Assignment #2

Alphas, betas, and beyond

Required materials: Python

**Directions:**

1. Collect returns data for $N = 5$ different stocks, which each have $T$ observations, where $T$ is in excess of 10 years.
2. For each stock, estimate the full-sample CAPM factor model ($r_i^e = \alpha_i + \beta_i r_m^e + \epsilon$) using:
    a. Ordinary least squares
    b. Least absolute deviations
    c. Shrinkage estimator
    d. Bayesian regression (use your choice of prior; just say what it is)

3. Put the coefficient results from 2.a-2.c in a table. Plot the posterior distributions for each of the coefficients for 2.d.
4. Consider the estimates from 2.a. (Using the t-statistic) Do any of the stocks have alphas that are significantly different from 0? If so, which ones?
5. Out-of-sample tests:
    a. Consider a 60-month initial window.
    b. What are the 1-month out of sample root mean squared error (RMSE) for each stock when fitting returns using OLS with a:
        i. Rolling fixed 60-month estimation window
        ii. Cumulative rolling estimation window
    c. What are the RMSE from assuming an expected return of 0 for each stock?
    d. Plot the time series of regression coefficients for b.i and b.ii.
    e. For the rolling fixed 60-month window.
        i. Use the rolling factor model results to allocate your stocks into the maximum Sharpe ratio portfolio.
        ii. What is the out-of-sample utility for a mean variance investor with a risk aversion coefficient of 4? ($\hat{u} = \widehat{\mathbb{E}}\{r\} - \frac{1}{2} \cdot 4 \cdot \widehat{\mathbb{V}}\{r\}$)
    f. For the cumulative fixed 60-month window.
        i. Use the cumulative rolling factor model results to allocate your stocks into the maximum Sharpe ratio portfolio.
        ii. What is the out-of-sample utility for a mean variance investor with a risk aversion coefficient of 4? ($\hat{u} = \widehat{\mathbb{E}}\{r\} - \frac{1}{2} \cdot 4 \cdot \widehat{\mathbb{V}}\{r\}$)
6. Use the Kalman filter to plot the time series of the factor loading for each of the stocks over the full sample period.