

## **Assignment 2: Option Pricing Algorithms**

### **Overview**

For this assignment, we will implement the four option pricing methods we have covered in the course:

1. Monte Carlo simulation
2. Binomial Option pricing model
3. Black-Scholes
4. Put-call parity

Write the code to implement the option pricing algorithm in a programming language of your choice. I want you to write your code before venturing onto the internet. You will find many implementations on line. These will be useful to check your results.

### **Model Parameters**

We will price options on a stock with 15% annualized volatility of log returns. We will assume that when the option is valued:

1. The stock price is \$50
2. The stock pays an annualized 2% dividend. The dividend is paid continuously throughout the year.
3. The annualized risk-free rate is 5% (at a continuously compounded rate).

We will value European put and call options. Both have a strike price of \$55. Both options will expire one year and two months from now. Assume a 360 day year, with 30 days in each month.

### **Monte Carlo simulation**

Use Monte Carlo simulation to value the put and call.

What are the option prices when the number of iterations,  $N$ , equals 1,000? 10,000? 100,000?

For each simulation:

1. Report the option price.
2. If the simulation is for the call option, price the put option using put-call parity and the call option value from the Monte Carlo simulation.
3. If the simulation is for the put option, price the call option using put-call parity and the call option value from the Monte Carlo simulation.
4. Report the simulated option prices and option prices using put-call parity. What happens to the difference between the put-call parity price and the simulated option price?

### **Binomial Option pricing**

Find the price of both put and call option when the stock follows a binomial process.

1. What are the option prices when the number of time steps in the binomial tree equals 100? 500? 1,000?
2. If the binomial tree is for the call option, price the put option using put-call parity and the call option value from the binomial model.
3. If the binomial tree is for the put option, price the call option using put-call parity and the put option value from the binomial model.
4. Report the binomial option prices and option prices using put-call parity. What happens to the difference between the put-call parity price and the simulated option price?

### **Black-Scholes**

4. Compare the Monte Carlo and Binomial option prices to the prices from the Black-Scholes option pricing model. Which model, if any, is closest in value to the option price from Black-Scholes?

## Deliverables

This report is due on 26 April at 5 pm in the ESD 40.242 homework box. Work in groups of up to five people to produce the written report.

Please submit a hard copy (paper copy) document with your responses to the tasks. The document should use 12 point font, A4 paper and 1.5 line spacing. Follow the format below:

Executive Summary (maximum 1 page) highlighting what you feel are the most significant results of your analysis.

Monte Carlo Prices and answers to questions

Binomial Tree Prices and answers to questions

Black-Scholes and answers to questions

Bibliography

Computer code **with comments**

Include tables and/or figures addressing the requested data analysis in the body of the report. Each table should have a self-explanatory title, and include labels for the numerical information presented.

Note: If you draw on outside sources when writing your report, you must cite the source and include the source in a bibliography. This includes any graphs or figures you may happen to find on the internet. Use the APA style when citing works.

**If you draw on outside sources when writing your report and do not cite these sources and reference them in a bibliography, you will receive a 50 (fifty) percent deduction on your final grade.** If you are unfamiliar with the APA style, please google “APA style” for more information.