$Y$ = mpg

$X_1$ = cyl

$X_2$ = disp

$D$ = mtcars$vstype → $D = \begin{cases} 1 & \text{if mtcars\$vstype} = 1 \\ 0 & \text{o.w.} \end{cases}$

(1) $Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \gamma D + \varepsilon$

(2) $Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$.

(3) vs = 1, intercept

$= \alpha_0 + \gamma = 35.88 - 0.633$

(4) p-value for F-test is $7.7 \times e{-}09 < 0.05$

so significant

(5) None of them are individually significant as p-values for t-statistics are $> 0.05$.

(6) $Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \gamma D + \delta_1 X_1 D$ ——— (*)

(7) vs = 1. ($\Rightarrow D = 1$)

$Y = (\alpha_0 + \gamma) + (\beta_1 + \delta_1) X_1 + \beta_2 X_2$

Slope coeff for $X_1$ is $\beta_1 + \delta_1$

(8) $H_0: \delta_1 = 0$ $H_1: \delta_1 \neq 0$. (in model ⑥, prob-6). last page.

(9) The interaction is not significant as cgl: mtcars $ vstype1 p-value $> 0.05$.

(1) vstype — 2 categories.
antype — 2 categories.

So, linear model is —

$$Y = \alpha_0 + \gamma_1 D_1 + \gamma_2 D_2 + \varepsilon$$

$D_1 = 1$ if vstype = L
$= 0$ o.w.

$D_2 = 1$ if antype = 1
$= 0$ o.w.

(2) ——

(3) Yes — F-test p-value $\ll 0.05$. ∴ together significant
$= 5.05 \times e{-}08$

(4) Yes, the t-test p-value are $6.5e{-}06 < 0.5$
& $4.96e{-}05 < 0.05$, so both are significant.

5

$\gamma_1 = \gamma_2 = 0.$

$Y = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$

$\alpha_2 - \alpha_1 = 0$

$\beta_2 - \beta_1 = 0$

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(2) Dummy variable model

$$Y_i = \alpha_0 + \gamma_1 D_{1i} + \gamma_2 D_{2i} + \varepsilon_i \qquad i = 1, \ldots n$$

$D_{1i} = 1$ if rstype $= 1$

$= 0$ o.w.

$D_{2i} = 1$ if amtype $= 1$

$= 0$ o.w.

Anova model

$$y_{ijk} = \mu + \alpha_i + \beta_j + \varepsilon_{ijk} \qquad i = 1, 2 \quad j = 1, 2 \quad k = 1, \ldots n.$$

— Dummy variable hypothesis of no-effect

$\gamma_1 = \gamma_2 = 0$

— Anova hypothesis of no-effect

$\beta_2 - \beta_1 = 0$ , $\alpha_2 - \alpha_1 = 0.$