FinaMaze™

PRACTICAL INTERVIEW
IT REPRESENTS 80%

OVERVIEW

READ THE ENTIRE PROJECT AT LEAST TWICE BEFORE ATTEMPTING TO WRITE ANY CODE!!!!

Disclaimer: Obviously, there will be a lot of assumptions made in this exercise and it should in no way be seen as a realistic project tool but rather as a programming exercise. Should you want to make any adjustment to make the case more realistic you are invited to do so, however, don't get lost in this. Make sure that you focus on the main goal of this exercise which is to evaluate your skills in Python 3.XX with regard to the basic concepts in statistic and financial mathematics topic.

More importantly, this is a competitive programming and show your best and it represents 80% in the interview process, write properly, divide functions in different files if you think it is better, make sure your code is readable, respect international conventions and can be executed everywhere so you should not rely to much on advanced IDE.

DO WHAT YOU CAN ON YOUR OWN !!!

WE DO NOT EXPECT YOU TO FULLY AND PERFECTLY RESOLVE THE EXERCISE
WE WANT TO SEE HOW YOU THINK, CODE, AND WHERE YOU WILL STOP !!

BESIDE PYTHON STANDARD LIBRARIES YOU ARE ONLY ALLOWED TO USE

Numpy, Pandas, matplotlib and Scipy if needed.

STEP I : DATA PROCESSING

In this part of the exercise, you have to deal with data processing tasks. Actually, you have to write a function that will help to extract stock prices from the **data_market.json** file. That function should be scalable and flexible enough to allow these features :

- One or more stock prices(Only close prices are needed) can be extracted, but by default all stock prices must be returned
- Certain portions of stock prices can be extracted by giving start and end dates
- Stock prices should be stored in the format you think is efficient enough to handle the next step (You have to justify)

STEP II : DATA WRANGLING AND VISUALIZATION

In this part we will start by selecting three stocks randomly (exemple GOOG ,AAPL and TESLA) from the **data_market.json file**. You must use the function you created in STEP I, and extract data from a period of 2017-01-01 to 2021-12-31 :

- First of all, choose the method you want, to handle missing data in the prices and justify the choice of the method
- Then plot these two stocks prices on the same graph, you must suppose you invest 100 $ in each at 2017-01-01

STEP III : GET TO KNOW DATA

- Imagine that an investor invests $100 in each of these stocks (using the stocks of previous selection) . What would be the weekly value of each of these stocks investment ? Plot them on the same graph.
- Compute their daily returns and compare their distributions can we infer that they are normal.
- Compute the following metrics for every month of 2021 and annualize these metrics (Returns, volatility, sharp ratio)

Note : Remember theses stocks are randomly chosen, you can only rely on metrics and visuals facts to inform about their distribution characteristics so your program should be flexible and dynamic enough. Make a function for every answer and show a use case of it.

STEP IV : INVESTOR STRATEGIES SIMULATIONS

Now let's see how we can use the code written before to easily model the following scenarios or answer the following questions. Make a separate file called Simulations.py to model these results.

If you have written your code in a robust way, it should not take too much effort to adjust the following:

1. Bryan is an investor, who doesn't want to take too much risk (low unbiased Pearson variance), but at the same time he wants to invest in 3 stocks exactly. Help him to find the way to determine the portion of each of these three stocks (whichever they are, remember they are randomly selected in STEP II) perhaps you should write a function to do it regardless of selected stocks) for a USD 1,000 investment.
2. Do you think your allocation is more efficient than a Naïve uniform investment strategy that is putting the same weights in each stock ? Why ? Plot the daily values of these two strategies, the portfolio you found in 1. vs the Naïve one, on the same graphic visualization
3. Calculate the Beta of these two strategies considering that "NDX" is the benchmark

Note : You could use Sharpe-ratio to compare these strategies

STEP V : DEALING WITH OPPORTUNITIES

Bryan has met an old friend Omar who is by far very good in asset management. Omar has managed to structure a fund with a strategy that gives trade signals using simple moving average crossover (10 and 30 simple moving average). Omar asserts that his strategy would have generated more than 75% return in 2021 for AAPL.

1/ Help Omar backtest his strategy to confirm his result.

2/ Plot the moving averages and the signals in the same graph.

3/ Can you tell if Omar's strategy overperformed the benchmark ?

STEP VI : Numerical Techniques and Algorithms

Solve these problems by using only the Python Standard Library

a) Given a list of the first N consecutive natural numbers that is 1, 2, 3 … N, with a and b, two missing consecutives numbers. Find an efficient and elegant way to determine a and b.

b) To take a 56-seat bus making the Casablanca-Rabat shuttle, passengers board in order of arrival. Each passenger can occupy an empty seat that suits him at random. What is the probability that the last passenger occupies exactly 56th place, knowing that the bus always leaves full ?