8.6

(a) $\hat{\sigma}_M^2 = \frac{SSE_M}{577-4} = 169.57$ do not reject H_0 #

$\hat{\sigma}_F^2 = 12.024^2 = 144.58$

$\mathcal{F} = \frac{\hat{\sigma}_M^2}{\hat{\sigma}_F^2} = \frac{169.57}{144.58} = 1.178 \sim F(573, 419)$ ∉RR

RR = $F < 0.8317$ or $F > 1.197$.

(b) $\hat{\sigma}_S^2 = \frac{56231.0382}{400-5} = 142.36$ $\mathcal{F} = \frac{\hat{\sigma}_M^2}{\hat{\sigma}_S^2} = 1.189$

$\hat{\sigma}_M^2 = \frac{100403.0471}{600-5} = 169.25$. $F_{0.95, 595, 395} = 1.1647$.

RR = $F > 1.1647$. reject H_0 #

(c) $NR^2 = 59.03 \sim \chi^2_{(4)}$

rejection-region : $\chi^2 > 9.4877$.

reject H_0 #

(d) 78.82, $df = 1+4+4+C_2^4-X-2=12$.

$\chi^2_{0.95,12} = 21.026$.

reject H_0.

(e) narrow using robust : exper. female. metro.

wider using robust : intercept. educ Not consistent.

(f) It's compatible. B 检查 heteroskedasticity

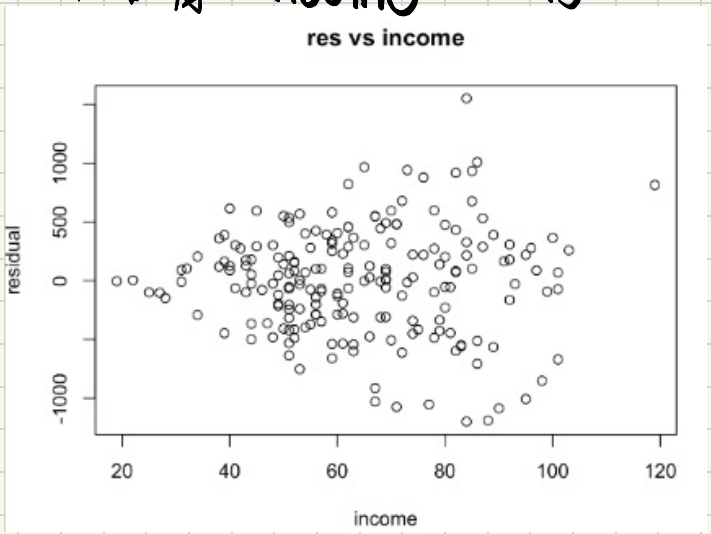
F 检查 the importance of the explantory variable.

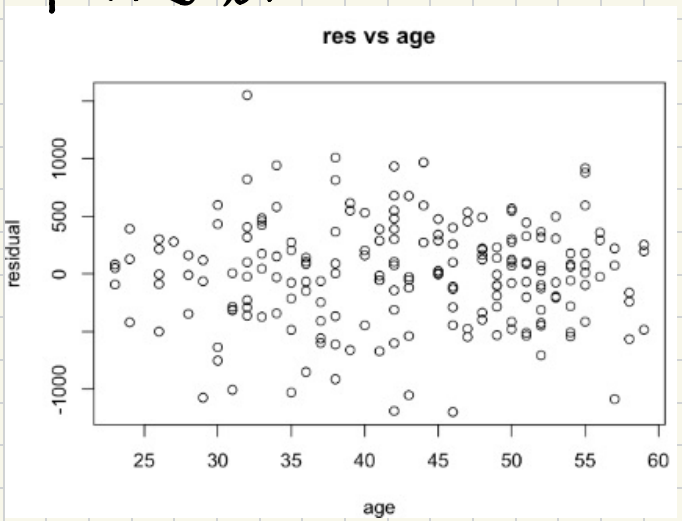
8.16.

a. β_4 95% C.I.

```
> lb
[1] -135.3298
> ub
[1] -28.32302
```

b. 隨著 Income 上升, residual 有上升的趨勢.





c.

```r
#c
vacation_sorted = vacation[order(vacation$income), ]
low_income = vacation_sorted[1:90, ]
high_income = vacation_sorted[111:200, ]
low_model = lm(miles ~ income + age + kids, data = low_income)
high_model = lm(miles ~ income + age + kids, data = high_income)
low_df = low_model$df.residual
high_df = high_model$df.residual
f = summary(low_model)$sigma^2 / summary(high_model)$sigma^2
(f > qf(0.025, low_df, high_df))*(qf(0.975, low_df, high_df) < f)
#reject H0
```

d. robust 方法的 standard error 比較小.

```
> lb
[1] -139.323
> ub
[1] -24.32986
```

e. 與a和d的估計值不同，區間估計 convention GLS 最窄

Conventional GLS

```
> gls_est
[1] -76.80629
> lb
[1] -119.8945
> ub
[1] -33.71808
```

Robust GLS

```
> gls_robust_est
[1] -76.80629
> lb
[1] -121.4134
> ub
[1] -32.19919
```

8.18

a.

```r
#a
modela = lm(log(wage)~educ+exper+I(exper^2)+metro, data = cps5)
male = cps5[cps5$female==0, ]
female = cps5[cps5$female==1, ]
male_lm = lm(log(wage)~educ+exper+I(exper^2)+metro, data = male)
female_lm = lm(log(wage)~educ+exper+I(exper^2)+metro, data = female)

male_df = male_lm$df.residual
female_df = female_lm$df.residual
f = summary(male_lm)$sigma^2 / summary(female_lm)$sigma^2
f_low = qf(0.025, male_df, female_df)
f_up = qf(0.975, male_df, female_df)
(f > f_low)*(f < f_up) #1 non-reject H0
#non-reject H0
```

b.

```r
#b
model1 = lm(log(wage)~educ+exper+I(exper^2)+female+black+metro+south+midwest+west, data = cps5)
ressq = resid(model1)^2
modres2 = lm(ressq~educ+exper+I(exper^2)+female+black+metro+south+midwest+west, data = cps5)
n = nobs(modres2) #9799
S = nobs(modres2) - df.residual(modres2) #10
rsqres = summary(modres2)$r.squared
chisq = n * rsqres
pval = 1-pchisq(chisq, S - 1) #0 reject H0
```

c.

```
#c
modres3 = lm(ressq~educ+I(educ^2)+exper+I(exper^2)+I(exper^4)+female+I(female^2)+black+I(b
           educ*exper+educ*I(exper^2)+I(exper^3), data = cps5)
n = nobs(modres3) #9799
S = nobs(modres3) - df.residual(modres3) #15
rsqres = summary(modres3)$r.squared
chisq = n * rsqres
pval = 1-pchisq(chisq, S - 1) #0 reject H0
```

d.

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	1.2014e+00	3.2794e-02	36.6340	< 2.2e-16	***
educ	1.0123e-01	1.9058e-03	53.1160	< 2.2e-16	***
exper	2.9622e-02	1.3149e-03	22.5276	< 2.2e-16	***
I(exper^2)	-4.4578e-04	2.7597e-05	-16.1533	< 2.2e-16	***
female	-1.6550e-01	9.4883e-03	-17.4428	< 2.2e-16	***
black	-1.1153e-01	1.6094e-02	-6.9297	4.482e-12	***
metro	1.1902e-01	1.1582e-02	10.2762	< 2.2e-16	***
south	-4.5755e-02	1.3902e-02	-3.2914	0.001001	**
midwest	-6.3943e-02	1.3724e-02	-4.6591	3.217e-06	***
west	-6.5891e-03	1.4557e-02	-0.4526	0.650813	

e.

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.190e+00  3.159e-02  37.659  < 2e-16 ***
educ         1.018e-01  1.764e-03  57.705  < 2e-16 ***
exper        3.013e-02  1.295e-03  23.260  < 2e-16 ***
I(exper^2)  -4.567e-04  2.679e-05 -17.049  < 2e-16 ***
female      -1.657e-01  9.483e-03 -17.476  < 2e-16 ***
black       -1.109e-01  1.698e-02  -6.532 6.79e-11 ***
metro        1.175e-01  1.156e-02  10.163  < 2e-16 ***
south       -4.474e-02  1.352e-02  -3.308 0.000942 ***
midwest     -6.327e-02  1.400e-02  -4.521 6.23e-06 ***
west        -5.568e-03  1.438e-02  -0.387 0.698523
```

f.

```
              Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)  1.1896e+00  3.2326e-02  36.8008 < 2.2e-16 ***
educ         1.0181e-01  1.8906e-03  53.8505 < 2.2e-16 ***
exper        3.0130e-02  1.3042e-03  23.1022 < 2.2e-16 ***
I(exper^2)  -4.5667e-04  2.7403e-05 -16.6649 < 2.2e-16 ***
female      -1.6573e-01  9.4379e-03 -17.5599 < 2.2e-16 ***
black       -1.1089e-01  1.5862e-02  -6.9911 2.906e-12 ***
metro        1.1747e-01  1.1557e-02  10.1636 < 2.2e-16 ***
south       -4.4742e-02  1.3833e-02  -3.2344  0.001223 **
midwest     -6.3274e-02  1.3708e-02  -4.6158 3.965e-06 ***
west        -5.5680e-03  1.4504e-02  -0.3839  0.701060
```

9. 再GLS+Robust，有考虑异质性