Q.No.1: - (2+5+5 = 12 points) Open the excel file that should contain a response variable (y) and three predictors.

(i) Find $y' y$ and $\hat{\beta}' X' y$

(ii) Using partial F test (extra sum of squares method) check the significance of $X_1$ and $X_3$ at $\alpha = 0.001$. Use the p-value approach.

$H_0$:  

$H_1$:  

Test Statistic: $F_0=$  

with $v_1=$ and $v_2=$  

P-value=  

Decision:

(iii) Suppose that the fitted multiple regression model is $\hat{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$. Find the correlation coefficient between $\beta_1$ and $\beta_3$. 
Q. No. 2: (2+1 = 3 points) Transform all the variables using unit length scaling and denote them by $y_0$, $w_1$, $w_2$ and $w_3$.

(i) Write the result for $W'W$ matrix.

Hint: The off-diagonal elements of $W'W$ will be the correlation coefficients between the original (untransformed) variables.

(ii) Write down the standardized regression model.

Some useful formulas

\[
\hat{\beta} = (X'X)^{-1}X'y, \quad H = X(X'X)^{-1}X', \quad \text{Var - Cov}(\hat{\beta}) = \sigma^2(X'X)^{-1}
\]

\[
SST = y'y - \frac{(\sum y_i)^2}{n}, \quad SSR = \hat{\beta}'X'y - \frac{(\sum y_i)^2}{n}
\]

\[
SSE = y'y - \hat{\beta}'X'y, \quad MSE = \frac{SSE}{n-k-1} = \sigma^2
\]

\[
F_0 = \frac{SSR/k}{SSE/(n-k-1)} = \frac{MSR}{MSE}
\]

\[
R_{adj}^2 = 1 - \frac{SSE/(n-p)}{SST/(n-1)}, \quad \hat{\beta}_j \pm t_{a/2, n-k-1} \text{se}(\hat{\beta}_j), \quad \text{PRESS} = \sum \left( \frac{e_i}{(1-h_i)} \right)^2, \quad R_{\text{prediction}}^2 = 1 - \frac{\text{PRESS}}{SST}
\]

\[
\hat{\mu}_{y|x=x_0} \pm t_{a/2, n-k-1} \sqrt{\frac{\hat{\sigma}^2}{n-k-1}} x_0' \left( \frac{1}{X'X} \right)^{--1} x_0, \quad \hat{y}_0 \pm t_{a/2, n-k-1} \sqrt{\frac{\hat{\sigma}^2}{n-k-1}} \left( 1 + x_0' \left( \frac{1}{X'X} \right)^{--1} x_0 \right)
\]