

Consider the daily stock price for Bank of America (BAC) from August 21, 2009 to August 20, 2010 in the file sp500hst.txt. In this problem, you are given \$10,000 capital to invest. Your goal is to maximize your client's profitability. But at the same time, you need to measure your investment risk based on your client's risk utility. Here we assume that your client is risk averse, but she is willing to adjust her risk position, if she can be convinced. You are considering to design a trading strategy for BAC stock based on this historical data.

Year S&P 500 Index Annual Return (Wikipedia)

2007	5.49%
2008	-37.00%
2009	26.46%
2010	15.06%
2011	2.05%

Note: You will use S&P 500 Index Annual Return as the benchmark r_f . You are to use the following formula to calculate P/L (r_i) for each of your trades as:

$$r_i = (\text{Sell price} - \text{Buy price}) - \text{Transaction cost}$$

Assume that you are considering many strategies, but particularly you are testing Moving Average Convergence/Divergence (MACD) at this point. Create a momentum trading strategy based on MACD method to invest \$10,000 client's money. Assuming you have an execution team to help you execute your orders. You do not have to worry about the price impact of your suborders.

You will need to do the following for this assignment:

(1) You need to use the fast EMA (12 days) and the slow EMA (26 days), and 9 days for the $signalline = ema(MACD_t; 9)$ to design a MACD trading strategy for this assignment. Note that your broker allows you to short sell. Each pair of long/short or short/long actions will be considered as a transaction. Assume there is a \$5 transaction cost for each transaction. **You need to provide a table of the buy and sell signals for the entire period with dates, and calculate profit when you close a position.** Remember whenever you have a buy/sell transaction, there will be a \$5 transaction cost in the P/L (r_i) calculation. (10 points)

(2) To simplify the problem, hedging is not part of your assignment. However, you do need to measure your risk. Suppose you can use S&P 500 Index return during the same period as your risk free rate (annual return rates of S&P 500 Index of the last five years are provided in the table above). Measure your risk adjusted performance using Sharpe ratio:

$$R_{Sharpe} = E[r_i - r_f] / \sqrt{Var(r_i - r_f)}$$

where r_f is the risk-free asset return, r_i is return at time i, and $\sqrt{Var(r_i - r_f)}$ is the standard deviation of the asset's excess return at time i. **Please calculate Sharpe ratio for from the previous question.** [Hint: calculate excessive return for each of your returns ($r_i - r_f$) to the Sharpe ratio, and r_f is only different for different years.] (10 points)

(3) Assume you choose parameter m for the $signalline = ema(MACD_t, m)$ to optimize your strategy. You need to evaluate the options of m = 7, 9, and 11. Please calculate Sharpe ratios for the three options and choose one best strategy for your client. (20 points)