STAT449/649 Homework 1

In this homework you are given commodity future (WTI crude oil and Henry Hub natural gas) prices as of any historical trading dates from end of year 1999. Note: The data set has not been updated since 2022.

You are asked to work individually on this homework. You may ask the TA questions. Follow the generative AI guidelines we set for the course (see final syllabus).

1. Access cmegroup.com, search for CL and NG future contracts, read the contract specifications, then derive the last trading dates based on the contract specifications for all future contract months starting from January 2000. (1 point)
   https://www.cmegroup.com/markets/energy/crude-oil/light-sweet-crude.contractSpecs.html
   Henry Hub Natural Gas Futures Contract Specs - CME Group

2. Concatenate the price time series of future contracts on last trading dates to generate generic nearby time series. The first nearby means the front month future. The second nearby stands for the second month future. Then run summary statistics of **daily returns and monthly returns** for **the second nearby** and SP500(SPX). The summary statistics shall include 10th, 25th, 50th, 75th, 90th percentiles and mean, standard deviation, skewness, and kurtosis. Compare the summary statistics for WTI, Natural Gas and SPX. (2 points for STAT449, 1 point for STAT649)
3. Calculate carry as of each trading date and run summary statistics. The carry is defined as $\frac{F_1 - F_{13}}{F_1}$, where F_1 and F_{13} represent the first and 13th nearby respectively. Compare WTI and Henry Hub. (2 points for STAT 449, 1 point for STAT649)

4. Simulate the performance of a managed future (MF) fund with following parameters
   - Keep longing the second nearby, either WTI or Henry Hub
   - Nominal $10M on inception 1/1/2000
   - Assuming fully collateralized, meaning if oil price is $100, lot size is 1,000 barrels, then you can hold 100 contracts
   - Five business days before the last trading date, roll over the contract to the 3 nearby, then in 5 business days, the 3rd nearby becomes the 2nd nearby

   Plot the nominal value of the fund through the history, and make summary statistics of both daily and monthly returns, compare WTI and Henry Hub, and propose reason that make the skewness and kurtosis different between daily and monthly returns. (5 points for STAT449, 3 points for STAT649)

STAT649 Only

5. Compare the performance of your MF with United States Oil (USO) fund and United State Natural Gas (UNG) fund, comment on the difference in performance and identify the causes. You may want to refer to the prospectus of the two funds (3 points)
   https://www.sec.gov/Archives/edgar/data/1327068/000119312512265421/d335842d424b3.htm

https://www.sec.gov/Archives/edgar/data/1376227/000119312511333376/d265089d424b3.htm

6. Run 1-year rolling regression analysis for your MF with respect to SPX based on weekly returns. Comment on the beta (the coefficient of the regression). (1 point).