Technical Analysis Description

Data Preprocessing

We first utilized data preprocessing provided by Tao to grab daily stock closing prices and calculate portfolio value and output dataset data1.csv.

Model Construction

1. Moving Average Analysis

The simple moving average is calculated by taking the arithmetic mean of a given set of prices over a specified period. For our analysis, we compute both the 21-day and 200-day moving averages of the 1-year total return.

Firstly, we determine the 1-year total return using the formula: ((end_price + total_dividends) / start_price) – 1. As Yahoo Finance does not provide dividend data, we proceed with the assumption that dividends are zero. Subsequently, we calculate the 21-day and 200-day moving average returns, which are defined as follows:

Where:

$$\mathrm{SMA} = \frac{A_1 + A_2 + \ldots + A_n}{n}$$

An = the price of an asset at period n
n = the number of total periods

Ultimately, we generate three separate graphs:
(1) A graph depicting each stock's 1-year total return over the time of portfolio investment.
(2) A graph showing the 21-day moving average of the 1-year total return for each stock over the investment period.
(3) A graph illustrating the 200-day moving average of the 1-year total return for each stock over the investment period.

The results of the 1-year total return and the moving average computations are saved in a CSV file. This allows users to easily export both the graphical plots and the

dataset into CSV format for further analysis.

2. Risk Attribution Analysis

Overall, our calculation of risk attribution utilized a weighted average of risk attribution of different stocks.

$$\Sigma_P = \sum_{i=1}^{N} C\Sigma_i = \sum_{i=1}^{N} w_i MC\Sigma_i$$

The formula for the marginal risk contribution of each stock is determined by the volatility and correlation with portfolio, as shown below:

$$MC\Sigma_i = \sigma_i \rho_{i,p} = \sigma_i \frac{\sigma_{i,p}}{\sigma_P}$$

Then after knowing the overall process, we will need to calculate portfolio value, standard deviation and stock weight, standard deviation as shown in the python code Vol.py. Worth noticing is that we calculate volatility using 21 days rolling window, as for a month's trading days.

Finally, we will have a graph of different stocks' risk contribution over the portfolio investing time. Meanwhile, we will have the output data set df1 in the python file, with last column "PC" as each stock each day's risk contribution. Users can directly output the plot and dataset into excel for further analysis.

3. Return Attribution Analysis:

In analyzing return contribution, we consider factors such as portfolio weights and the returns of individual securities or sectors. The return contribution is determined by multiplying the weight of a security or sector within the portfolio by its respective return.

$$R = \sum_{i=1}^{i=n} w_i R_i$$

where

n = the number of sectors or securities in the portfolio
wi = the weight of the sector or security in the portfolio
Ri = the return of the sector or security in the portfolio
wiRi = the contribution to portfolio return

For calculating daily returns in Python, we employ the pct_change() function, which operates on the formula:

$$Ri = \left(\frac{p_t}{p_{t-1}} - 1\right) \times 100\%$$

Here, Ri represents the return at time i, p_t is the price at time t, and p_{t-1} is the price at time t - 1.

The weight of a stock within the portfolio is defined as the ratio of the amount of stock held to the total value of the portfolio.

After completing these calculations, we generate a graph that visually represents the return attribution of each stock over the investment period. For convenience and further examination, the return attribution data is stored in a CSV file.