HOMEWORK 2

Please submit your homework to xm@bu.edu. Don't forget to attach your figures and code. Feel free to ask me if you have any question. GLHF! -Sean.

Problem 1: scaling behavior and power law

For this problem you need to find a NASDAQ company of which the stock has been publicly traded for at least fifteen years. Its P/E ratio (trailing twelve months) is between 15 to 25, and its beta is smaller than 2.0.

1. Find such a company. You may consider an investment!

2. We know that the log price return is defined as the difference between two consecutive log prices with time lag Δt. In this question, you should choose $\Delta t = 1, 2, 3, \ldots, 10$ days, generate ten 15-year-long arrays of returns with different Δt, and calculate their expectation and standard deviation correspondingly. Plot the expectation $E[\ln(P_{t+\Delta t}/P_t)]$ and standard deviation $\sigma[\ln(P_{t+\Delta t}/P_t)]$ with respect to Δt. They should both increase along with the time lag Δt. What are the scaling exponents for the expectation and standard deviation? i.e., find α and β so that $E[\ln(P_{t+\Delta t}/P_t)] \sim (\Delta t)^\alpha$ and $\sigma[\ln(P_{t+\Delta t}/P_t)] \sim (\Delta t)^\beta$. You may need log plots and linear fits to find the power-law relations.

3. If Δt changes, not only the expectation and standard deviation, but the shape of PDF itself will change as well. Draw the PDFs (or, normalized histograms) of returns with respect to $\Delta t = 1, 2, 3, \ldots, 10$ days. Remember that a PDF must be normalized. Find the peak of each PDF, $\max\{\mathcal{P}_{\Delta_t}\}$. It should decrease against the time lag Δt. Find γ, the negative scaling exponent which tells you the power law: $\max\{\mathcal{P}_{\Delta_t}\} \sim (\Delta t)^\gamma$.