

In the name of God

Implement your code in an ipynb file (you should write your own code in Julia language), so we can see your codes and results together.

You should use MarketData, Glm, Mlbase, DataFrames, CSV and Statistics packages.

- 1) Write a program to get the price from top five cryptocurrencies (by market cap); you can get the ticket name from [yahoofinance](#), aggregate last year's closing price of these cryptocurrencies, scale them based on the mean and standard deviation, and plot altogether, then decide which one is profitable in this year based on cumulative return.
- 2) Generate a data frame consisting of the above cryptocurrencies; based on the last 6-month daily returns, calculate how many days they had positive or negative returns; then calculate altcoins cumulative return when the bitcoin daily return is negative or positive.

$$1 + \text{CumulativeReturn}_i = \prod_{t=1}^t (1 + \text{return}_{it})$$

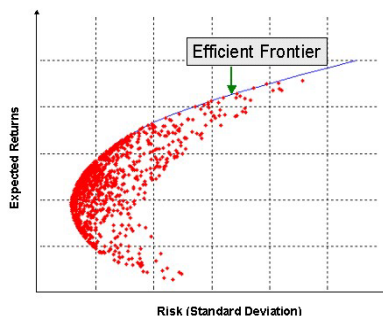
- 3) **Sharpe ratio:** Get last year's data for BTC, ETH, BNB, Cardano, and XRP; you want to create a portfolio from these; each of these tokens may contain 0 to 100% portfolio (for simplicity, assume each crypto share can range between 0 and multiplication of 5%), for each of possible composition, calculate portfolio return and volatility. ($\sum (\text{weights}_i) = 1$, and assume risk-free rate is 2% annually)

Portfolio variance = $\text{weights}^T * \text{covariance}(\text{portfolio}) * \text{weights}$

Portfolio return = $\sum (\text{weights}_i * \text{returns}_i)$

Sharpe ratio = $(\text{Portfolio return} - \text{risk free rate}) / \text{Portfolio std}$

Then plot all possible Sharpe you get into a 2-D scatter. Create a dataframe from these information for each portfolio and save it to “portfolio.csv”, and finally print out the best weights, which give us the highest Sharpe ratio. (your plot must look something like on the left side)



- 4) **golden cross over:** get the bitcoin closing prices for last 3 year, calculate moving averages from 5 to 100 days (for simplicity, consider a subset of 5 days to calculate moving average e.g.: the averages of 5, 10, 15, ... 100); the objective is to find which pair of the two moving averages crossed together gives us the highest profit.
- Calculate how many times you have “buy” signal and “sell” signal and calculate return for each signal. Finally, calculate the cumulative return when our initial deposit is 1000\$.
 - Revise your solution when you have 5% transaction cost for the “buy” signal.

(moving average strategy: When the shorter-term moving average crosses above the longer-term moving average, it's a buy signal, as it indicates that the trend is shifting up. meanwhile, when the shorter-term moving average crosses below the longer-term moving average, it's a sell signal, as it indicates that the trend is shifting down)

- 5) As a junior analyst in JP Morgan, you are asked to predict the Gold price. To do that, using MarketData package (or other alternatives), collect the historical price of the Gold, Crude oil, and the Federal funds rate for the months between 2015-01-01 & 2022-05-01.

Considering the dates until 2022-02-01, run the following regression models: first regress Gold on the first lag of Gold, next add Crude oil, then add Federal funds rate.

(Note that the price levels are normally non-stationary, and it may depend on many factors. Hence, we use differencing or calculate the return of the price)

- In each regression model, estimate and interpret the coefficients and predict the Gold price for 30 forward days.
- For each model, plot the actual and predicted value of the Gold and report the errors. Suggest which model has lower errors for our prediction and which one has higher errors.

Good luck