

# T-811-Project 2

October 15, 2021

## 1 Introduction

In this project I will ask you to value financial options using various methods. You may wish to read up on options using outside material, but relevant information is presented in this project description, lecture notes or in lectures.

Please include an explanation of what you are doing and why in your report. Include relevant graphs as you please, and mathematical formulae you use. 10% of the grade will be for good presentation of your results. The other 90% is for correct answers.

Include your code. I will not grade you on efficiency of code, only correctness.

## 2 Project

You will be valuing options on Apple that expire on 2022-04-14.

Assume an interest rate of 2%.

Assume no dividends.

As of writing, Apple is trading at 143.76\$. Make your start date today, October 15th 2021, for the purposes of time calculation.

The annualised return is 8,21%, and the annualised volatility is 11,63%.

### 2.1 The Black-Scholes model

Using the Black-Scholes formula,

1. Find the price of a European Call option with Strike price 180.
2. Find the price of a European Put option with Strike price 110.

### 2.2 Binomial Tree

Using a binomial tree with 30 steps, and again for 100 steps,

1. Find the price of a European Call option with Strike price 180.
2. Find the price of a European Put option with Strike price 110.

Include at least a portion of one of your trees in your report.

## 2.3 Simulation

Assume that the Apple stock price follows a Geometric Brownian Motion. Using simulation, simulate price paths and

1. Find the price of a European Call option with Strike price 180.
2. Find the price of a European Put option with Strike price 110.

## 2.4 Barrier Options

A Down-and-in option is an option that only pays if the underlying has reached a certain level before expiry. This level can be different from the strike price. For example, a Down-and-in call option with strike price 100 and barrier 80 would only pay out if the stock price goes down to 80 at some point before expiry, and then ends up above 100 at expiry. If the stock price remains above 80 for the entire time, it pays nothing, no matter how far above 100 it is. A down-and-out works the same way except that if it reaches the barrier it does not pay out. The same holds for up-and-in and up-and-out options.

Using the same parameters for Apple as before, use simulation to

1. find the price of a Up-and-in put option with strike price 130, and barrier 150.
2. find the price of a down-and-out call options with strike price 160, and barrier 130.