Project 1: Portfolio Simulation.

Cs 217.

Tahsin Alam.

You can choose to invest your money in one particular stock or put it in a savings account. Your initial capital is 1000 dollars. The initial stock price is 100 dollars. The interest rate r is 0.5% per month and does not change. Your stochastic model for the stock price is as follows:

- next month the price is the same as this month with probability 1/2,
- with probability 1/4 it is 5% lower,
- and with probability 1/4 it is 5% higher.

The principle applies for every new month. There are no transaction costs when you buy or sell stock.

Your investment strategy for the next 5 years is:

- convert all your money to stock when the price drops below 95 dollars,
- and sell all stock and put the money in the bank when the stock price exceeds 110 dollars.

** This part of the Question has been done through programming and attached into report section**

Determine number of simulation so the Monte Carlo study would attain the margin of error ±0.01 with probability 0.99.

Determining the simulations: The probability of 0.99 with the margin of error ±0.01.

With the probability of 0.99 it falls within 0$\leq p \leq 1$.

So, p(1-p) =0.26.

So, for the Monte Carlo Method To obtain N number of simulation we come up with this formula,

$$N \geq 0.25\left(\frac{z_{\alpha/2}}{\varepsilon}\right)^2$$

Here ε =±0.01 and $\frac{\alpha}{2} = \frac{1-0.99}{2} = 0.005$.

If we use the textbook A4 table, we get corresponding value for $z_{0.005} = 2.57$.

So,

$$N \geq 0.25\left(\frac{z_{\alpha/2}}{\varepsilon}\right)^2 = \mathbf{16577}.$$

<u>How does this strategy compare to gains from the savings account for the same period of time? Determine success rate the above strategy related to gains from the savings account.</u>

** Calculated Separately in Coding Part**

Success rate =22%.

<u>Calculate 95% confidence interval for estimated strategy success rate</u>.

Calculating the Confidence Interval:

After running the code, we have following value,

$$\bar{X}(Mean) = 1151.70$$

$$N = 16577$$

$$Variance = 77729.831; Std\ dev\ \sigma = \sqrt{77729.831} = 278.80$$

$$\alpha = 1 - 0.95 = .05(Given)$$

We need $\alpha = 0.05\ and\ \alpha/2$=0.025, Hence we are looking for quantiles.

$$q_{0.025} = -z_{0.025}\ \ and\ q_{0.975} = z_{0.025}$$

By using table A4 in book we find, $q_{0.975} = 1.960$ and there substituting the values into equation to obtain a 95% confidence interval.

$$\bar{X} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}} = 1151.67 \pm (1.960)\frac{278.8}{\sqrt{16577}} = \mathbf{1151.67 \pm 4.24}$$

<u>Assume another investment strategy when you put money in stock when price drops below 100 dollars and sell these stocks when price is above 115 dollars.</u>

- <u>Is there a significant difference between two strategies?</u>
- <u>Is it true that the difference between strategies is less then 50 dollars?</u>

<u>Formulate and test the hypotheses at a level α=0.05.</u>

Stock bought at $100; Stocks sold at $115

Sample mean M= 1112.522

Population mean μ =1104.65

Sample Variance = 91271.992

Standard Deviation $\sigma \quad = \sqrt{91271.992} = 302.1$

The sample size for this problem, mainly depend on us. How many samples we take means if we estimate the income after stocks being sold and bought at the designated price and take like 50 sample of it then our sample would be 50.

So, n=50.

The null hypothesis is that, we state both the statements are true.

We can define a "rare event" arbitrary by setting a threshold for our p values , alpha level α.

If p value < α then reject null hypothesis.

If p value $\geq \alpha$ then fail to reject null hypothesis.

So, $Z = \frac{M-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{1112.522-1104.65}{\frac{302.1}{\sqrt{50}}} = 0.184$

From the above Z Test it is 0.184 and from the standard normal probabilities chart,

P(Z>0.184) = 0.5714; which is our p value.

So, we can conclude that 0.5714≥0.05(p value $\geq \alpha$) which state, we fail to reject null hypothesis and for the above value null hypothesis is true.