

2016 R MFE Programming Workshop Lab 4

Brett R. Dunn

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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 in week 1).

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:

$$S_T = S_0 e^{(r - \sigma^2/2)T + z\sigma\sqrt{T}}$$

Where z is a standard normal random variable.

Given that a call option pays off $\max\{0, S_T - K\}$, we can evaluate the price of the option using Monte Carlo 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:

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

Write these steps into a R function and check the results with the closed form solution from the previous exercise.

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.