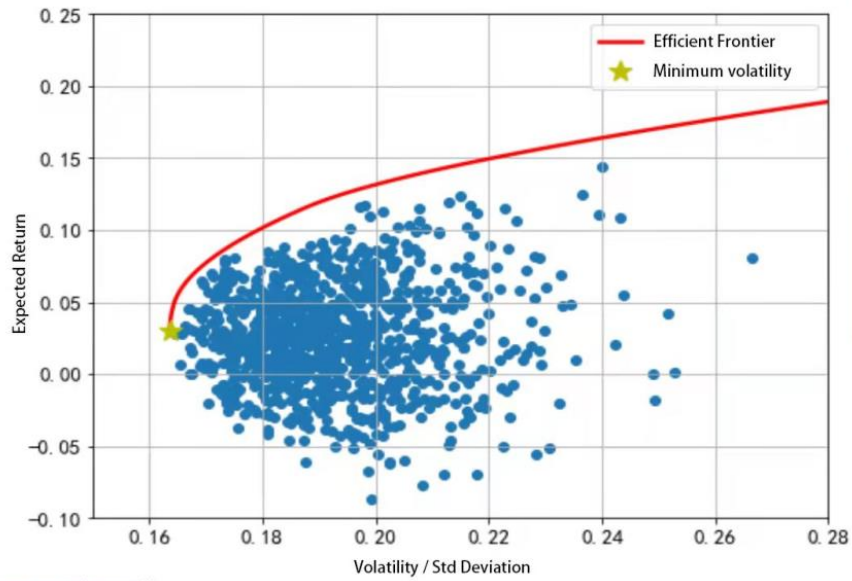


Figure 4: The effective frontier plot

Figure 4 shows the effective frontier plot for one of the days, when we set an acceptable maximum risk α , we can find the corresponding maximum return $f(\alpha)$ on the curve.

In conclusion, by building the three models and running the code (too much code to go into here), we can tentatively derive the results of the problem, which contains the specific daily trading operations for gold and bitcoin whether to buy or sell and the amount of each transaction, and finally, we calculate the June 21, 2021 expected maximum return of \$15,022.19. Please see the table 1 below for more details.

Table 1: Our result of the maximum return

Number	Date of Purchase	Purchase Price	Date of Sale	Selling Price	Yield	Bitcoin Account
1	2016/10/1	614.82	2017/1/10	906.05	43.37%	1433.68
2	2017/1/24	919.97	2017/3/13	1227.68	29.45%	1855.87
3	2017/3/15	1257.40	2017/3/18	952.23	-28.27%	1331.22
4	2017/4/4	1141.60	2017/6/18	2507.39	115.64%	2870.62
5	2017/7/7	2491.20	2017/7/8	2502.86	-3.53%	2769.23
6	2017/7/22	2807.61	2017/9/11	4248.09	47.31%	4079.25
7	2017/9/29	4193.57	2017/11/15	7301.43	70.11%	6939.21
8	2017/11/16	7815.03	2017/12/24	13949.18	74.49%	12108.34
9	2018/1/6	17319.20	2018/1/12	13912.88	-23.67%	9242.56
...
39	2021/2/4	37676.25	2021/2/28	46155.87	18.51%	25333.74
40	2021/3/11	55997.23	2021/3/26	51415.92	-12.18%	22328.18
41	2021/4/2	58736.92	2021/4/21	56507.91	-7.79%	20587.72
42	2021/5/4	57213.33	2021/5/15	49922.52	-16.74%	17140.68
43	2021/6/14	39066.82	2021/6/21	35592.35	-12.89%	14930.62
						Gold Account
44	2019/1/14	1292.75	2021/2/26	1742.85	33%	91.58
Until June 21, 2021 , THE TOTAL AMOUNT OF CASH ACCOUNT IS:						15022.19

5. Conclusion

The main advantage is its enormous extensible, which means the model can be applied to a more complex portfolio, including many assets. We visualize the framework of our work and show the result clearly which is analyzed by models in the form of graphs and tables. The models we establish can effectively achieve all of the goals in a quick speed and higher accuracy. We consider the defect of each model and find ways to improve.

In this paper, different thresholds of trading prices, frequencies of trades and final returns are

generated. To prove the strategy is the best, we use the describe function, where the following conclusion is drawn. The threshold value helps to improve the accuracy of the trading signals and reduce the transaction costs. As the threshold value increases, it will exclude fluctuations in sideways trading at the beginning, reducing transaction costs and increasing returns.

References

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