FRE-6971 Final Project (Part 2 of 2), Spring 2017 (due 5/16/2017 at 12pm)

Instructions:

Your work for this final must be independent. It's understood that some discussions with classmates might occur, but I encourage you to work as independently as possible. Incomplete work is not a failure. Copying somebody else's work is.

Part 2, Data:

'Constant_Maturity_EDs.csv' contains constant-maturity Eurodollar rates we interpolated in Homework3 (feel free to use your own data). There are 19 time series in the file: 3m, 6m, ... 4.75y futures rates on 3M LIBOR.

Part 2, Historical samples:

June 2011 through Jan 2014, Training Sample (A)

June 2014 through June 2015, Cross-Validation Sample (B)

June 2015 through June 2016, Testing Sample (C)

Part 2, Steps:

1. Use Sample A to compute 3 cointegrated vectors (weighted calendar spreads) from the futures rates: [2y, 3y], [3y, 4y], [4y, 4.75y] and construct the following 2 signals for each of the cointegrated vectors:
   - AR(1) model fitted to each of the 3 cointegrated vectors (Signal 1)
   - AR(1) model fitted to each {cointegrated vector - EMA(α)} (Signal 2)

     http://pandas.pydata.org/pandas-docs/stable/computation.html#exponentially-weighted-windows
2. Compute half-lives (HL1) for Signal 1 models. Choose α to make sure that half-life of Signal 2 (HL2) is approximately 10 days.
3. For each cointegrated vector, define a Gaussian Mixture of Signals 1 & 2 (weight of the mixture, θ, is a free parameter you will determine during Cross-Validation).
4. We will use Cross-Validation Sample B to define a trading strategy and solve for the optimal weight of the Mixture. For simplicity sake, we will use the AR(1) estimations from the Training Sample A.
   - Trading Horizon (H): 5 days
   - For each day t in Sample B, compute t+H forecast, E[x(t+H)|t] using the Mixture Signal. x(t) is a cointegrated vector.
   - Define Expected Gains(t) = E[x(t+H)|t] - x(t)
   - If |Expected Gains(t)|>0.1 basis point, your trade is initiated, and you hold it for H days

- Positive Gains(t) indicate the x(t) is expected to increase, negative Gains(t) indicate that x(t) is expected decrease

- Compute cumulative realized trading gains for all trades by summing up returns of x(t) over the trading windows. Solve for optimal θ^* by maximizing these cumulative gains. We are ignoring all transaction costs in this calculation.

5. Test the optimized signal in the Testing Sample C. Apply any of the signal quality metrics we discussed in class.

6. Analyze results.

Part 2, Additional Instructions:

i. If you are having difficulties with the Gaussian Mixture - use Signals 1 & 2 (without mixing them), and optimize trading horizon (H) in the Cross-Validation Phase.

ii. If you understand what needs to be done, but you are struggling with code - for a partial credit it's acceptable to describe parts of your algorithm as a pseudo-code.