# Computational Finance

Jan 30, 2023

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Available time: 90 minutes

## 1 Exercise 1

Consider an underlying asset that evolves according to an exponential Lévy model (Extended Variance Gamma) and a knock&out call option with maturity $T = 2$, strike $K = 100$ and barrier $L = 80$ and $U = 110$. Assuming the following parameters

$$\sigma_{VG} = 0.12,\ \theta_{VG} = 0.03,\ k_{VG} = 0.20,\ \sigma_{GBM} = 0.4$$

a value for the asset $S_0 = 95$ and an annual risk-free rate $r = 3.67\%$, calculate the option price with:

1. Monte Carlo simulations with and without variance reduction using antithetical variables and control variables. The candidate compares the accuracy of the methods and their computational cost, as the number of simulations varies, commenting on the results obtained.
2. a finite difference method, starting from the file Exercise1.m. Compare the methods in terms of accuracy and computational cost.

## 2 Exercise 2

Consider an underlying that evolves according to a Merton-type Lévy exponential model. Assuming the following parameters of the Merton model

$$\sigma = 0.126349,\ \mu = -0.390078,\ \lambda = 0.174814,\ \delta = 0.338796,$$

a value for the asset $S_0 = 95$ and an annual risk-free rate $r = 3.67\%$:

1. compute the price of a floating strike Asian put option with payoff

$$\left(S_T - \frac{1}{N}\sum_{i=1}^{N} S(i\Delta t)\right)^+$$

with maturity $T = 1$, $N = 52$ and $\Delta t = T/N$. Consider MC methods with and without variance reduction (antithetical or control variable) and analyze the confidence intervals as the number of simulations increases. Comment the results.

2. Compute the price of a weekly monitored up-and-out put option with strike K=95 and barrier U=125.

3. Calculate the price of a continuously monitored up-and-out put option with strike K=95 and barrier U=125. Use a finite difference method starting from Exercise1.m. Compare with the weekly monitored option price, and comment.