

Assignment - 1

RE 69004: Reliability Simulation Laboratory – Spring 2026
Subir Chowdhury School of Quality and Reliability, IIT Kharagpur

Q1: Simulation of coin toss experiment

- (a) Simulate a fair coin toss experiment for $N = 10^2, 10^3, 10^4$ trials.
- (b) Estimate the probability of obtaining heads and plot its convergence with increasing N .
- (c) Modify the simulation to represent a biased coin with probability of heads $p = 0.6$.
- (d) Repeat the simulation and compare the estimated probability with the true value.
- (e) Compute and plot the absolute estimation error as a function of the number of trials.

Q2: Dice roll simulation and probability estimation

- (a) Simulate the rolling of a fair six-sided die for $N = 10^3, 10^4, 10^5$ trials.
- (b) Estimate the probability of each face and verify uniformity.
- (c) Estimate the probability of the following events:
 - (i) Rolling an even number
 - (ii) Rolling a number greater than 4.

Q3: Estimation of π using Monte Carlo simulation

- (a) Use Monte Carlo simulation to estimate the value of π by randomly generating points inside a unit square.
- (b) Determine whether a point lies inside the largest circle that can be inscribed in the square.
- (c) Estimate π using

$$\pi \approx 4 \times \frac{\text{Number of points inside the circle}}{\text{Total number of points}}$$

- (d) Perform simulations for increasing sample sizes $N = 10^3, 10^4, 10^5$.
- (e) Plot the estimated value of π and the estimation error as a function of N .