

MTH 441A: Lab 2

P 1. The Rocket Propellant Data: Consider the Rocket Propellant Data from Example 2.1 on page 15 of the book Introduction to Linear Regression Analysis by Montgomery et.al. Fit a simple linear regression model for the Rocket Propellant Data.

P 2. The Delivery Time Data: Consider the Delivery Time Data from Example 3.1 on page 74 of the book Introduction to Linear Regression Analysis by Montgomery et.al. Fit a multiple linear regression model for the Delivery Time Data.

Note: Save both data sets to **.xlsx** files and have a copy of it before coming to the lab. You must know how to import the data in R.

P 3. For the data in **P 1** compute the following:

- (1) Value of the unbiased estimator of σ^2 .
- (2) $t_j = \hat{\beta}_j / \sqrt{\text{Var}(\hat{\beta}_j)}$.

P 4. Generating sample from a Chi-square random variable:

- (1) Generate $n = 5000$ samples using $W = \sum_{i=1}^3 Z_i^2$, where $Z_i \sim \mathcal{N}(0, 1)$ for $i = 1, 2, 3$.
- (2) Plot the histogram of W . Compute the sample mean and variance of W .
- (3) Compute the theoretical mean and variance of chi-square random variable with 3 degrees of freedom.
- (4) Compare the results of (2) and (3).

P 5. Generating sample from a Chi-square random variable:

- (1) Given a full rank 8×5 matrix X (create using *matrix* function) compute $P_X = X(X'X)^{-1}X'$. Verify if P_X is idempotent.
- (2) Generate 5000 samples using $u = Y'P_X Y$ where $Y \sim \mathcal{N}(\mu, I)$, $\mu = (0, 0, 0, 0, 0, 0, 0, 0)'$ and I is a 8×8 diagonal matrix with all ones as diagonal.
- (3) Plot the histogram of u . Compute the sample mean and variance of u .
- (4) Compute the theoretical mean and variance of chi-square random variable with 5 degrees of freedom.
- (5) Compare the results of (3) and (4).

P 6. Generating sample from a F-distribution:

- (2) Generate 5000 samples using $f = (Y'P_{X_2}Y/df_1)/(Y'P_{X_1}Y/df_2)$ where $Y \sim \mathcal{N}(\mu, I_8)$, $\mu = (0, 0, 0, 0, 0, 0, 0, 0)'$ and I_8 is a 8×8 diagonal matrix with all ones in diagonal, $P_{X_2} = I_8 - P_{X_1}$, $df_1 = \text{Rank}(P_{X_2})$, $df_2 = \text{Rank}(P_{X_1})$ and X_1 is same as X from **P 5.** (1).
- (3) Plot the histogram of f . Compute the sample mean and variance of f .
- (4) Compute the theoretical mean and variance of F-random variable with (3,5) degrees of freedom.
- (5) Compare the results of (3) and (4).