FINM 25000 **Mark Hendricks**
Summer 2021

Midterm (A)

Due on Monday, July 19, at 8:30pm CT.

1 Data Analysis (25pts)

The Exam requires you to use the data from two sources:

- Sections 1-4: `commodities_return_data.xlsx`. This data has returns on 15 commodities.
- Section 4: `fama_french_data.xlsx`. This is the same data set you used in the homework. It is posted with the midterm, but it is exactly the same as the version posted with the homework. In addition to Section 4, you will use the risk-free rate from this file immediately to convert the commodity returns to excess returns.

All the data are listed as **total** returns. Use the risk-free rate in the Fama-French data to convert the commodites data to **excess** returns. (Do this by subtracting the "RF" column of data given in the Fama-French data set.)

- **We will use these excess returns throughout the rest of the exam–not the total returns given.**
- **For the rest of sections 1-3, you only need the excess returns on the commodities–we will not make further use of the Fama-French data until Section 4.**

1. (10pts) Calculate and display the mean, volatility, and Sharpe ratio of each **excess** return. Annualize the answers.
2. (10pts) For each asset, calculate and report the statistics on extreme returns:
   - The minimum excess return.
   - The 1st quantile (1st percentile) of the excess returns.
   - The maximum drawdown.[1] Though we usually calculate maximum drawdown on **total** returns, keep things simple and just continue to use the **excess** returns we're already using in all the other problems.
3. (5pts) Calculate and display the correlation matrix of the 15 assets' excess returns.

   Which pair of assets has the highest correlation? And the smallest correlation?

[1] No need to identify the period over which it happens.

2 Allocation (30pts)

1. (10pts) Calculate the weights of the tangency portfolio formed from the 15 commodities.
2. (5pts) Recalculate the tangency portfolio, but instead of using the covariance matrix, use a diagonalized version which zeros out every element off the main diagonal. (So it is just a matrix of the variances, with zeros everywhere else.)
3. (10pts) Calculate the mean, volatility, and Sharpe ratio for the full-tangency and diagonalized-tangency portfolios. Annualize the statistics.
4. (5pts) Should we expect the full-tangency portfolio (from 2.1) to weight assets according to their Sharpe ratios? And the diagonalized tangency (from 2.2?)

3 Return Decomposition (20pts)

Suppose we want to replicate "CL1" (Crude oil) with ['NG1', 'KC1', 'CC1', 'LB1', 'HG1']. Calculate the optimal replication using a regression of the target, (y), on the assets being used for the replication, ($\boldsymbol{x}$).

1. (10pts) Report the α, β, and R-squared.
2. (5pts) Describe specifically what we would need to do with these regression estimates to replicate the target. (i.e. If we want to replicate a portfolio of \$100 in the target, how much would we invest in the individual instruments?)
3. (2pts) Would this replication under-perform or over-perform the target?
4. (3pts) What is the correlation between the replication and the target?

4 Pricing (25pts)

1. (10pts) Test the CAPM on the 15 commodity returns. Namely, run 15 time-series regressions, where each regresses a commodity on the MKT factor of Fama-French. (Remember that we are using **excess** returns everywhere.

   For each regression, report the estimated α, β, and r-squared statistic.
2. (5pts) Which security has the highest Information Ratio?
3. (5pts) Do your estimates give evidence against the CAPM? (We are not worried about formal significance testing. But from the results above, what does or does not fit with the CAPM?)
4. (5pts) Is the following statement True or False?[2] If we test these securities on the Fama-French model, the extra factors will boost the r-squared of the regressions, which makes it a more accurate pricing model.

[2] Either way, explain why you think it is True or False.