MATH 6205 - Numerical Methods for Financial Derivatives
Fall 2018

Purpose:

The objective of this Python program is to compute the prices of European calls and puts using Fourier transform techniques. Geometric Brownian Motion as the underlying diffusion process for the Stock price. Under risk neutral evaluation, the Brownian Motion is transformed in such a way that we can make use of Fourier transform provided the characteristic function is known. The pricing integrals using the Fourier transform and inverse Fourier transform are derived and then the summation is approximated using the Trapezoidal rule. Half frequency domain and Full frequency domain are used to compute the option prices. The algorithm gives us the European call or put option prices based on the dampening factor(alpha) give. For a positive alpha, it gives us the European call option price where for negative alpha, we will get the European put option price. The input parameters required are provided by the user.

Output:

```
In [171]: runfile('/Users/khan/Desktop/Sem-III/MATH 6204/hw6_Mohammed_Ameer_Khan.py', wdir='/Users/khan/
Desktop/Sem-III/MATH 6204')
Reloaded modules: hw6_Mohammed_Ameer_Khan

In [172]: runfile('/Users/khan/Desktop/Sem-III/MATH 6204/main3.py', wdir='/Users/khan/Desktop/Sem-III/MATH
6204')

 Table 1: European Call option values using Fourier Transform for different frequency domains(alpha)

        Full Frequency Domain  Half Frequency Domain
alpha
2.5                 31.792518              31.792518
5.0                 31.792518              31.792518
10.0                31.792518              31.792518


 Table 2: European Put option values using Fourier Transform for different frequency domains(alpha)

        Full Frequency Domain  Half Frequency Domain
alpha
-2.5                 7.890872               7.890872
-5.0                 7.890872               7.890872
-10.0                7.890872               7.890872

In [173]:
```

Analysis:

The Fourier transform techniques are used to calculate the prices of European call and put options. The main observation here is that the option prices for both European call and put are not changing with respect to the dampening factor(alpha) or with respect to the frequency domain. In case of the frequency domains, we took the real part of the complex number for half frequency domain but for the full frequency domain, our number of frequencies (N) varied from -N to N and then we had a ½ factor which wasn't present for half frequency domain. In case of full frequency domain, the imaginary parts cancel each other and we are left with only real part which is equal to half frequency domain value since we took only the real part in half frequency domain.