1.

a) $\frac{(n-k-1+q)\hat{\sigma}_r^2}{\sigma^2} - \frac{(n-k-1)\hat{\sigma}_{ur}^2}{\sigma^2} \sim \chi^2(q)$ implies that the difference of SSR of restricted and unrestriced model has chi-squared distribution.

Such that F statistic $= \frac{(SSR_r - SSR_{ur})/q}{SSR_{ur}/(n-k-1)} \sim F(q, n-k-1)$ #

(b) $R_r^2 = 1 - \frac{SSR_r}{SST}$, $R_{ur}^2 = 1 - \frac{SSR_{ur}}{SST}$

$\Rightarrow F = \frac{(SSR_r - SSR_{ur})/q}{SSR_{ur}/(n-k-1)} = \frac{SST[1-R_r^2-(1-R_{ur}^2)]/q}{SST(1-R_{ur}^2)/(n-k-1)} = \frac{(R_{ur}^2 - R_r^2)/q}{(1-R_{ur}^2)/(n-k-1)}$ #

2.

(a) $R = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 3 & -6 & 0 \\ 0 & -2 & 1 & 0 & 4 & 0 \\ 1 & 3 & 0 & 1 & 0 & 5 \end{pmatrix}$ $c = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 4 \\ -1 \\ 7 \end{pmatrix}$

(b) F statistic $\sim F(q, n-k-1) = F(6, 150-6) = F(6, 144)$

3.

(a) $y_i = \alpha_0 + \alpha_1 D_{i1} + \alpha_2 D_{i2} + \beta X_i + u_i$

(b) $y_i = \alpha_0 + \alpha_1 + \beta X_i + u_i$; $y_i = \alpha_0 + \alpha_2 + \beta X_i + u_i$; $y_i = \alpha_0 + \beta X_i + u_i$

4.

(a) The votes received due to the campaign expenditure by its own (A).

(b) $H_0: \beta_1 + \beta_2 = 0$

(c) Since it is a single hypothesis question, we use t test by constructing $R = (0\ 1\ 1\ 0)$, $c = 0$ to acquire t statistic $\sim \frac{R\hat{\beta} - c}{\hat{\sigma}\sqrt{R(X'X)^{-1}R'}}$

(d) hypothesis 1 : $\beta_1 = 0$ $\Rightarrow$ use F test

hypothesis 2 : $\beta_2 = 0$

(e) $R = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix}$ $c = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ to acquire F statistic by $\dfrac{(R\hat{\beta}-c)'[R(X'X)^{-1}R']^{-1}(R\hat{\beta}-c)}{\hat{\sigma}^2 q}$