**University of Chicago**
**Masters in Financial Mathematics**

**FINM 36700** **Mark Hendricks**
**Autumn 2019**

# Midterm

Coding Portion

- This examination consists of two parts: a written portion and a coding portion. This document contains the coding portion. You have **90** minutes to complete this portion. Pace yourself appropriately.
- You will complete this portion on your laptop, in class. You must submit your code via Canvas before the exam deadline.
- You must submit your code. Your results should be formatted in a document in Microsoft Word or nicely formatted in a Jupyter notebook. You will lose points if your results are not formatted in an easy-to-read way.
- This test is **"open-everything"**. This, however, does not include communicating with classmates or others via any messaging, emailing, posting, etc. Anyone caught with messaging software open will receive zero on this portion, regardless of intent.

| | |
|---|---|
| 1 | /10 |
| 2 | /10 |
| 3 | /10 |
| 4 | /20 |
| Total | /50 |

For this exam, use the included data file, `factor_model_data_with_momentum.xls`. This is the same file that we used for HW #3.

- The first tab contains the factors. Note that you need to compute,

$$\tilde{r}^m = r^m - r^f.$$

- The second tab contains monthly excess returns on 30 test portfolios, $\tilde{r}^i_t$, corresponding to equities grouped by industries.

We won't be using the other tabs in this exam.

1. (10 pts)

   For the 30 industry portfolios in the second tab of the data, compute the means and standard deviations of each. Be sure to annualize them. Plot the means on the y-axis and the standard deviations on the x-axis. In your report, only include the final plot.

2. (10 pts)

   Run single factor time series regressions for each of the 30 portfolios, using excess market returns as the single factor. Compute the Treynor ratio for each industry portfolio. Report the 5 portfolios with the highest Treynor ratio and the 5 portfolios with the lowest Treynor ratio. Additionally, report the average Treynor ratio among these portfolios.

3. (10 pts)

   Suppose that you can only invest in the 30 industry portfolios listed in the second tab. You cannot invest in a risky security. Use the appropriate formula from the notes to construct and plot the mean-variance efficient frontier. Your plot should resemble the one shown in Figure 1. It should have the axes appropriately labelled. (Though, you do NOT need to match the styling.) Be sure to annualize all statistics.

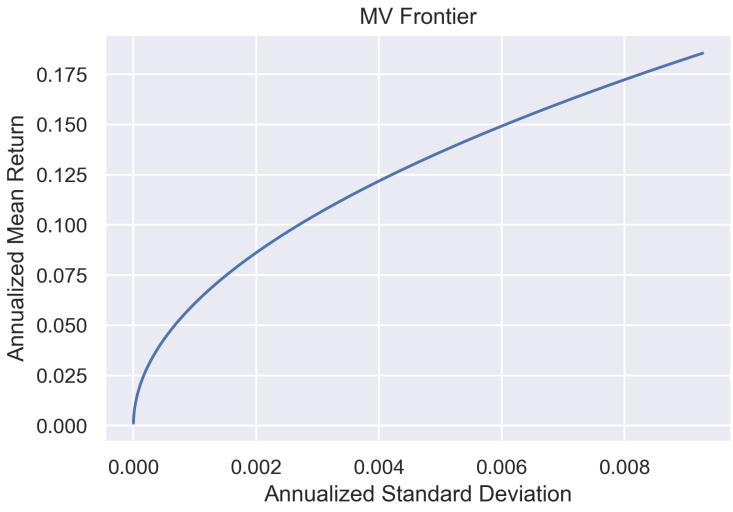


Figure 1: Mean-Variance Efficient Frontier

4. (a) (5 pts) Which industry has the highest skewness? List only the top 5 industries. List them in order from highest to lowest. Report the industry label and the skewness statistic associated with each. Don't scale skewness.

   (b) (5 pts) Compute the 10% level, 1-month Value-at-Risk of the Oil industry portfolio in terms of returns. Do NOT annualize the return statistic here. Give in terms of monthly returns.

   (c) (5 pts) Compute the expected shortfall at the 1-month, 10% level of the Oil industry portfolio. Again, do this in terms of returns. (The mean of returns that are less than or equal to the 10th percentile.)

   (d) (5 pts) Regress the oil industry portfolio on the excess returns of the market. Compute the information ratio resulting from this regression.