Homework #3

FE-570 S22

March 15, 2022

Problem 3.1.
Use the provided dataset `sampleTQdata.RData` which contains a tick level trades and quotes TAQ prices (level 1 data). This is the same dataset we used for the midterm exam.

```
library(xts)
library(highfrequency)

########################################
# load the TAQ dataset
Sys.setenv(TZ = "GMT")  # work in East Coast Time Zone
options(digits.secs=3)

load("sampleTQdata.RData")
```

Use this dataset to estimate the volatility of the efficient security price.

1. Calibrate the Roll model on the time series of trade prices p_t, and estimate the Roll model parameters c, σ_u. What is the estimated bid-ask spread $2c$?

2. Repeat the calibration, using this time the time series of the log-trade prices $\log p_t$. What are the parameters?

3. Compute the signature plot showing $\sigma^2_{day}(q)$ for lags $q = 1 : 100$. Recall that $\sigma_{day}(q)$ is the daily price volatility measured by keeping only every q-th trade price. For this part use the function `realizedVar(q)` defined as

```
realizedVar <- function(q){rCov(diff(p, lag=q, differences=1))/q}

# compute the signature plot sigma.day(q) = sqrt(RV(q))

sig_data <- NULL

for(q in 1:100){

  sig_data <- c(sig_data, sqrt(realizedVar(q)))

}

plot(sig_data, type ="l", main="Signature plot")
```

Comment on the shape of the signature plot. What do we learn from it?

4. Compare the daily volatility obtained from point 1. $\sigma^2_{day,Roll} = n_{trades}\sigma^2_u$ with the daily volatility obtained in point 3 with a lag q_{5min} corresponding to a 5 minute interval between trades, assuming that the rate of trading is constant during the day.

First determine the lag $q_{5min} = n_{trades}\frac{5}{390}$ and then compute the volatility.