FBE 551 Homework 2

Due on 10/01/2025 by 11:59pm

This is an individual homework assignment. You will need to use the following data files:

- SPY_HW2.csv: SPY ETF, daily prices
- IRX_HW2.csv: 13 Week Treasury Bill, daily prices
- OAKMX_HW2.csv: Oakmark value fund, daily prices
- ARKK_Monthly_HW2.csv: ARK Innovation ETF, monthly prices
- FamaFrenchMonthly_HW2.csv: Fama-French 3 Factors, monthly returns

Carry out the following calculations in a single Jupyter notebook. Make sure that I will be able to run it. For example, read in the CSV files from the current directory. I.e., do not write the full path of the file in your code. Do not have your code change directories to a pathway that is probably not valid on my computer. This will allow me to run your notebook in any directory on my own computer.

Please use markdown cells to help me understand what you are doing. (I know it may be obvious, but I want to see that you know how to use markdown.) Clearly highlight what parts of your notebook are used to answer each question below.

Question 1 (10 points)

Using the full **SPY_HW2.csv** dataset, compute daily close-to-close returns (using Adjusted Closing prices) on SPY. What is the average return on SPY over the full sample, during the first trading day of the month, and during the third-to-the-last trading day of the month? When reporting your final answer multiply the mean return by 100 and round it to three decimal places. So, for instance, if the raw mean value is 0.0012345 please display this as 0.123.

Question 2 (10 points)

Create a new dataframe that includes all dates on which there is price data available for SPY. Add the T-Bill yield (the Close column of **IRX_HW2.csv**) to this dataframe. Compute T-bill returns following the instructions at the bottom of this sheet. What are the mean and standard deviation of excess SPY returns, defined as the SPY return minus the T-bill return? When reporting your final answer multiply the mean return and standard deviation by 100 and round it to three decimal places. So, for instance, if the raw mean value is 0.0012345 please display this as 0.123.

Question 3 (10 points)

What is the maximum drawdown of OAKMX? (Hint: use adjusted closing prices for portfolio values and then the cummax() method to get the prior highs.) Again, multiply the maximum drawdown by 100 and

round it to three decimal places. So, for instance, if the raw mean value is 0.0012345 please display this as 0.123.

Question 4 (10 points)

What is the downside deviation of OAKMX? As a benchmark return, use the T-Bill return. Again, multiply the downside deviation by 100 and round it to three decimal places. So, for instance, if the raw mean value is 0.0012345 please display this as 0.123.

Question 5 (10 points)

What is the average *excess* return on OAKMX when the previous Adjusted Close price is above its 200-day moving average? What about when it is below the moving average? Are these means statistically significant? (Hint: use the formula for the test statistic: $tstat = \frac{\bar{x}}{SD(x)} \times \sqrt{N}$ where $\bar{x}$ and $SD(x)$ are the mean and standard deviation of the excess return of the moving average strategy and N is the number of periods.) Again, when reporting the numbers, multiply the means by 100 and round it to three decimal places for the t-stat, just round to three decimals. So, for instance, if the raw mean value is 0.0012345 please display this as 0.123 and a raw t-stat of 1.2345 would be 1.234.

Question 6 (50 points, each part is worth 10 points)

For this question, use the **ARKK_HW2.csv** file, which contains **monthly** prices for the ARK Innovation ETF. Construct a dataframe which includes the monthly returns for this ETF over the months for July 2018-June 2023. This should include a sample of 60 monthly returns. Add to this dataframe the Fama-French 3-factor data from the file '**FamaFrenchMonthly.csv**'. For reporting answers to parts a-e, multiply all returns, annualized alphas by 100 and report all Sharpe Ratios and Betas rounded to three decimal places as in the previous questions.

    a. What has been the average annual return, average annual excess return, and average annual standard deviation for the ARKK ETF? (Hint: here use the monthly 'RF' value from the **FamaFrenchMonthly_HW2.csv** file as the risk-free return, not the daily values from the IRX spreadsheet.)

    b. What has been the annualized Sharpe ratio for ARKK over this period? How does it compare to that for the Mkt-Rf benchmark over the same period?

    c. Using just the Mkt-rf factor, compute the CAPM beta for the ARKK fund. What has been the annualized alpha for ARKK over this period?

    d. Run the full Fama-French 3-factor regression on the ARKK fund. What are the factor loadings? What has been the annualized alpha under the 3-factor model?

    e. In a markdown cell, explain why the alpha from the CAPM model is different from the alpha from the FF 3-factor model. Explain how the factor loadings from the 3-factor model regression reflect the type of stocks that ARKK tends to hold in its portfolio.

Computing T-bill returns from IRX.csv

This file contains <u>annualized Treasury Bill yields.</u> These can be transformed into approximate T-Bill returns $R_{Tbill,t}$ by taking the first lag, dividing by 36500 (365 to convert annual to daily × 100 to convert percentage to decimal), and multiplying by the number of calendar days in the holding period N_t, i.e.

$$R_{Tbill,t} = \frac{IRX_{t-1}}{36{,}500} \times N_t$$

For example, if day t is a Monday and day $t-1$ is a Friday, then there are three calendar days in the holding period starting on Friday and ending on Monday, implying $N_t = 3$. For a regular weekday, $N_t = 1$. For a three-day weekend, $N_t = 4$.

Computing N_t will likely be the hardest part of this calculation. Just try your best on this! Note that, while the homework assignment is asking you to covert yields into returns, the **FamaFrenchDaily_HW2.csv** file also includes daily returns for the risk-free rate. It may be helpful (although not required) to cross-reference your calculated returns to the returns listed in this file.