Problem# 1. In this problem, we conduct simulation study to understand the performances of the four methods: LSE, LAD, Huber, and LTS (Least Trimmed Squares) under the following three cases:

- **Case 1:** $\epsilon$s are from normal distribution.
  - Step1: Generate $x_{100 \times 1}$ from $N(0, 1)$.
  - Step2: Generate $\epsilon_{100 \times 1}$ from $Normal(0, 2^2)$.
  - Step3: Generate $y_{100 \times 1} = \beta_0 1 + \beta_1 x_{100 \times 1} + \epsilon_{100 \times 1}$, where $\beta_1 = 1$ and $\beta_2 = 2$.
  - Step4: Estimate parameters using LSE, LAD, Huber, and LTS.
  - Repeat Step 1-Step 4, 100 times.

- **Case 2:** $\epsilon$s are from log normal distribution.
  - Step1: Generate $x_{100 \times 1}$ from $N(0, 1)$.
  - Step2: Generate $\epsilon_{100 \times 1}$ from $logNormal(0, 2^2)$.
  - Step3: Generate $y_{100 \times 1} = \beta_0 1 + \beta_1 x_{100 \times 1} + \epsilon_{100 \times 1}$, where $\beta_1 = 1$ and $\beta_2 = 2$.
  - Step4: Estimate parameters using LSE, LAD, Huber, and LTS.
  - Repeat Step 1-Step 4, 100 times.

- **Case 3:** $\epsilon$s are from Cauchy distribution.
  - Step1: Generate $x_{100 \times 1}$ from $N(0, 1)$.
  - Step2: Generate $\epsilon_{100 \times 1}$ from $Cauchy(0, 2)$.
  - Step3: Generate $y_{100 \times 1} = \beta_0 1 + \beta_1 x_{100 \times 1} + \epsilon_{100 \times 1}$, where $\beta_1 = 1$ and $\beta_2 = 2$.
  - Step4: Estimate parameters using LSE, LAD, Huber, and LTS.
  - Repeat Step 1-Step 4, 100 times.

Report means squared errors (MSE), where $MSE = Bias^2 + Var$, discuss which method is the best in each case, and explain why you think.

- $Bias^2 = (\beta_{true} - samplemean(\beta_{sim}))^2$, where $\beta_{sim}$ are the estimated betas from simulations.
- $Var = sample variance(\beta_{sim})$