CFRM 501 - Investment Science
Assignment 6

Due: December 7, 2020 - 11:59 pm

Late submissions will receive an automatic grade of zero.

Question 1: Download daily prices from November 1, 2015 to September 30, 2020 of the following equities: International Business Machines Corporation (IBM), McDonald's Corp. (MCD), 3M Company (MMM), and Wal-Mart Stores Inc. (WMT). Also download price data of the S&P500 ETF (SPY).

1. Let $\boldsymbol{r}$ represent arithmetic returns of each of the stocks, and let F represent arithmetic returns of the S&P index. Perform a regression analysis to estimate a 1-factor model:

$$\boldsymbol{r} = \boldsymbol{\alpha} + \boldsymbol{\beta} F + \boldsymbol{\epsilon}$$

2. Construct the matrix of residual errors $\hat{\mathcal{E}} = \mathcal{R} - \mathcal{F}\hat{\mathcal{B}}$ and compute the sample correlation matrix of these errors. Compare this to the sample correlation matrix of the original returns $\mathcal{R}$ and comment on the results.

Question 2: Download the file `data.csv` from Canvas. Each row represents a single data point observation of a 4-dimensional random vector $\boldsymbol{X}$.

1. Define $L = X_1 + X_2 + X_3 + X_4$ so you have 10,000 observations of L. Plot the histogram of L. Also compute its sample mean and variance.

2. What is the eigenvector corresponding to the first principal component of $\boldsymbol{X}$? How can the magnitude of the components of this vector be understood in terms of the behavior of $\boldsymbol{X}$?

3. Approximate $\boldsymbol{X}$ by using its first two principal components as factors (set the error terms to zero). Recompute the 10,000 observations of L with this approximation, compute its mean and variance again, and plot its histogram.

Continued Reading: Chapters 6, 7, and 9 of Asset Management by Andrew Ang must be completed before the final exam (December 14, 2020).