**Quantitative Financial Analysis (Spring, 2015)**

**Midterm Exam, 1.5 Hours**

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| *Your Name*: |  |

**Instructions:**

* When complete, zip up your original Matlab files and bring your laptop to the instructor.
* Please use *DC\_52\_Midterm\_Exam\_your name* as the name of your zip file (Example: *DC\_52\_Midterm\_Exam\_StuartUrban*)
* Name your Matlab files appropriately so that I can tell what they are.

Before Leaving the Classroom

* You must verify that the instructor retrieves your Matlab code.
* You MUST return these exam sheets to the instructor.

**Exam Policies:**

* Nothing may be on your desk except for scratch paper and the school laptop
* No talking with classmates or looking at their work
* You must sign the Honor Code statement below prior to beginning the exam:

**I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_( student name), pledge that the work I am submitting is of my own ideas and the work of others will be properly cited. It adheres to the Carey Business School’s Honor Code. I will strive for excellence, honesty, integrity and originality in the work I submit, both individually and as a member of a group.**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Signature**

**General Parameters:**

* **Trading days per year = 250**
* **For all stock price simulations, use the following stock price movement process (note that the GenerePaths() function from in-class examples already uses this process):**
  + **, where is distributed standard normal and simulated using the randn() function in Matlab.**

1. **Handling Vectors In Matlab (10 points)**

The function below can calculate the payoff for an option given a single stock price at maturity, sT, and two strike prices. Please re-write this function so that it can take a vector of values for sT, then write a Matlab script that calls the new function to calculate the payoffs, and plot those payoffs on the Y axis with the sT values on the X axis, passing in the following parameters when you call your function:

* sT is a vector with the values from 10 to 50, incrementing by one.
* strike\_price1 is 15
* strike\_price2 is 40

function the\_payoff = crazy\_payoff(sT,strike\_price1,strike\_price2)

if (sT >= strike\_price2)

the\_payoff = 12;

elseif (sT >= strike\_price1)

the\_payoff = 30;

else

the\_payoff = 6;

end

1. **Probability of Portfolio Losses**

Suppose your boss wants to you to estimate the probability that your firm’s holdings in a particular stock will drop by more than 10% over the next year. You can accomplish this through Monte Carlo simulation using known parameters for that stock.

Relevant parameters: T = 1 year, s0 = 42, µ = 0.1, and σ = 0.2

This equation will calculate the probability that the portfolio will lose over 10%:

, where, E is the expected value, and where is 1 when the relation is true and zero otherwise.

Please compute the relevant probability and standard errors using Monte Carlo simulation, using the number of Monte Carlo trials, N = 10, 100, 1000, 10000, 100000 and 1 million. **(15 points)**

1. **Long Call Ladder Strategy (plotting)**

A long call ladder strategy involves buying one call that is in the money, while selling one that is at the money and one that is out of the money.

1. Write a Matlab function that returns the payoff of a long call ladder strategy, taking the following as inputs:

* stock\_price – a vector of stock prices at option maturity
* k\_itm – the in-the-money call price (we are long in this call)
* k\_atm – the at-the-money call price (we are short in this call)
* k\_otm – the out-of-the-money call price (we are short in this call)

Use this function to calculate the payoff of a long call ladder strategy when the stock price at maturity varies from 20 to 50 (incrementing by 1), with:

k\_itm = 30, k\_atm = 35 and k\_otm = 40.

Plot these payoffs with the stock price at maturity on the X axis and the long call ladder payoff on the Y axis. **(10 points)**

1. Use Monte Carlo simulation to compute the price and standard error of a long call ladder strategy when N = 10; 100; 1,000; 10,000; 100,000; and 1 million using the following parameters:

Initial stock price s0 = 35, annual volatility σ = 0.20, the strike prices from part (a), risk-free interest rate r =0.1, maturity = 6 months. **(10 points)**

1. **Range Options (MC and plotting)**

Range Options are options with discontinuous payoffs. A range option pays off nothing if the asset price, sT, ends up above the upper strike price or below the lower strike price at time T, and pays a fixed amount, Q, if it ends up between these strike prices. Assume strike price = 45 and =39, time to maturity T = 0.5 years, initial asset price s0 = 42, risk free interest rate r = 0.1, annual volatility σ = 0.2, and the fixed pay-off amount Q = 10.

1. Please use Monte Carlo methods to price this option and compute the standard error, showing convergence to a particular price (using N = 10, 100, 1000, 10000 and 1 million). **(15 points)**
2. The value of a range option is , where , and N(x) is the cumulative distribution function of the standard normal distribution, normcdf() in Matlab. Please use this formula to compute the value of the call for s0 = 20:60 and plot the results. **(15 points)**

**HINT: You can use your outputs for part (a) to check your output for part (b) and vice versa by zooming in on the plot at the appropriate point.**