

Quantitative Trading strategies report

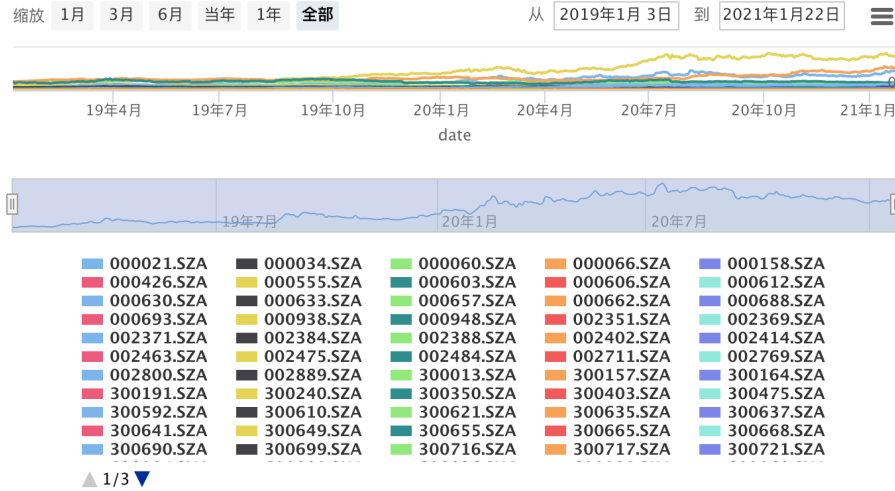
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Here I used BigQuant platform <https://bigquant.com/> for the simulation and development of trading strategies listed below.

1 Introduction

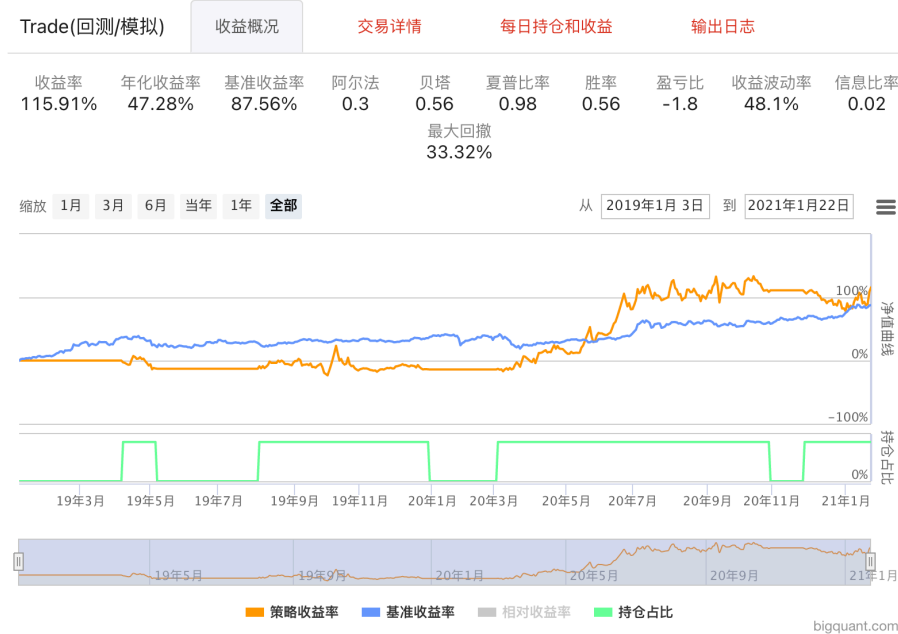
In this strategy, I pick from a prefixed set of stocks to form the portfolio here in my strategies, which includes more than 100 stocks in the file. And here I use the period of 01/03/2019 - 1/22/2021 as the backtesting period. The transaction fee is set as 0.3%, and if the fee is less than 5 RMB, then it's set as 5 RMB. I use "CSI300 Index" as the benchmark. And in the simulation graph, we can find metrics including asset return, sharpe ratio and drawdown, etc. Before diving into any of the strategies below, we may first get a quick glimpse at the general trend of the stock prices.



2 Strategy based on technical indicators

2.1 Strategy 1: MACD + MA

Empirically Traders find that the analysis of 12- and 26-day EMA(exponential moving average) very useful for determining buy-and-sell points. The standard MACD is the 12-day EMA subtracted by the 26-day EMA, which is also called the DIF. The MACD histogram measures the signed distance between the MACD and its signal line calculated using the 9-day EMA of the MACD, which is the DEA. When DIF crosses above DEA, there's a buy signal in the strategy. Another indicator we take into consideration is the simple moving average. The strategy when the 5-day short-term moving average line is above the 20-day long-term moving average line, we'll buy these stocks. So the strategy presented here is a combination of the above two indicators. The detailed strategy is as follows: The rebalance period is every 20 workdays, the maximum number of stocks in portfolio is 10. Now suppose we have 10,000 RMB, and today is the first day of trading. We select some stocks according to the indicators listed above, and we distribute the capital evenly on these 10 stocks (when the stock number is less than 10, we'll just evenly distribute cash on them as well). And 20 workdays later, we'll first sell these stocks at their open price, then we'll use the cash obtained to buy the first 10 stocks selected again according to the above indicators, and evenly distribute our cash on them as well, etc. and etc. And the result of backtesting is as follows



As we can see, the strategy is close to the benchmark, while the sharpe ratio is 0.98, and drawdown is 33.32%.

2.2 Strategy 2: MACD only

This time, I kept everything else the same and only used MACD indicator, the strategy became worse than the benchmark, and has both a negative yearly return and a negative sharpe ratio.



3 Quadratic Programming based methods

Here we define a few variables

1. $x = (x_1, \dots, x_n)$ represents the weight of each stock, where n is the size of the portfolio. Here $\sum_{i=1}^n x_i = 1$
2. $\mu = (\mu_1, \dots, \mu_n)$ is the expected return for each stock based on historical data. The calculation is based on the average of every 5 workdays.
3. Σ is the covariance matrix of stock returns.

In the following QP strategies, we set the rebalance period as 10 days consistently.

3.1 Strategy 3: classical QP

The idea is to obtain a sharpe ratio as high as possible. So here we consider the following Lagrangian strategy with

$$\underset{x}{\text{minimize}} \quad -\mu^T x + \frac{1}{2} x^T \Sigma x$$

$$\text{subject to } \sum_{i=1}^n x_i = 1$$

$$x_i \geq 0; i = 1, 2, \dots, n$$

For the sake of operating time of the platform, here I selected the first 30 stocks in the stock list and include them in the optimization. The result is as follows.



3.2 Strategy 4: diversify the portfolio

If we use the classical QP method, a potential problem is that some of the weights might be very high while some might be very low, this would be equivalent to selecting only a few stocks among the many stocks, which doesn't diversify away the risk. So another way to tackle this is that we can limit the weight of each stock, and at the same time, also limiting the weights of each sector of the stocks. And in our example of the top 30 stocks, we have 3 sectors which are '710000', '210000', '220000'.



3.3 Comparison

Strategies	Return	Sharpe Ratio	Drawdown	Volatility
MACD+MA	115.91%	0.98	33.32%	48.1%
MACD	-33.63%	-0.29	45.86%	64.58%
classical QP	0.44%	0.24	70.53%	58.57%
Diversified QP	-13.23%	-0.43	36.44%	19.33%

Table 1: Comparison of different strategies

Seems like so far using technical indicators MACD+MA works best among all the methods, while the diversification did help with lowering volatility. Perhaps we may try to add in more stocks into the original MACD+MA strategy, e.g. trading 20 or 30 stocks instead of just 10, which may help with lowering volatility.