2017 R MFE Programming Workshop Lab 4

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1 Black-Scholes Formula

The file *optionsdata.csv* contains the parameters for various options. Read in this file and compute the Black-Scholes price for these options (you did this for lab 1 in week 2).

2 Monte Carlo Option Pricing in R

Assuming that a stock starts at price S_0, one random realization of the price at time T (under the risk-neutral pricing measure, which you will learn about in your derivatives class) can be modeled as:

$$S_T = S_0 \, e^{\left(r - \frac{1}{2}\sigma^2\right)T + \sigma B_T}$$

Where $B_T \sim \mathcal{N}(0, T)$ is a normal random variable with zero mean zero and *variance* equal to T.

Given that a call option pays off, $\max\{0, S_T - K\}$, we can evalute the price of the option using Monte Carlo simulation as the discounted expected payoff in a few simple steps:

1. Generate a large number (say 10,000) of random values for the terminal stock price S_T
2. Evaluate the option price at each terminal price
3. Average over the option prices
4. Discount this expected final value by multiplying by e^{-rT}

These steps are equivalent to evaluation of:

$$\mathbb{E}\left[e^{-rT} \max\{0, S_T - K\}\right]$$

Write these steps into a R function and check the results with the closed form solution from the Section 1 above.

3 Monte Carlo Option Pricing in C/C++

Convert the R simulation code to C++. Run the C++ code in R. Use the package `rbenchmark` to compare the speed of the two simulations.