Ma323-LAB 09

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This Lab assignment was done by using the values of μ = 0.0002981060700200021 and $\sigma^2 = 0.000496475360718651$ and S(0)=185.399994 as calculated in Lab 7.

For simulating the Jump diffusion model with the ratio of asset price after and before a jump following the log-normal distribution LN(μ , σ^2), I have used the first approach i.e. Simulating the dates to generate the path of stock prices S(t).
The stock prices S(t) were generated for N ~ Poisson (λ) for λ = 0.01.

Mean and variance of the price of avg price Asian put option calculated without using control variate with the payoff formula given in the lab assignment, and are tabulated below:

$\mu^{\wedge}$(sampling mean)	$\sigma^{\wedge 2}$(sampling variance)	$\sigma^{\wedge}$(sampling standard deviation)
18.126696976444737	141.5480987072622	11.89739

The calculated 95% Confidence interval without using control variate is:
[17.38928855772834, 18.864105395161136]

Mean and variance of the same avg price Asian put option calculated by using the price of an European put option as the control variate are tabulated below:

$\mu^{\wedge}$	$\sigma^{\wedge 2}$	$\sigma^{\wedge}$
18.126696976444737	41.23432433411153	6.421395

The calculated 95% Confidence interval after using control variate is:
[17.728694739815438, 18.52469921307403]

Note:
- After introducing the control variate the variance decreases from 141.5480987072622to 41.23432433411153.
- It can be seen that even after introducing the control variate the $\mu^{\wedge}$ remains same which shows that the control variate (European put option price) is an unbiased estimator.

The output of the code can be seen below:

```
C:\Users\harshy\Desktop\Ma323_Monte_Carlo_Simulation\Lab9>python "180123015-harsh .py"
Mean of the price of avg price Asian put option calculated without using control variate is: 18.126696976444737
Variance of the price of avg price Asian put option calculated without using control variate is: 141.5480987072622
Confidence Interval without using the control variate: [ 17.38928855772834 , 18.864105395161136 ]
Mean of the same avg price Asian put option calculated by using the price of an European put as the control variate is: 18.126696976444734
Variance of the same avg price Asian put option calculated by using the price of an European put as the control variate is: 41.23432433411153
Confidence Interval without using the control variate after using control variate: [ 17.728694739815438 , 18.52469921307403 ]
```

Reference for data: https://finance.yahoo.com/quote/SBIN.NS/history/