Monte Carlo Simulation

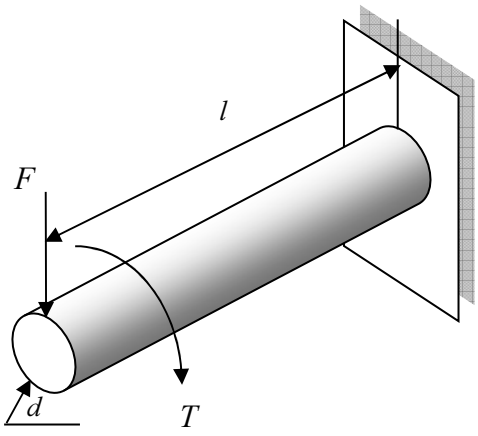
Please attach your source code.

1. The limit-state function of a shaft in a speed reducer is defined by the difference between the strength and the maximum equivalent stress. It is given by

$$g(\mathbf{X}) = S - \frac{16}{\pi d^3}\sqrt{4F^2l^2 + 3T^2}$$

where

$d = 39$ mm, the diameter of the shaft
$l = 400$ mm, the length of the shaft
$F =$ the external force
$T =$ the external torque
$S =$ the yield strength



The distributions of the independent random variables are given below.

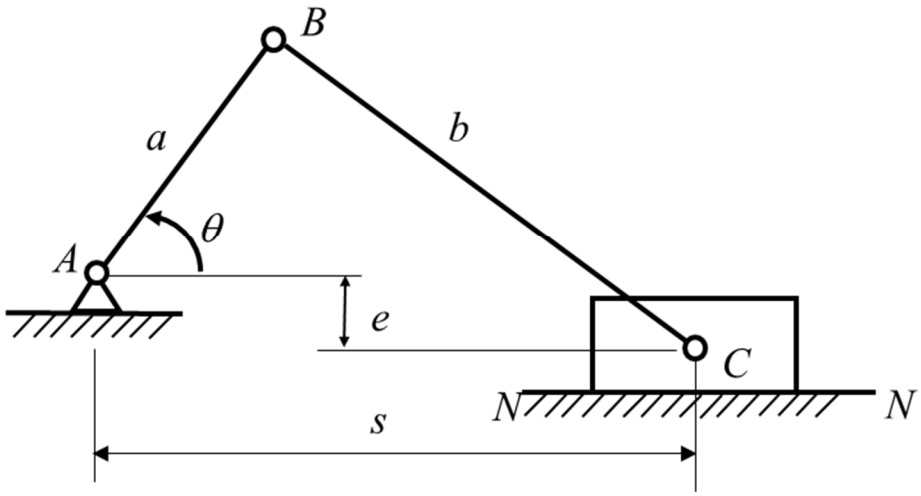
Table 1 Distributions

Variables	Mean	Std	Distribution
External force F	2000 N	220 N	Normal
Torque T	450 N·m	50 N·m	Normal
Strength S	250 MPa	30 MPa	Normal

Use Monte Carlo simulation to calculate the probability of failure. Please give the 95% confidence interval for the MCS solution.

2. The position of a slider-crank mechanism s is required to be 350 mm when $\theta = 10^\circ$. A failure occurs if the actual position s is outside the range 350 ± 1 mm. The tolerance of the three independent dimension variables a, b, and e is $\Delta = 1$ mm. Their distributions are given in

Table 2. Use Monte Carlo simulation (MCS) to calculate the probability of failure. Please give the 95% confidence interval for the MCS solution.



The distributions of the independent random variables are given below.

Table 2 Distributions

Variables	Mean	Std	Distribution
a	136.6 mm	$\frac{1}{3}\Delta$	Normal
b	216.8 mm	$\frac{1}{3}\Delta$	Normal
e	0 mm	$\frac{1}{3}\Delta$	Normal

3. (This is Question 5 in Homework 3.) The weight of the crate follows a normal distribution $W \sim N(1500, 180^2)$ k. The allowable tensions of the cables 1 and 2 are also normally distributed with $S_1 \sim N(1200, 80^2)$ kN and $S_2 \sim N(2200, 100^2)$ kN, respectively. The three random variables are independent. Determine the reliability of the system. (Consider only the two cables. Neglect the weight of the pulley.) Compare the simulation solution with the solution you have obtained before.