HW4 : Uncertainty Analysis of the Ten-Bar Truss (Monte Carlo Simulation)

Robust and Reliability in Mechanical Design
Department of Mechanical Engineering,
National Taiwan University

Due November 20, 2018

A ten-bar truss as shown in Fig.1 is considered. An external force is applied to node 2 with $F = 10^4 kN$. All members have circular cross sections. Members $\{1, 2, 3, 4, 5, 6\}$ are identical with length $l = 914$ cm and cross section radii r_1, members $\{7, 8, 9, 10\}$ are also identical with cross section radii r_2 .

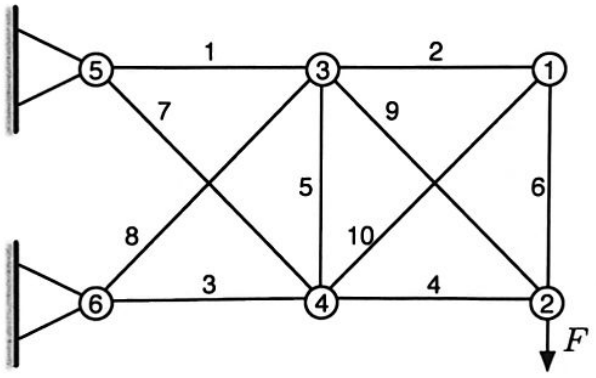

Figure 1: Ten-bar Truss

The modulus of elasticity is E and the yielding strength is Y. The tensile stress σ have subscript i indicating the number of the bar element. δ_2 is the node 2 displacement. Structural steel (ASTM-A36) with density $\rho = 7860 \text{kg/m}^3$ is used.

variance

Due to manufacturing variations, r_1 follows Gaussian distribution as $N(0.2, 0.5^2)$, r_2 follows Gaussian distribution as $N(0.3, 0.3^3)$. Due to material variation, $E \sim N(200, 50^2)$ GPa, $Y \sim N(250, 100^2)$MPa.

1. Please obtain the final distribution of the stress at bar No.5 and No.6
2. What is the probability of Bar 1 failing using Monte Carlo Simulation (MCS) with 1 million samples

normrnd (0.2, 0.5)
↗
deviation

TenBarAnalysis $\xrightarrow[\text{output}]{}$ Array

hist (Array)