EUROPEAN OPTION PRICING

OBJECTIVE:

To Value an ATM European Call Option using the **Black-Scholes-Merton Model** and using **Monte-Carlo Simulation.**

Underlying: Amazon Shares

Time to Expiry: 1 year

BLACK-SCHOLES MODEL

$C = S*\Phi(z1) - K*\Phi(d2)*\exp(-r*t)$

We will use the 10-year US T_bond Yield as a Proxy for the risk-free rate.

r=0.0425

MONTE-CARLO SIMULATION

We continue with the above assumptions and the required parameters.

We assume the values of mu,Sigma,T as before.

N : Number of time steps

we assume N=252 (252 Trading days in a year)

i.e We simulate Share Price per day.

ASSUMPTIONS

1. Share Price follows a Geometric Brownian Motion.

2.W is a Standard Brownian Motion

3. $dW \sim N(0,dt)$ [$dW(t) = W(t+1)-W(t)$]

4. $W \sim N(0,t)$

5.We use the closed form solution of the SDE $dS(t)=S(t)*[mu*dt+Sigma*dW]$

The solution being

$S(t) = S0 * \exp((mu-0.5*sigma^2)*T + Sigma * W)$

S(t) is the price of the share at time t

CONCLUSION

Call Option Price using the BSM model is **7.5984742787065045 $**

Call Option Price using Monte Carlo Simulation is **9.153387804513887 $**

The Estimates are different from each other, but some degree of randomness is expected when we are simulating Share Prices.

If we re-run the simulation, the Simulated estimate may/may not differ by a greater degree.

In order to increase the accuracy of the estimate, we can increase the number of sample paths.