# MF 803 HW 1
# Sketch of Solutions

September 28, 2018

Claim: in the solutions I won't give you detailed answers for all the questions. Instead, I'm trying to provide intuitions or algorithms for the most crucial and confusing parts.

## 1

To get annualized return, the formula is roughly

$$r_{annual} + 1 = (r_{daily} + 1)^{252}$$

since in practice we count 252 trading days per year. I notice that some of you calculate the standard deviation of daily return and mutiply it by $\sqrt{252}$, this is not true because we're not sure if the daily returns are independent from each other.
The monthly return follows the same principle.

(d) Notice first that the correlations are bounded between -1 and 1. If not, you must be wrong somewhere. The variation in time series can be caused by different stages of a bull (or bear) market. The variation in cross sections can be explained by different weights of sectors in SP Index.

(e) The beta and correlation should be positively correlated but the exact relationship is hard to tell from graphs. Looking at the formulas will be more intuitive:

$$\rho = \frac{Cov(r_{etf}, r_{spy})}{\sigma_{etf}\sigma_{spy}}$$

$$\beta = \frac{Cov(r_{etf}, r_{spy})}{Var(r_{spy})}$$

## 2

Notice first that we you simulate $dS_t$ and approximate $dt \approx \Delta$, $dW_t$ is not a random normal(0,1) but normal(0,$\Delta$).

(d) Both results should be very close, that's the whole point of Monte-Carlo on pricing options.

(f) The premium can never be negative otherwise it has arbitrage opportunity. For the European we obtain the payoff as the difference between the strike and the terminal value of the asset. So for the premium to be negative we would need to have the minimum value of the asset above its terminal value, which is impossible.

(g) When $\sigma$ is large enough, the premium is positively correlated with $\sigma$. The intuition is that $\sigma$ controls "how far" can stock price go during the path. The further it goes, the wider the range from which you can pick the optimal exercise price.