MA323 - Monte Carlo Simulation

Lab – 8

NAVEEN KUMAR A G 210123075

Question 1:

For n = 100

Simple Monte Carlo

Probability = 0.74

Confidence Interval = [0.6400037085095548, 0.8399962914904452]

Variance = 0.1507070707070708

Interval Length = 0.1999925829808904

Stratification Method

Probability = 0.8169523203608925

Confidence Interval = [0.7878459710399872, 0.8460586696817978]

Variance = 0.1507070707070708

Interval Length = 0.058212698641810556

For n = 10000

Simple Monte Carlo

Probability = 0.7703

Confidence Interval = [0.7594248384516114, 0.7811751615483886]

Variance = 0.1782531753175283

Interval Length = 0.021750323096777727

Stratification Method

Probability = 0.8011054299833138

Confidence Interval = [0.797837453367397, 0.8043734065992306]

Variance = 0.1782531753175283

Interval Length = 0.006535953231833647

Is there a valid reason to combine cases where S is greater than or equal to 6 into a single strata?

Combining S values greater than or equal to 6 into a single strata is justified due to their rarity in the model. The occurrence of such high S values is infrequent, primarily because of the low λ value, which is only 2.9. This rarity results in a low probability of these events happening. By grouping them together, the stratification process is simplified, and it increases the sample size within this strata. This, in turn, enhances the overall efficiency of calculations and makes the analysis more practical and computationally efficient.

Question 2:

Value of μ = P(X19 = max i (Xi)) using conditional monte carlo technique is 0.02632

Conditional Expectation using direct dirichlett distribution from scipy library is μ: 0.02615

The code efficiently calculates the probability 0.02632 using the conditional Monte Carlo technique. Several observations regarding this code include the generation of random variables from a Dirichlet distribution with specific alpha parameters, which is essential for probability estimation. It also utilizes the gamma distribution to generate random variables with shape parameters corresponding to the given alpha values, simplifying the calculation of Dirichlet random variables. The code conditions on the value of Y19 (linked to alpha[18]) to determine whether it is the largest Yj, streamlining the probability calculation.

Question 3:

So, mu_values that I took are [1.0, 1.2, 0.8, 1.5, 1.3]

So, sigma2_values that I took are [0.1, 0.2, 0.15, 0.3, 0.25]

Total number of iterations to estimate actual expectation is 100,000

Estimated mean using covariate method comes out to be 3.658320037278464

Observations:

The code effectively implements the covariate technique to estimate μ = E(f(X)), considering specific log-normal random variables. Users have the flexibility to specify parameters (μ and σ^2) for each log-normal distribution.