MA323 – Monte Carlo Simulation

Lab - 09

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a) E_{10} in terms of T_j, j = 1, 2, …, 10 can be given as: -

$E_{10} = T_{10} + \max(E_4, E_8, E_9)$

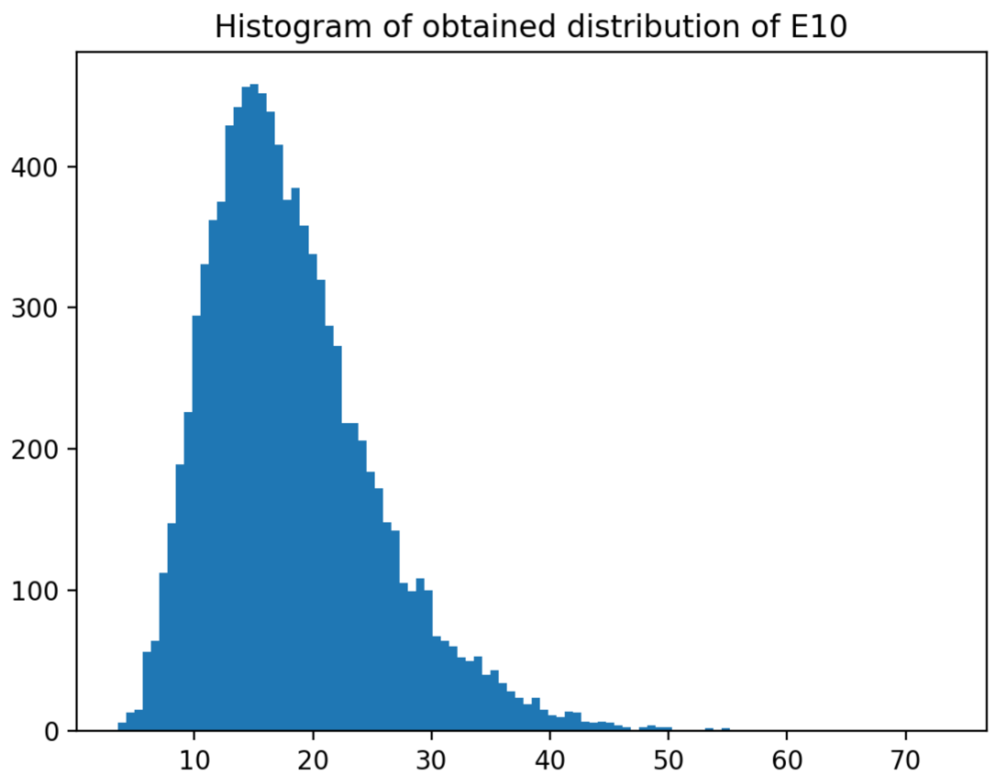
$= T_{10} + \max(T_4 + T_2 + T_1, T_8 + T_3 + T_1, T_9 + \max(E_5, E_6, E_7))$

$= T_{10} + \max(T_4 + T_2 + T_1, T_8 + T_3 + T_1, T_9 + \max(T_5 + T_2 + T_1, T_6 + T_3 + T_1, T_7 + T_3 + T_1))$

$= T_{10} + T_1 + \max(T_4 + T_2, T_8 + T_3, T_9 + \max(T_5 + T_2, T_6 + T_3, T_7 + T_3))$

b) Taking n = 10000, the approximate mean value of E_{10} comes out to be 18.27925649318392

c) The histogram of generated E_{10} values is given as follows: -



The obtained distribution is light tailed and skewed to the left.

d) The approximate probability of missing the deadline of 70 days is 1×10^{-4}.

The standard deviation of the distribution is approx. 7.253568607076187. The probability of missing the deadlines is very low as the distribution frequency are decreasing for large values of deadlines.

1e)

To Estimate probability using importance method:

$$\mu = \frac{1}{n}\sum_{i=1}^{n} I\{E_{i,10}>70\}\prod_{j=1}^{10}\frac{e^{-T_{ij}/\theta_j}/\theta_j}{e^{-T_{ij}/\lambda_j}/\lambda_j}$$

Where I is indicator function for even $E_{10} > 70$ θ_j is the mean time of the i’th process $\lambda_j = \kappa*\theta_j$

The product calculated is the likeliness ratio(weight).

Estimated probability using Importance method=$2.879\text{x}10^{-5}$

Standard Deviation = 0.00086

Estimated Sample Size = 3.2701

The sample size is too small, this is because multiplying 4 to all the means is causing too much of a distortion.

1f,g,h)

The formula for calculating the probability will remain same, except that when $j\in\{3, 5, 6, 7, 8, 9\}$, $\kappa=1$, or, the likeliness ratio = 1

κ	**Estimated Probability**	**Number of E_{10}>70**	**Standard Deviation**	**99% Confidence Interval for probability**	**Estimated Sample Size**
3	$3.04889\text{x}10^{-5}$	1447	0.00017206	[$2.6049\text{x}10^{-5}$, $3.4927\text{x}10^{-5}$]	917.95

4	2.82657×10^{-5}	3142	0.00014025	$[2.4647 \times 10^{-5}, 3.1884 \times 10^{-5}]$	327.47
5	3.38229×10^{-5}	4793	0.00017824	$[2.9224 \times 10^{-5}, 3.8422 \times 10^{-5}]$	141.05

Since only the processes on critical path, I.e, {1,2,4,10}, contribute to E_{10}, while the the rest do not contribute as much, so we do not have to increase the mean for all the T_j, that is the reason the estimated sample sizes here are greater than the value obtained in (e).

$\kappa=5$ has the smallest estimated sample size and

the 99% confidence interval of probability = $[2.9224 \times 10^{-5}, 3.8422 \times 10^{-5}]$