ITM option probability calculator – collective/team Homework
In-class, February 10, 2020

Mudd (Palm Island Traders) finance

1. Find this Jupyter Notebook (linked from the same page as this):

https://www.palmislandtraders.com/econ136/option_itm_prob_student.html

option_ITM_prob_student

This program allows calculation of the the probability that a call option will be ITM (and OTM of course).
This model assumes the Markov chain assumption, which uses an adjustment for the ITO method of half variance.
This also allows for drift (alpha) and requires a drift input, which can be zero.

In [1]:
```
import math
import numpy as np
```

Part 1 - a call option

In [2]:
```
sto_pr = 100.0              # 100.0  default
str_pr = 105.0              # 105.0
daily_vol = 0.025           # 0.025 (sigma)
alpha = 0.000               # 0.000 or 0.000794
days_to_expiry = 16.0       # 16.0
PROVIDE = "junk string"     # replace with solutions
```

In [3]:
```
sto_pr_exp = PROVIDE # Expected value of stock price allowing for drift
```

In [4]:
```
dur_vol = PROVIDE  # Duration volatility
```

Note: The Ito half-variance adjustment simply requires adding half duration volatility to the normalized log spread, as shown in the third step below (but the team can arrange these three equations in whatever way works for you .. this is just being suggested as step-wise).

In [5]:
```
log_spread = PROVIDE  # Calculate the unadjusted log spread
```

In [6]:
```
norm_ls = PROVIDE  # Calculate the unadjusted normalized log spread (normalize to SN)
```

In [7]:
```
norm_ls_adj = PROVIDE # Adjust the normalized log spread for the Ito method.
```

In [8]:
```
prob_itm = PROVIDE  # Use your choice of the cumulative SND to solve for the probability of being ITM.
prob_itm                              # 0.295322 at default zero drift, 0.340587 at default non-zero drift
```

Out[8]:
```
'junk string'
```

Part 2 - a put option

Now, using these new values, compute the probability that a PUT is in the money. (**Hint** Believe it or not, you have to only change **1 equation** of all of those above to make this calculation!

In [9]:
```
str_pr = 95.0        # The default put strike .. use all other values from the call.
                     # 0.321706 at default zero drift, 0.24511 at default non-zero drift
```

In [10]:
```
print("Calculation complete")
```

```
Calculation complete
```

2. Give your team access to the lecture entitled "Stock Price Probability Estimator" and review the Markov Chain formulas at the end of the lecture. You will essentially be coding those.

3. Go the Part 1 of the Jupyter Notebook on the left and solve it for the probability that the call option in default will expire in the money (ITM) if held to expiry, assuming zero drift. Use your choice of the cumulative standard normal density function (Prof Evans uses his own, which uses the error function).

4. Now solve the same using the suggested default drift (0.000794)

5. Go to Part 2 and try to figure out how to calculate the probability that a PUT (using a strike price of $95, all other values that same as Part 1) for a zero drift assumption and the same default drift assumption.

Modify this model to your heart's content, BUT keep a clean copy of exactly this model for exam purposes.