# Homework 3


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# How to Run

- Download and extract the zip file
- There are four c++ files, namely `main.cpp`, `Option.cpp`, `OptionPrice.cpp` and `UnitTest.cpp`.
- Compile the program using following command

## Compiling

```
g++ -o A1 -std=c++11 main.cpp Option.cpp  OptionPrice.cpp UnitTest.cpp
```

## Running the code

```
./A1
```

# Implementation details

## BSM model

- The values of `d1` and `d2` are calculated using the formulas given in the `IntroductiontoOptions_Sept17_19.pdf` file in the class.
- Then we compute the value of option using the analytical formula of the Black–Scholes model (again as given in the handout)
- The standard normal function was implemented based on lab 1. It estimates the normal distribution.

## Binomial Option Pricing model

- I have set the number of levels in the tree to be a constant number 50. This was the number that
- I first compute entire forward tree. The values of each nodes are stored so that they can be utilised later if required.
    - The tree is stored in a `vector<vector<double>>` data structure.
- Once the forward tree is constructed, we calculate the terminal nodes of the backwards tree using the strike price and the terminal values of the stock price.
- Once the terminal nodes is computed, we compute the value of the risk neutral probability measures p and q to compute the remaining nodes of the tree in backward direction.
- Here also, the entire tree is saved in `vector<vector<double>>` , and thus, saving all the intermediate values in the tree.
- The following function computes the backwards tree

# Unit Tests

- Online calculator was used to compute the prices of options using black-scholes model.
    - This calculator can be found at https://goodcalculators.com/black-scholes-calculator/
    - These test cases were encoded in a function, which is run at the beginning of the main file.
- One test was also run to regenerate the results from Homework 3 in Stochastic Processes in Finance.
    - This test can be found in the results snapshot below.

# Results

- Following snapshot contains the results of the experiment.