Carlo_Doc

April 2, 2022

0.1 This Document will describe and demonstrate the way that the Python code works.

0.1.1 Dependencies:

- [Python](https://www.python.org/)
- [Jupyter Notebook](https://jupyter.org/)
- [Numpy](https://www.numpy.org/)
- [Matplotlib](https://matplotlib.org/)
- [Pandas](https://pandas.pydata.org/)
- [Math](https://docs.python.org/3/library/math.html)

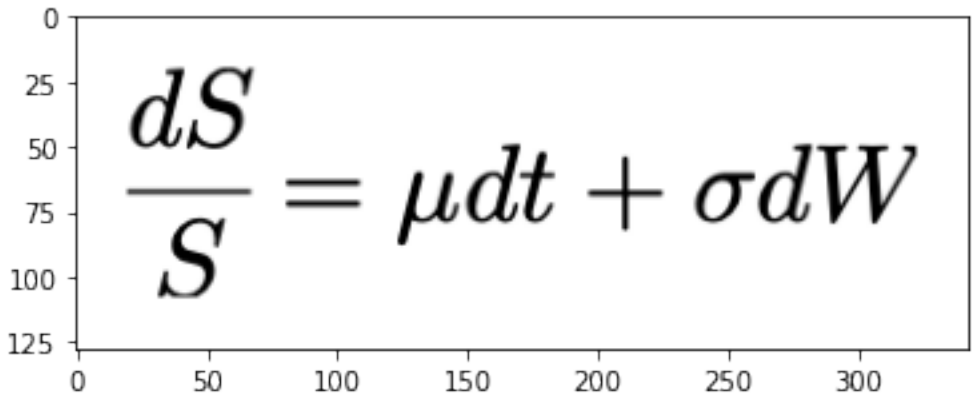
0.1.2 First the random stock prices are generated.

First the Class that will be used to generate the random stock prices is defined. This Code is shown below:

[9]:
```
# Import all the necessary packages

import matplotlib.pyplot as plt
import numpy as np
import math
import pandas as pd


class GBM:

    def simulate(self):
        while(self.total_time > 0):
            # ***
            dS = self.current_price*self.drift*self.time_period + self.
 ↪current_price*self.volatility*np.random.normal(0, math.sqrt(self.
 ↪time_period))
            self.prices.append(self.current_price + dS)
            self.current_price += dS
            self.total_time -= self.time_period

    def __init__(self, initial_price, drift, volatility, time_period,␣
 ↪total_time):
```

```
        # Initialize fields
        self.initial_price = initial_price
        self.current_price = initial_price
        self.drift = drift
        self.volatility = volatility
        self.time_period = time_period
        self.total_time = total_time
        self.prices = []
        # Simulate the diffusion process
        self.simulate()    # Simulate the diffusion proces
```

[10]:
```
# Displays the Eqation used for the Generating Brownian Motion

import matplotlib.image as mpimg

img = mpimg.imread('GBM_Equation.png')
imgplot = plt.imshow(img)
plt.show()
```



0.1.3 This Class is defined so that it can be called later in the code to generate the random stock prices.

Next we must define the parameters that will be used to generate the random stock prices.

Variables:

```
- Simulations: [], This creates the list that will contain the random stock prices.
It is empty at the beginning and will be filled with the random stock prices later on.

- Number of Simulations: "n",
This is the number of random stock prices that will be generated.

- Total Time: "total_time", This is the total time that the random stock prices will
```

```
be generated for. 1 = 1 year. 1/12 = 1 month. 1/365 = 1 day.

- Initial Stock Price: "initial_price", This is the initial stock price
that will be used to generate the random stock prices.

- Drift: "drift", This is the drift that will be used to generate the random stock prices.

- Time Step: "time_period", This is the time between each random stock price.
1 = 1 year. 1/12 = 1 month. 1/365 = 1 day.

- Volatility: "volatility", This is the volatility that will be used to generate the
random stock prices. 0.01 = 1% volatility, .02 = 2% volatility, .03 = 3% volatility, etc.
```

These are all of the parameters that will be used to generate the random stock prices. Later in the code there will be more parameters will be defined to generate a fair price for the stock.

The Class is called and the parameters are passed to the Class. The Class will then generate the random stock prices and fill the empty list with the random stock prices.

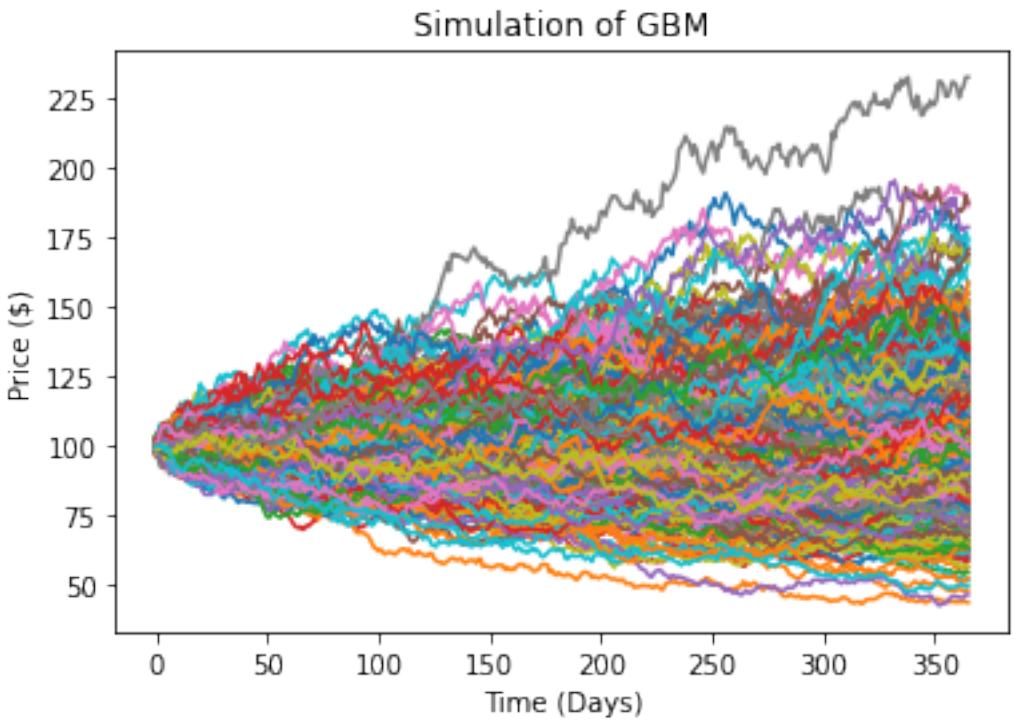
0.1.4 Code:

[11]:
```
simulations = []
n = 500
initial_price = 100
drift = .02
volatility = .25
time_period = 1/365 # Daily
total_time = 1




for i in range(0, n):
    simulations.append(GBM(initial_price, drift, volatility, time_period,␣
 ↪total_time))
```

Finally To complete the Geometric Brownian Motion process, the graph of the random stock prices is generated.

0.1.5 Code:

[12]:
```
for sim in simulations:
    plt.plot(np.arange(0, len(sim.prices)), sim.prices)
    plt.title('Simulation of GBM')
    plt.xlabel('Time (Days)')
    plt.ylabel('Price ($)')
```


Simulation of GBM
Price ($)
225
200
175
150
125
100
75
50
0
50
100
150
200
250
300
350
Time (Days)