5.6

a $\beta_2 = 0$

$H_0: \beta_2 = 0$

$H_a: \beta_2 \neq 0$

$\alpha = 0.05$

test statistic: $\frac{b_2 - \beta_2}{se(b_2)} \overset{H_0}{\sim} t(N-K)$

$RR = |T| \geq t_{\frac{\alpha}{2}}(63-3) \approx 2$

$T = \frac{3-0}{\sqrt{4}} = 1.5$

$T \notin RR$, do not reject H_0. #

b. $\beta_1 + 2\beta_2 = 5$

$H_0: \beta_1 + 2\beta_2 = 5$

$H_a: \beta_1 + 2\beta_2 \neq 5$

$\alpha = 0.05$

$var(b_1 + 2b_2)$

$= var(b_1) + 4\,var(b_2) + 4 \cdot cov(b_1, b_2)$

$= 3 + 4 \cdot 4 + 4 \cdot -2$

$= 3 + 16 - 8 = 11$

$se(b_1 + 2b_2) = \sqrt{11}$

test statistic: $\frac{b_1 + 2b_2 - 5}{se(b_1 + 2b_2)} \overset{H_0}{\sim} t(N-K)$

$RR: |T| \geq t_{\frac{\alpha}{2}}(60) \approx 2.$

$T = \frac{2+6-5}{\sqrt{11}} = 0.9045$, $T \notin RR$, do not reject H_0

#

c. $\beta_1 - \beta_2 + \beta_3 = 4$

$H_0: \beta_1 - \beta_2 + \beta_3 = 4$

$H_a: \beta_1 - \beta_2 + \beta_3 \neq 4$

$\alpha = 0.05$

Test statistic: $\dfrac{b_1 - b_2 + b_3 - 4}{se(b_1 - b_2 + b_3)} \overset{H_0}{\sim} t(N-K)$

RR: $|T| \geq t_{\frac{\alpha}{2}}(60) \approx 2$

$$\begin{aligned} var(b_1 - b_2 + b_3) &= var(b_1) + var(b_2) + var(b_3) \\ &\quad - 2cov(b_1, b_2) - 2cov(b_2, b_3) + 2cov(b_1, b_3) \\ &= 3 + 4 + 3 - 2\cdot(-2) - 2\cdot(0) + 2\cdot 1 \\ &= 16 \end{aligned}$$

$se(b_1 - b_2 + b_3) = \sqrt{16} = 4.$

$T = \dfrac{2-3-1-4}{\sqrt{16}} = \dfrac{-6}{4} = -1.5$

$T \notin RR$, do not reject H_0 #

5.31

	Estimate	Std. Error
(Intercept)	20.8701	1.6758
depart	0.3681	0.0351
reds	1.5219	0.1850
trains	3.0237	0.6340

	t value	Pr(>|t|)	
(Intercept)	12.454	< 2e-16	***
depart	10.487	< 2e-16	***
reds	8.225	1.15e-14	***
trains	4.769	3.18e-06	***

$\beta_1 = 20.8701$. means when depart. reds. Trains equal 0, The expected time bill take to drive to work is 20.8701 minutes.

$\beta_2 = 0.3681$, means when Bill leaves later than 6:30 A.M, for every one minutes, the expected time bill take to drive to work will increase 0.3681 minutes, holding other variable constant.

$\beta_3 = 1.5219$, means when bill encounters one red light, then the expected time he take to drive to work will increase 1.5219 minutes, holding other variable constants.

$\beta_4 = 3.0237$, means when bill wait for one train, then the expected time he take to drive to work will increase 3.0237 minutes, holding other variable constants.

b.

	2.5 %	97.5 %
(Intercept)	17.5694018	24.170871
depart	0.2989851	0.437265
reds	1.1574748	1.886411
trains	1.7748867	4.272505

These intervals are relatively narrow ones, we have obtained precise estimates of each of the coefficients.

c. $H_0: \beta_3 \geq 2$ $\Rightarrow$ test statistic: -2.583562

$H_a: \beta_3 < 2$ RR: $T < -1.651097$.

$\alpha = 0.05$

$T \in RR$, reject H_0, the expected delay from each red light is less than 2 minutes.

d. $H_0: \beta_4 = 3$ test statistic: 0.03737

$H_a: \beta_4 \neq 3$ RR: $|T| < 1.651097$.

$\alpha = 0.1$

$T \notin RR$, do not reject H_0, the expected delay from each train is 3 minutes.

e. $H_0: \beta_2 \geq \frac{1}{3}$ test statistic: 0.991

$H_a: \beta_2 < \frac{1}{3}$ RR: $T < t_{cr} = -1.651097$

$\alpha = 0.05$.

$T \notin RR$, do not reject H_0, the delaying departure time by 30 minutes increases expected travel time by at least 10 minutes.

f. $H_0: \beta_4 \geq 3\beta_3$ test statistic: -1.825

$H_a: \beta_4 < 3\beta_3$ RR: $T < t_{cr} = -1.651097$

$\alpha = 5\%$

$T \in RR$, reject H_0. the expected delay from a train is less than three times the delay from a red light.

g. $H_0: \beta_1 + 30\beta_2 + 6\beta_3 + \beta_4 \leq 45$

$H_a: \beta_1 + 30\beta_2 + 6\beta_3 + \beta_4 > 45$

$\alpha = 5\%$

test statistic: -1.725964

RR: $-1.726 < 1.65$. do not reject H_0

h. If Bill not late for his meeting, he will wish to build a high probability that his commute time will be less than 45 minutes. So the alternative hypothesis is commute time less than 45 minutes

$$\Rightarrow \begin{cases} H_0: \beta_1 + 30\beta_2 + 6\beta_3 + \beta_4 \geq 45 \\ H_a: \beta_1 + 30\beta_2 + 6\beta_3 + \beta_4 < 45 \end{cases}$$

we will reject Ho because $-1.726 < -1.651$.

Bill's expected commute time is such that he can expect to be on time for the meeting

5.33

(a) All coefficient estimates are significantly different from 0 at 1% level of significance, but I(educ^2) is significant at a 11.49% significance level.

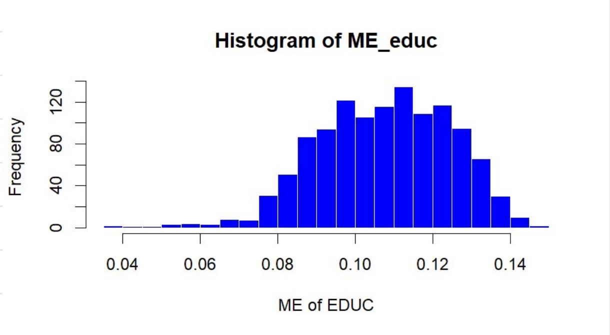
(b) $$\frac{\partial E[\ln(WAGE) \mid EDUC, EXPER]}{\partial EDUC}$$

$= \beta_2 + 2\beta_3 EDUC + \beta_6 \cdot EXPER$

$= 0.08954 + 0.002916 \cdot EDUC - 0.001010\ EXPER$

EDUC $\uparrow$ marginal effect $\uparrow$,
EXPER $\uparrow$, marginal effect $\downarrow$

(c)



most of the marginal effects concentrated between 0.08 – 0.13,

and the $\widehat{ME}(EDUC, 0.05) = 0.080$, $\widehat{ME}(EDUC, 0.5) = 0.1084$,

$\widehat{ME}(EDUC, 0.95) = 0.1336$

(d) $$\frac{\partial E[\ln(WAGE) \mid EDUC, EXPER]}{\partial EXPER}$$

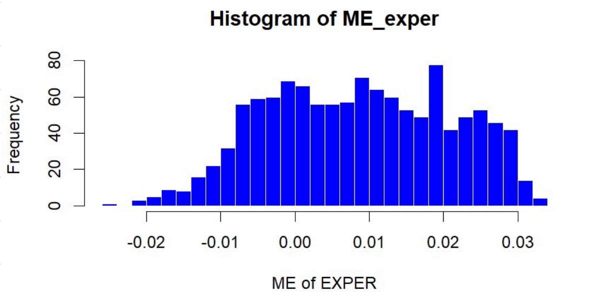
$= \beta_4 + 2\beta_5 \cdot EXPER + \beta_6 \cdot EDUC$

$= 0.04488 + 2 \cdot -0.000468 \times EXPER - 0.00101 \cdot EDUC$

$= 0.04488 - 0.000936\ EXPER - 0.00101\ EDUC$

EDUC $\uparrow$ ME $\downarrow$, EXPER $\uparrow$, ME $\downarrow$

(e)



the marginal effects are almostly positive, but little of them are negative. $\widehat{ME}(EXPER, 0.05) = -0.010$, $\widehat{ME}(EXPER, 0.5) = 0.0084$, $\widehat{ME}(EXPER, 0.95) = 0.02793$ #

(f) David: $\beta_1 + \beta_2 \cdot 17 + \beta_3 \cdot 289 + \beta_4 \cdot 8 + \beta_5 \cdot 64 + \beta_6 \cdot 136$

Svetlana: $\beta_1 + \beta_2 \cdot 16 + \beta_3 \cdot 256 + \beta_4 \cdot 18 + \beta_5 \cdot 324 + \beta_6 \cdot 288$

$$\Rightarrow \beta_1 + 16\beta_2 + 256\beta_3 + 18\beta_4 + 324\beta_5 + 288\beta_6$$
$$- (\beta_1 + 17\beta_2 + 289\beta_3 + 8\beta_4 + 64\beta_5 + 136\beta_6)$$

$H_0 = -\beta_2 - 33\beta_3 + 10\beta_4 + 260\beta_5 + 152\beta_6 \geq 0$

$H_a: -\beta_2 - 33\beta_3 + 10\beta_4 + 260\beta_5 + 152\beta_6 < 0$

$\alpha = 5\%$

test statistic: -1.6461

$t_{cr} = 1.670$, do not reject H_0 #

(g). $H_0: -\beta_2 - 33\beta_3 + 10\beta_4 + 420\beta_5 + 144\beta_6 \geq 0$

$H_a: -\beta_2 - 33\beta_3 + 10\beta_4 + 420\beta_5 + 144\beta_6 < 0$

t-statistic $= -2.062$, $t_{cr} = -1.646$

$\Rightarrow$ reject H_0 #

(h) $\text{wendy} = \beta_4 + 2\cdot\beta_5\cdot 17 + \beta_6\cdot 12 = \beta_4 + 34\beta_5 + 12\beta_6$

$\text{Jill}: \beta_4 + 2\cdot\beta_5\cdot 11 + \beta_6\cdot 16 = \beta_4 + 22\beta_5 + 16\beta_6$

$H_0: \beta_4 + 34\beta_5 + 12\beta_6 - (\beta_4 + 22\beta_5 + 16\beta_6) = 0$

$H_0 = 12\beta_5 - 4\beta_6 = 0$

$H_a: 12\beta_5 - 4\beta_6 \neq 0$

$\alpha = 5\%$

t-statistics $= -1.0273$.

$t_{cr} = \pm 1.962$, do not reject H_0.

(i) $\text{Jill}: \beta_4 + 2\cdot\beta_5\cdot x + 16\beta_6 = 0$

$$x = -\frac{(\beta_4 + 16\cdot\beta_6)}{2\cdot\beta_5} - 11 = 19.667$$

C.I (delta 法) = [15.96, 23.40]