FINM 25000 **Mark Hendricks**
Summer 2022

Midterm (A)

Due on Monday, July 11, at 9:00pm CT.

You have **180 minutes** to work through **120 points**. Pace yourself accordingly. If you finish early, you are welcome to submit your work and leave the exam.

The exam uses data from the Github repo, (also posted on Canvas with the exam questions, for your convenience.)

- The file is `midterm_A_data.xlsx`.

1 Return Analysis (25pts)

This section only uses the excess return data from the `assets` tab.

1. (a) (5pts) For each of the 10assets, report the following **annualized** excess return statistics:
   - mean
   - volatility
   - Sharpe ratio

   (b) (2pts) Which asset has the
   - highest mean return?
   - highest Sharpe ratio?

2. (5pts) For each of the 10assets, report the following statistics (no annualization needed).
   - VaR (0.05). That is to say, the 5th quantile of returns.
   - CVaR (0.05). That is to say, the average of the returns less than the 5th quantile.
   - 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) Which pair of assets has the highest correlation? And the smallest correlation?

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

2 Mean-Variance Optimization (35pts)

This section only uses the excess return data from the `assets` tab.

1. (10pts) Calculate the weights of the tangency portfolio formed from the 10assets.
2. (a) (5pts) What are the weights of the optimal portfolio, w^*, with a targeted mean excess return of 0.01 per month?
   (b) (5pts) Is the optimal portfolio, w^*, invested in the risk-free rate?
3. (5pts) Report the mean, volatility, and Sharpe ratio for the optimized portfolio, w^*, (calculated in the previous question.) Annualize the statistics.
4. (5pts) Suppose an endowment is optimizing the multi-asset-class ETFs we used in our case study of Homework 1.

   Briefly describe one thing that should be considered in deciding whether to make Bitcoin an (additional) asset class for the endowment's allocation.
5. (5pts) In Homework 1, we tried estimating the mean-variance solution using data from 2009-2020 and testing it out of sample in 2021-2022.

   We found the out-of-sample performance of the MV solution was **worse** than an equally weighted portfolio.

   Explain from a technical perspective why MV failed out of sample.

3 Pricing (25pts)

This section uses the `factor` data in a factor pricing model for testing the `asset` data.

1. (10pts) Test a 3-factor pricing model on the 10assets. All this data is already given in excess returns, so no further adjustment is needed.

   Report the

   - annualized alphas
   - annualized Information ratios
   - r-squared statistics
2. (5pts) Which asset does the pricing model fit best?
3. (5pts) Instead of the 3-factor model above, suppose the CAPM is true and fits perfectly in our sample.

   For n assets, what do we know about their...

   - time-series r-squared metrics?
   - Treynor Ratios?
   - Information Ratios?
4. (5pts) Suppose the CAPM is true and fits perfectly in our sample, yet we estimated the 3-factor model as above.

   Would the betas on the extra regressors (HML and RMW) be zero?

4 Forecasting (35pts)

This section uses the MKT factor from the `factors` tab as well as the risk-free rate, RF, from the `risk-free rate` tab.

1. (7pts) Forecast the market return, MKT, using the lagged risk-free rate as a signal.

   Report the beta and r-squared from the regression.

2. (5pts)

   Calculate the fitted values.

   $$\hat{y} = \alpha + \beta x_t$$

   Use them to calculate the weights:

   $$\begin{aligned} w_t =& 100\hat{y}_t \\ =& 100(\alpha + \beta x_t) \end{aligned}$$

   Report the final value in the timeseries of w_t.

3. (8pts)

   Use the weights to calculate the strategy return:

   $$r^x_{t+1} = w_t r^{\text{MKT}}_{t+1}$$

   Report the strategy's **annualized**

   - mean
   - volatility
   - Sharpe ratio

4. (10pts)

   Estimate the factor decomposition of the strategy versus the MKT factor:

   $$r^x_t = \alpha + \beta r^{\text{MKT}}_t + \epsilon_t$$

   Report

   - the annualized alpha and Info Ratio.
   - beta
   - r-squared.

5. (5pts)

   Suppose you wanted to hedge the timing strategy against movements in MKT. Based on the previous calculation, explain how to set up this hedge.