FINM 36700 **Mark Hendricks**
Autumn 2021

Midterm #1A

Due on Monday, Oct 18, at 7:40pm.

Please note the following:

- The exam is 90 points.
- You have 100 minutes to complete the exam.
- For every minute late you submit the exam, you will lose one point.
- You will upload your solution to the Midterm #1 assignment on Canvas, where you downloaded this.
- Your submission should be readable, (the graders can understand your answers,) and it should include all code used in your analysis.
- The exam is open-material, closed-communication.
- If you find any question to be unclear, state your interpretation and proceed.
- The exam will be graded for partial credit.

If you are unsure how to interpret a question, use your best judgement, note your assumption, and continue. We will only answer questions of interpretation if there is a typo, error, etc.

1 Short Answer (25pts)

1. (5pts) True or False. (And explain your reason.)

   Mean-variance optimization goes long the highest Sharpe-Ratio assets and shorts the lowest Sharpe-ratio assets.

2. (5pts) True or False. (And explain your reason.)

   Investing in an LETF makes more sense for a long-term horizon than a short-term horizon.

3. (5pts) This week ProShares launches BITO on the NYSE. The ETF holds Bitcoin futures contracts. Suppose in a year from now, we want to try to replicate BITO using SPY and IEF as regressors in a LFD. Because BITO will only have a year of data, we do not trust that we will have a good estimate of the mean return.

   Do you suggest that we (in a year) estimate the regression with an intercept or without an intercept? Why?

4. (5pts) Is HDG effective at tracking HFRI in-sample? And out of sample?

5. (5pts) A hedge fund claims to beat the market by having a very high alpha. After regressing the hedge fund returns on the 6 Merrill-Lynch style factors, you find the alpha to be negative. Explain why this discrepancy can happen.

2 Allocation (25 pts)

Consider the Merrill-Lynch Style Factors found in "`proshares_analysis_data.xlsx`", sheet "`merrill_factors`". We will use "USGG3M Index" as the risk-free rate. Subtract it from the other 5 columns, and proceed with those 5 risky assets.[1]

1. (5pts) What are the weights of the tangency portfolio, $w^{\texttt{tan}}$?

2. (5pts) What are the weights of the optimal portfolio, w^*, with a targeted excess mean return of .02 per month?

   Is the optimal portfolio, w^*, invested in the risk-free rate?

3. (5pts) Report the mean, volatility, and Sharpe ratio of the optimized portfolio. Annualize all three statistics.

4. (5pts) Re-calculate the optimal portfolio, w^* with target excess mean of .02 per month. But this time only use data through 2018 in doing the calculation. Calculate the return in 2019-2021 based on those optimal weights.

   Report the mean, volatility, and Sharpe ratio of the 2019-2021 performance.

[1] If we have a pandas dataframe named `rets`, then we can subtract one column from all the others by using the command `retsx = rets.subtract(rets["USGG3M Index"], axis=0)` we can then drop the column used as the risk-free rate, `retsx = retsx.drop(columns=["USGG3M Index"])`

5. (5pts) Suppose that instead of optimizing these 5 risky assets, we optimized 5 commodity futures: oil, coffee, cocoa, lumber, cattle, and gold.

   Do you think the out-of-sample fragility problem would be better or worse than what we have seen optimizing equities?

   No calculation is needed for this question–we just want a conceptual (though specific) answer.

3 Hedging & Replication (20pts)

Continue to use the same data file from the previous problem.[2]
Suppose we want to invest in EEM, but hedge out SPY. Do this by estimating a regression of EEM on SPY.

- Do NOT include an intercept.
- Use the full sample of data.

1. (5pts) What is the optimal hedge ratio over the full sample of data? That is, for every dollar invested in EEM, what would you invest in SPY?
2. (5pts) What is the mean, volatility, and Sharpe ratio of the hedged position, had we applied that hedge throughout the full sample? Annualize the statistics.
3. (5pts) Does it have the same mean as EEM? Why or why not?
4. (5pts) Suppose we estimated a multifactor regression where in addition to SPY, we had IWM as a regressor. Why might this regression be difficult to use for attribution or even hedging?

4 Modeling Risk (20pts)

Continue to use the same data file used in the previous problem. But for this problem use the total returns of SPY and EFA. That is, use the returns as given in the spreadsheet–without subtracting USGG3M Index.

1. (10pts) SPY and EFA are highly correlated, yet SPY has had a much higher return. How confident are we that SPY will overperform EFA over the next 10 years?

   To answer the question,

   - use statistical estimates of the total returns of SPY and EFA over the full sample.
   - Assume that log returns for both assets are normally distributed.

2. (10pts) Calculate the 60-month rolling volatility of EFA.

   Use the latest estimate of the volatility (Sep 2021), along with the normality formula, to calculate a Sep 2021 estimate of the 1-month, 1% VaR. In using the VaR formula, assume that the mean is zero.

[2] Consider the Merrill-Lynch Style Factors found in "`proshares_analysis_data.xlsx`", sheet "`merrill_factors`". But subtract USGG3M Index from the other 5 factors to get excess returns.