University of California, Los Angeles
Department of Statistics

Statistics C183/C283 **Instructor: Nicolas Christou**

Homework 9

Exercise 1:
Suppose a stock has annual expected return and standard deviation $\mu = 0.20$ and $\sigma = 0.25$. The current price of the stock is $s = \$50$. Suppose that $\Delta t = 1$week.

a. Find the distribution of the return of the stock during Δt.

b. Simulate the path of the stock from now until 1 year from now (52 weeks). Submit the random samples and the plot of the price of the stock against time.

Exercise 2:
Suppose that a stock price has an expected return of $\mu = 0.16$ per year and standard deviation $\sigma = 0.30$ per year. Suppose at the end of a certain day the price of the stock is $s = \$50$. Find:

a. The expected stock price at the end of the next day.

b. The standard deviation of the stock price at the end of the next day.

Exercise 3:
A stock price follows the lognormal distribution. Its current price is \$38, its annual expected return is $\mu = 0.16$, and its annual standard deviation is $\sigma = 0.35$.

a. What is the probability that a European call option on this stock with an exercise price of 40 and expiration date 6 months from now will be exercised?

a. What is the probability that a European put on this stock with an exercise price of 40 and expiration date 6 months from now will be exercised?

Exercise 4:
Using the lognormal distribution result of the price of a stock at time T show that:

$$P\left(Se^{(\mu-\frac{\sigma^2}{2})(T-t)-1.96\sigma\sqrt{T-t}} \leq S_T \leq Se^{(\mu-\frac{\sigma^2}{2})(T-t)+1.96\sigma\sqrt{T-t}}\right) = 0.95.$$

Suppose the current price of a stock is $s = \$40$, and the annual expected return and standard deviation $\mu = 0.10$, $\sigma = 0.15$. Find:

a. A 95% confidence interval for the price of the stock in 2 months.

b. The expected price of the stock in 2 months.

c. The standard deviation of the price of the stock in 2 months.

Exercise 5:
Using the lognormal property of stock prices estimate the annual volatility of `APPLE` (ticker is `AAPL`) using the adjusted daily close prices for the period `01-March-2022` to `25-May-2022`. Save the data in a csv file and then read the data in `R` as follows:

```
s1 <- read.csv("AAPL.csv", sep=",", header=TRUE)
```