Week 4

Problem 1:

For the Classical Brownian Motion:

$$P_t = P_{t-1} + r_t$$

For the Arithmetic Return System:

$$P_t = P_{t-1}\left(1 + r_t\right)$$

For the Geometric Brownian Motion:

$$P_t = P_{t-1} e^{r_t}$$

Here is the table to show the simulation result and my expectation:

	Expected Mean	Fitted Mean	Exp SD	Fitted SD
Classical Brownian	100	100	0.02	0.02
Arithmetic Return	100	100	2	2
Geometric Return	4.6	4.56	0.02	0.02

From the above table, I think my simulation matched my expectation. For the Geometric return, it has a little different; however, I think it still match.

For the first two methods, I think the expected mean will equals to p(0) because these two simulation will not change the mean. For the Geometric return, I think it will close to log(p(0)). The result shows my expectation match the return.

Problem 2:

For this question, I firstly implement the return_calculate function and calculate the arithmetic returns for INTC. I also remove the mean.

After that, I calculate the VaR, Here is the results:

	1% VaR	5% VaR
Normal Distribution	-4.87%	-3.44%
Normal with EWV	-3.70%	-2.61%
MLE fitted T distribution	-4.92%	-2.63%
Historic Simulation	-11.72%	-2.06%
Empirical Distribution (in sample)	-6.28%	-2.07%
Empirical Distribution (out sample)	-5.86%	-2.63%

From the above table, I find the VaR for first three methods are in similar range. The Normal Distribution will return higher VaR compare to Normal with Exponentially Weighted Variance and MLE fitted T distribution. The Historic Simulation will return higher result on 1% VaR and lower result on 5% VaR. The Empirical Distribution also return higher result on 1% VaR and lower result on 5% VaR.

When I compare the Empirical Distribution using out sample, I find the normal with EWV and MLE fitted T distribution has a very good performance.

I think for small dataset, the Historic Simulation will not accurate compare with other methods.

I think other models have good ability to describe the risk in this stock because the result they return are close to the out sample data real market return in recent weeks.

Problem 3:

For this question we will calculate the VaR for each portfolio and the overall portfolio.

Here is the VaR result:

Portfolio	PV	Delta VaR	MC VaR	MC VaR KDE	Historical	His VaR KDE
A	**364,532.9604**	**6003.221298**	**6031.353035**	**6133.180296**	**5298.490899**	**6607.530596**
B	**326,770.1488**	**4886.596042**	**4713.121717**	**4877.027258**	**5576.130248**	**5948.630563**
C	**326,727.670717**	**3679.556069**	**3678.559149**	**3809.341859**	**3307.758233**	**3987.124178**
All	**1,018,030.78**	**14100.55012**	**14159.42006**	**14209.99006**	**12460.87375**	**15411.86675**

In my perspective for the first three methods, they have similar estimation for the VaR The historical VaR will influence a lot due to the data and Historical VaR with KDE will estimate the VaR much higher than other methods.

I think for the risk purpose, if we much more care about the risk, we can use Historical VaR with KDE. Otherwise, I think the Delta, MC and MC with KDE will has similar return for VaR.