Xuyang Liu
xyangliu@bu.edu

MF731 HomeWork 2 Part 1

1. VaR 1. VaR for a Portfolio of Microsoft, Apple and Google Stocks.

(a) The estimated mu and Sigma are shown below:

```
mu[-1] # mu for 8/31/21
```

```
array([0.00263687, 0.00238145, 0.00312769])
```

```
matrix([[9.47092473e-05, 8.21428718e-05, 5.37927754e-05],
        [8.21428718e-05, 1.58101963e-04, 7.23027640e-05],
        [5.37927754e-05, 7.23027640e-05, 1.02648243e-04]])
```

(b) (i)the results for empirical distribution are shown below:

```
The VaR of emprical full loss is 28072.07832181451
The VaR of emprical linear loss is 28518.35845134412
The VaR of emprical quadric loss is 28067.05184032034
```

(ii) the results for normal distribution using EWMA and standard eatimstors are shown below:

```
The VaR of simulation full loss is 12824.363958321215
The VaR of simulation linear loss is 12767.46428767112
The VaR of simulation quadric loss is 12142.339340669829

The VaR of simulation full loss is 30804.142089729598
The VaR of simulation linear loss is 30953.022771690412
The VaR of simulation quadric loss is 30368.61355517262
```

It seems that normal distribution using standard and empirical distribution results are about similar, but the normal distribution using EWMA results are different. From my perspective, that's might because using moving average we decrease the mean and deviation from a big picture.

2. VaR and Time Aggregation.

The results are shown below: (for details, please see the code file)

```
the 1 day VaR is about:  30.529933682155015
the 10 day VaR is about:  89.20855753972728
the result of one day VaR times Sqrt(10):  96.54412724950096
```

It's really close the result that professor obtained.

3.Backtesting VaR.

I got exceedances for empirical distribution about 44 and for EWMA about 80(in class we got 79, I think its because I keep different decimal).

The Average is about 75.4 and the CI is about [58.81194118269656, 91.98805881730357].