**Team Assignment 2**

**These questions are all related to the examples I use in classes. As they are not textbook questions, ambiguities are unavoidable (and sometimes intentionally). There are no standard answers. You can make up assumptions as you see fit.**

1. Use the same companies we picked in the Session - 2 Frontier Analysis example, and the same time period (2016-2021). Risk free interest rates can be download yfinance (using the 13 week T-bill yield, symbol is ^IRX). However, we know that the interest rate has been very low, so for this exercise, you may assume risk-free rate .
   1. One the first business day of January, 2021, use monthly data for to estimate of the covariance matrix.
   2. Use any ML learning tools to forecast the returns for each stocks for January of 2021. You can use the LSTM (or others) for the forecast. If you have difficulty here, you can use the average return from the past (Jan 2016-Dec 2020).
   3. Use your estimations from a) and b) to find the portfolio with the highest Sharpe ratio, i.e, the efficient frontier portfolio. You might assume that there is no short sale (portfolio coefficients are nonnegative).
   4. What is your portfolio’s actual rate of return in January 2021? What is the rate of return for an equally portfolio?

Bonus marks (4)

* 1. Repeat this approach on the first day of each month and compute your portfolios returns. For the covariance matrix, you can update your estimation by only using the past 50 months. Your estimation of the expected returns for each stocks should also be updated.
  2. Compute the mean and standard deviation for the monthly returns of the tangent portfolio.
  3. Use the data from 2021, compute the mean and standard deviation of the month returns for the equally weighted portfolio (rebalanced at the beginning of each month).
  4. Compare the results.

Make up assumptions as needed.

1. For the companies we used in Q1, use monthly data from 2016-2021 to implement the following models:
   1. One factor mode (use S&P 500 to represent the market)
   2. Fama-French 3 and 5 factor models.
   3. Use the resulting models to calculate the predicted monthly returns for each month in 2021. You can use the actual factor values in 2021 (S&P 500 index, and the F-F factor values).
   4. Compare them with the actual average monthly returns for the stocks.
2. This is question is stated in the file “Session 3 - Stock Price Predict - LSTM.ipynb”. In the example, we use the last 60 days prices to predict the closing price for next day. Modify the program to perform the following task:
   1. Use past 60 days price to predict the price in one week (5 days). You can choose any stock.
   2. Use your prediction to generate trading signals for the testing period (20% of you dataset): if the predicted price is higher than the current price (you can specify a threshold), you should buy one share; if it is lower than the current price, you can short one share.
   3. Assume that you will always close your position in one week, calculate your accumulated PnL for testing data
   4. Repeat a)-c), adding S&P 500 to the features for the prediction (as I explained in the class).
   5. You can try to add another (that you believe is relevant) variable to the input.