**Course in Derivatives**

**Programming Assignment #1**

**Due Date: Feb 3, 7pm**

In this assignment you will work with the “CornOilGold.csv” data set. This contains monthly prices for these three commodities front-end futures contracts. Prices are as of month end; if I refer to the return for a particular commodity, for example, as the return for December 2018, this means the return from the price given at the end of November 2018 to the price at the end of December 2018. Similarly, if I refer to a return for a particular commodity for the calendar year 2018, that would be the return from the price at end of December 2017 to the price at the end of December 2018.

Be sure that your code is generalizable to a similar data set with different inputs, as your code will be graded upon an alternative file (same structure, but different commodities and different prices). Please upload your code to the Dropbox folder on BeachBoard for “Programming Assignment #1”, in both .py and .ipynb format.

1. Calculate monthly returns for each of these commodities. Output a tuple (with length = 3) including the arithmetic mean monthly return for these three commodities across the entire observation period.
2. Output a tuple (length = 3) including the standard deviation for each commodity’s return across the entire observation period.
3. Output a tuple (length = 3) for the returns for these commodities for the month of October, 2008.
4. Output a tuple (length = 3) for the arithmetic mean monthly returns for each commodity over the calendar year 2009.
5. Output a tuple (length = 3) for the compounded returns for each commodity over calendar year 2009.
6. Annualize your answer from question 4 by multiplying the mean monthly returns by 12. Compare this arithmetic yearly return to the compounded (geometric) yearly return from question 5. Output a tuple (length = 3) of the differences between these two ways of calculating annual returns. Be sure to calculate as the geometric return minus the arithmetic return.
7. Each month, rank the commodities by their monthly return and assign them to a group with 1 = lowest return and 3 = highest return. For now, this is straightforward with only three commodities every month. In the future, we will group a larger number of commodities into three groups in a similar manner. Create three new monthly data series, one for each commodity, and store the ranking (1, 2, or 3) for each commodity for that month. Output a tuple (length = 3) showing the average ranking score for each commodity across the entire observation period.
8. Now we will create trend-following portfolios. Each month, we will follow an investment strategy that buys the future contract for the top-performing commodity in the previous month, and sells short the lowest-performing commodity in the prior month. (Be sure that you are using last month’s ranking variable and not the coincident ranking variable!) Start by forming a monthly time series for each of these three portfolios. For example, you could create a “Lowest” series and store the lowest ranked return each month into that series, and similarly create a “Middle” and “Highest” series including the appropriate returns. Output a tuple (length = 3) with the arithmetic mean monthly returns for these three portfolios, ordered as (lowest, middle, highest).
9. Create a series that represents the returns to an investment strategy that, each month, buys the top ranked commodity and sells short the bottom ranked commodity. (This is easily achieved by subtracting the “Lowest” series from the “Highest” series.) Calculate the average **annual** return (monthly arithmetic return times 12), the annualized standard deviation (the monthly standard deviation times the square root of 12), and the Sharpe ratio (annual return divided by annualized standard deviation) for this portfolio. Output these three summary statistics as a tuple (return, standard deviation, Sharpe ratio).