Q8.6

Var(e_i | x_i, FEMALE=0) controls 4 parameters!!

a. $H_0: \frac{\sigma_M^2}{\sigma_F^2} = 1$ v.s. $H_1: \frac{\sigma_M^2}{\sigma_F^2} \neq 1$

$$\varphi = \frac{\hat{\sigma}_M^2}{\hat{\sigma}_F^2} \sim F(573, 419)$$

$$RR = \{\varphi \mid \varphi > F_{0.975}(573, 419) = 1.197 \quad \text{or} \quad \varphi < F_{0.025}(573, 419) = 0.8377\}$$

$$\varphi^* = \frac{SSE_M / 573}{\hat{\sigma}_F^2} = \frac{169.57}{144.58} = 1.1728 \notin RR$$

do not reject the Null

b. $H_0: \frac{\sigma_M^2}{\sigma_S^2} = 1$ v.s. $H_1: \frac{\sigma_M^2}{\sigma_S^2} > 1$

$$\varphi = \frac{\hat{\sigma}_M^2}{\hat{\sigma}_S^2} \sim F(595, 395)$$

$$RR = \{\varphi \mid \varphi > F_{0.95}(595, 395) = 1.1641\}$$

$$\varphi^* = \frac{\frac{100,903.0411}{595}}{\frac{56,231.0382}{395}} = 1.189 \in RR, \text{ reject } H_0$$

c.

$$NR^2 = 59.03 \sim \chi^2(4)$$

$$RR = \{\varphi \mid \varphi > \chi^2_{0.95}(4) = 9.4877\}$$

$\varphi^* = NR^2 \in RR$ reject H_0

d. $NR^2 = 78.82$

$RR = \{ \psi \mid \psi > \chi^2_{0.95}(12) = 21.026 \}$ $NR^2 \in RR$ reject H_0

e. Narrower for robust SE of EXPER, METRO, FEMALE

Wider for robust SE of EDUC, Intercept

f. It's compatible, we cannot tell wether the variable is heteroskedastic simply by White standard error t statistic (Not consistent)

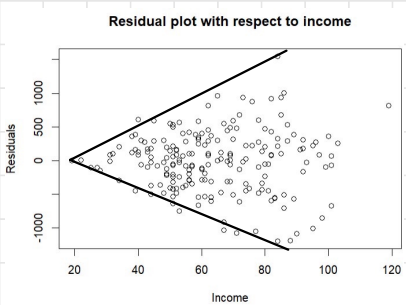
The result from b.

8.16

a. 95% CI for β_4: $[-135.33, -28.32]$

	2.5 %	97.5 %
(Intercept)	-726.36871	-56.72731
income	10.65097	17.75169
age	8.33086	23.15099
kids	-135.32981	-28.32302

b. Income seems to be heteroskedastic



c. $\psi = \frac{\hat{\sigma}^2_{high}}{\hat{\sigma}^2_{low}} = 3.104 > F_{0.05}(86, 86) = 1.42$

reject H_0

```
> cat(pivot,crit)
3.104061 1.428617
```

d. 95% Robust CI for β_4: [-139.32, -24.33]

	Estimate	Lower_CI	Upper_CI
(Intercept)	-391.54801	-672.883378	-110.21263
income	14.20133	10.377633	18.02503
age	15.74092	7.919934	23.56191
kids	-81.82642	-139.322973	-24.32986

e.

	2.5 %	97.5 %
(Intercept)	-664.50116	-185.49119
income	11.02744	16.86718
age	10.75260	22.68240
kids	-119.89450	-33.71808

```
> c(ci_lower, ci_upper)
      kids       kids
-121.41245  -32.20013
```

8 18

a.

```
> cat(flc,fuc,fstat)
0.9452566 1.058097 1.05076
```

$H_0: \frac{\sigma_m^2}{\sigma_F^2} = 1$ v.s. $H_1: \frac{\sigma_m^2}{\sigma_F^2} \neq 1$

$\varphi = \frac{\hat{\sigma}_m^2}{\hat{\sigma}_F^2}$

$RR = \{\varphi \mid \varphi > fuc = 1.058 \text{ or } \varphi < flc = 0.945\}$

$\varphi^* = 1.0507 \notin RR$ doesn't reject H_0

b. NR^2 test

```
studentized Breusch-Pagan test

data:  base
BP = 23.557, df = 3, p-value = 3.091e-05
```

Using metro, female, and black to test heteroskadesticity

Assuming $Var(e|X)$ depends on metro, female, and black.

p-value < 0.05 reject the null that $Var(e|X)$ isn't dependent on metro, female, and black.

NR^2 test

```
studentized Breusch-Pagan test

data:  base
BP = 109.42, df = 9, p-value < 2.2e-16
```

Using all explanatory variables to test heteroskadesticity

p-value < 0.05 reject the null that $Var(e|x)$ isn't dependent on all explanatory variable

These two test shows the regression explicit a heteroskatic problem.

c.

```
studentized Breusch-Pagan test

data:  base
BP = 3447.9, df = 187, p-value < 2.2e-16
```

With White test, adding X^2 term to explain $\hat{e}_i$ and the reported outcome shows an heteroskadestic problem too.

d.

$OLS_CI

	2.5 %	97.5 %
(Intercept)	1.1384302204	1.2643338265
educ	0.0977830603	0.1046761665
exper	0.0270727569	0.0321706349
I(exper^2)	-0.0004974407	-0.0003941203
female	-0.1841810529	-0.1468229075
black	-0.1447358548	-0.0783146449
metro	0.0948966363	0.1431441846
south	-0.0723384657	-0.0191724010
midwest	-0.0915893895	-0.0362971859
west	-0.0348207138	0.0216425095

$Robust_CI

	2.5 %	97.5 %
(Intercept)	1.1371314921	1.2656325548
educ	0.0974957176	0.1049635093
exper	0.0270455202	0.0321978715
I(exper^2)	-0.0004998484	-0.0003917125
female	-0.1840914354	-0.1469125250
black	-0.1430561098	-0.0799943899
metro	0.0963285858	0.1417122350
south	-0.0729915998	-0.0185192668
midwest	-0.0908319319	-0.0370546435
west	-0.0351089553	0.0219307510

e.

```
> confint(gls1)
```

	2.5 %	97.5 %
(Intercept)	1.127694057	1.2515350381
educ	0.098351366	0.1052682659
exper	0.027590905	0.0326693606
I(exper^2)	-0.000509177	-0.0004041652
female	-0.184317568	-0.1471399412
black	-0.144166923	-0.0776164205
metro	0.094808099	0.1401225846
south	-0.071252312	-0.0182311336
midwest	-0.090708494	-0.0358393299
west	-0.033747215	0.0226111169

f.

```
> confint(coeftest(gls1, robust_cov_gls1))
```

	2.5 %	97.5 %
(Intercept)	1.1262817514	1.2529473436
educ	0.0981057405	0.1055138913
exper	0.0275749128	0.0326853527
I(exper^2)	-0.0005103596	-0.0004029826
female	-0.1842195257	-0.1472379834
black	-0.1419684532	-0.0798148899
metro	0.0948218577	0.1401088263
south	-0.0718433109	-0.0176401343
midwest	-0.0901306476	-0.0364171760
west	-0.0339841097	0.0228480111