October 03, 2024

Project 2: Monte Carlo Valuation of Options

Valuation of Calls and Puts using the correct Process for S

As with project 1, I provide a template, but you must adjust it to use the specifications for this project Fall 2024 as laid out below!

In this tab of the option pricing spreadsheet we are going to use the correct process for **S** to model $\mathbf{S_T}$ using a Monte Carlo simulation technique. To do this, we can model the share price S very much like we have done in project 1, except now with a drift term and a coefficient for the dz process. And now, instead of modelling the path for S, we will use a closed-form formula for S_T itself and, since these options are European style, we don't have to model the path of how we are getting to S_T.

The formula that was developed for this process in the 1970s is included in the slides and in the spreadsheet template and was discussed in class.

$$S_T = S_0 * e^{(\mu - \sigma 2/2)T + \sigma\varepsilon\sqrt{T}}$$

Once we set the time **T** at which the option expires, a strike price **K**, a starting share price $\mathbf{S_0}$, an interest rate **r**, and a volatility for the stock of **σ** then the only unknown in that process is **ε** which we can simulate.

Assume:	Share price (S_0):	**$130**
	Strike Price (K):	**$130**
	Risk-free rate (r):	**4.75%** continuously compounded
	Stock volatility (σ):	**33%**
	Term of the option (T):	**4** months

To value a Call or Put

- Calculate S_T for each trial using the above formula. Do that over **12,500 trials**
- For each trial, calculate the payout from the option as either 0 or PV(S_T – K) for Calls and PV(K – S_T) for Puts. The value of the option for a trial is then simply the PV of the expected payout just calculated

- Then take the simple Average() over those PVs of payoffs and that is the value of the option !!!!!

To calculate the Standard Error (SE) of the estimate

- The SE of the estimate for the value of the option is calculated as the:

(Standard Deviation calculated over the 12,500 Option values) / sqrt(# of trials)

In other words, the SE is lower the greater the denominator, i.e. the higher the number of trials calculated in the Monte Carlo.

To calculate the **97.50%** confidence interval

- The true option value lies between a lower and higher bound with a probability of 97.5%. Calculate the values the true option value is bounded by as follows:

[Option Value – 2.24*SE)] and **[Option value + 2.24*SE]**

Required Output

Call option Value
Call option value Standard Deviation **(try and use STDEV.p function in Excel, but either one is acceptable)**
Call option Standard Error (SE)
Call option **97.5%** confidence interval

Put Option Value
Put option value Standard Deviation **(try and use STDEV.p function in Excel but either one is acceptable)**
Put option Standard Error (SE)
Put option **97.5%** confidence interval

***** You must use the template provided for your submission to be considered for grading. *****