**Assignment 6**

All work to be done in 1 Jupyter NB.

1. **Problem 1 (25 points)**: K-Means and Macro Man on BBG
   1. Import FX spot rates from Currencies\_1y.xls.
   2. Calculate daily return.
   3. Calculate mean return and stdev of return.
   4. Perform K means using K = 3,4,5,6.
   5. Plot a 2x2 figure with scatter plots with each color representing a cluster and currency label on the scatter plot. Visualization exercise – your opportunity to play with graphics.
   6. Use elbow method discussed in class plus qualitative argument to recommend # of clusters.
   7. Discuss cluster traits.
2. **Problem 2 (25 points):** Shrinking the covariance matrix
   1. Read http://www.ledoit.net/honey.pdf, <https://scikit-learn.org/stable/modules/covariance.html#shrunk-covariance>. Write 2 sentences on your understanding of the methodology.
   2. Create a 1000x20 matrix “X” from random normal dist. Create new matrix X\* that is a copy of X. Replace last two columns with first column with 1e-4 random normal noise added to it.
   3. Calculate the covariance matrix of X and X\* (Sigma, Sigma\*) and the corresponding condition number.
   4. Shrink covariace matrix using OAS and Ledoit and Wolf. Calculate the condition number after shrinkage.
   5. One sentence on the difference between the two.
3. **Problem 3 (50 points)**: Hierarchical Risk Parity: use the price data provided in index\_prices.csv.
   1. Calculate Daily Returns
   2. Calculate covariance matrix
   3. Calculate condition number
   4. Use OAS, calculate condition number
   5. Perform agglomerative clustering
   6. Plot Dendrogram – describe the different clusters.
   7. Get HRP weights using provided functions.