8.6

(a) $H_0: \sigma_M^2 = \sigma_F^2$ $\quad \sigma_M^2 = \frac{99161.9174}{577} = 168.3915$ $\quad F = \frac{\sigma_M^2}{\sigma_F^2} = \frac{168.3915}{12.024^2} = 1.1647$, $df1 = 573$, $df2 = 419$

$H_a: \sigma_M^2 \neq \sigma_F^2$

$F_{573,419,5\%} = 0.8377$ and $1.1968 \Rightarrow [0.8377, 1.1968]$, $0.8377 < 1.1647 < 1.1968$

do not reject H_0. there's no sufficient evidence to show that $\sigma_M^2 \neq \sigma_F^2$

(b)

$H_0: \sigma_{MR}^2 = \sigma_S^2$ $\quad \sigma_{MR}^2 = 169.6384$ $\quad F = 1.1925$

$H_a: \sigma_{MR}^2 = \sigma_S^2$ $\quad \sigma_S^2 = 140.5776$ $\quad F_{595,595,5\%} = [0.8366, 1.1994]$. 1.1925 在這區間 $\Rightarrow$ dont reject H_0

There is no sufficient evidence to show that $\sigma_{MR}^2 \neq \sigma_S^2$

(c)

$MR^2 = 59.03$

$\chi^2_{4,0.05} = 9.4877 < 59.03 \Rightarrow$ reject H_0

There is sufficient evidence to show that heteroskedasticity exists and same as (b)

(d) $df = 12$

$\chi^2_{12,0.05} = 21.0267 < 98.82 \Rightarrow$ reject H_0

There is sufficient evidence to show that heteroskedasticity exists and same as (b)

(e) Wider: Intercept, EDUC

Narrower: EXPER, METRO, FEMALE $\Rightarrow$ No inconsistency

(f) part (b) state heteroskedasticity $\Rightarrow$ not conflict

8.16

(a)

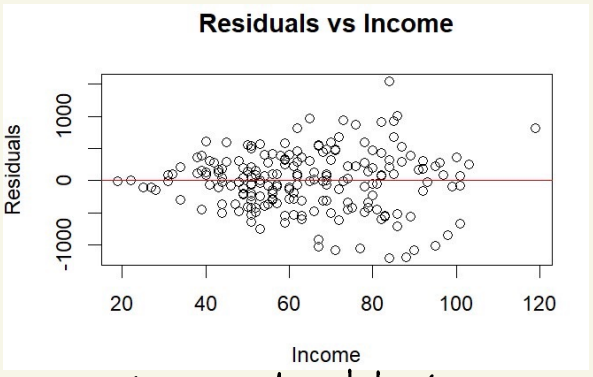
```
Residuals:
     Min       1Q   Median       3Q      Max
-1198.14  -295.31    17.98   287.54  1549.41

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -391.548    169.775  -2.306   0.0221 *
income        14.201      1.800   7.889 2.10e-13 ***
age           15.741      3.757   4.189 4.23e-05 ***
kids         -81.826     27.130  -3.016   0.0029 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 452.3 on 196 degrees of freedom
Multiple R-squared:  0.3406,    Adjusted R-squared:  0.3305
F-statistic: 33.75 on 3 and 196 DF,  p-value: < 2.2e-16
```

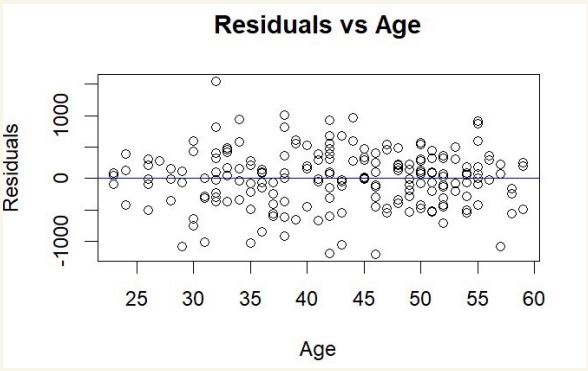
```
             2.5 %     97.5 %
kids -135.3298 -28.32302
```

(b)



income ↑ ⇒ spread will be larger

heteroskedasticity exists



no pattern

(c) $H_0: \sigma_2^2 = \sigma_H^2$

$H_a: \sigma_2^2 < \sigma_H^2$

```
        Goldfeld-Quandt test

data:  miles ~ income + age + kids
GQ = 3.1041, df1 = 86, df2 = 86, p-value = 1.64e-07
alternative hypothesis: variance increases from segment 1 to 2
```

> 1.4256

⇒ reject H_0, there's no sufficient evidence to show heteroskedasticity exists

(d)

```
[1] -138.96900  -24.68383
```

$-139.323 < -135.3298$ (compare with (a)) ⇒ wider

$-24.68383 > -28.32302$

(e)

```
Call:
lm(formula = miles ~ income + age + kids, data = vacation, weights = gls_wts)

Weighted Residuals:
     Min       1Q   Median       3Q      Max
-15.1907  -4.9555   0.2488   4.3832  18.5462

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -424.996    121.444  -3.500 0.000577 ***
income        13.947      1.481   9.420  < 2e-16 ***
age           16.717      3.025   5.527 1.03e-07 ***
kids         -76.806     21.848  -3.515 0.000545 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.765 on 196 degrees of freedom
Multiple R-squared:  0.4573,    Adjusted R-squared:  0.449
F-statistic: 55.06 on 3 and 196 DF,  p-value: < 2.2e-16
```

interval of GLS standard error has biggest lower bound and smallest upper bound

⇒ narrower

8.18

(a) $H_0: \sigma_M^2 = \sigma_F^2$
$H_a: \sigma_M^2 \neq \sigma_F^2$ $F = 1.05076$, $F_{0.05} = [0.9453, 1.0581]$ $0.9453 < 1.05076 < 1.0581$

$\Rightarrow$ do not reject H_0. no sufficient evidence to show $\sigma_M^2 = \sigma_M^2$

(b) $H_0: \alpha_5 = \alpha_6 = \alpha_7 = 0$
H_a: not all α_i is 0

$NR^2 = 23.55681 > 11.34487$ $\Rightarrow$ reject H_0. not sufficient evidence to show the heteroskedasticity exists.

$H_0: \alpha_1 = \alpha_2 = \alpha_3 = \cdots = \alpha_{10} = 0$
H_a: not all α_i is 0

$NR^2 = 109.4243 > 21.16599$ $\Rightarrow$ reject H_0. not sufficient evidence to show the heteroskedasticity exists.

(c) H_0: homoskedasticity
H_a: heteroskedasticity

$NR^2 = 194.4444 > 60.48089$ $\Rightarrow$ reject H_0. not sufficient evidence to show the heteroskedasticity exists.

(d)

```
      OLS..Intercept.    OLS.educ   OLS.exper OLS.I.exper.2. OLS.female  OLS.black
97.5 %       0.1259036 0.006893106 0.005097878   0.0001033205 0.03735815 0.06642121
       OLS.metro  OLS.south OLS.midwest   OLS.west Robust..Intercept. Robust.educ
97.5 % 0.04824755 0.05316606   0.0552922 0.05646322          0.1285011 0.007467792
       Robust.exper Robust.I.exper.2. Robust.female Robust.black Robust.metro Robust.south
97.5 %  0.005152351      0.0001081359    0.03717891   0.06306172   0.04538365   0.05447233
       Robust.midwest Robust.west Change..Intercept. Change.educ Change.exper
97.5 %     0.05377729  0.05703971             wider       wider       wider
       Change.I.exper.2. Change.female Change.black Change.metro Change.south
97.5 %           wider       narrower     narrower     narrower         wider
       Change.midwest Change.west
97.5 %       narrower       wider
```

	OLS_p	Robust_p	OLS_sig	Robust_sig
(Intercept)	2.122456e-286	1.002569e-275	TRUE	TRUE
educ	0.000000e+00	0.000000e+00	TRUE	TRUE
exper	5.712676e-112	1.030809e-109	TRUE	TRUE
I(exper^2)	2.760763e-63	5.285645e-58	TRUE	TRUE
female	1.427018e-66	3.454261e-67	TRUE	TRUE
black	4.859552e-11	4.371440e-12	TRUE	TRUE
metro	5.016366e-22	1.140396e-24	TRUE	TRUE
south	7.438266e-04	9.945792e-04	TRUE	TRUE
midwest	5.861847e-06	3.180265e-06	TRUE	TRUE
west	6.473209e-01	6.506470e-01	FALSE	FALSE

(e)

```
      Robust..Intercept. Robust.educ Robust.exper Robust.I.exper.2. Robust.female
97.5 %          0.1285011 0.007467792  0.005152351      0.0001081359    0.03717891
      Robust.black Robust.metro Robust.south Robust.midwest Robust.west FGLS..Intercept.
97.5 %   0.06306172   0.04538365   0.05447233     0.05377729  0.05703971        0.1248431
        FGLS.educ  FGLS.exper FGLS.I.exper.2. FGLS.female FGLS.black FGLS.metro FGLS.south
97.5 % 0.006905656 0.005092118     0.000104173   0.0372653 0.06651303 0.04651022  0.0530913
      FGLS.midwest  FGLS.west Change..Intercept. Change.educ Change.exper
97.5 %   0.05506411 0.05641345            narrower    narrower     narrower
      Change.I.exper.2. Change.female Change.black Change.metro Change.south
97.5 %          narrower         wider        wider        wider     narrower
      Change.midwest Change.west
97.5 %          wider    narrower
```

(f)

```
      FGLS..Intercept.   FGLS.educ  FGLS.exper FGLS.I.exper.2. FGLS.female FGLS.black
97.5 %       0.1248431 0.006905656 0.005092118     0.000104173   0.0372653 0.06651303
      FGLS.metro FGLS.south FGLS.midwest  FGLS.west FGLS_Robust..Intercept.
97.5 % 0.04651022  0.0530913   0.05506411 0.05641345                0.1274491
      FGLS_Robust.educ FGLS_Robust.exper FGLS_Robust.I.exper.2. FGLS_Robust.female
97.5 %      0.007430449       0.005124196           0.0001075916         0.03702899
      FGLS_Robust.black FGLS_Robust.metro FGLS_Robust.south FGLS_Robust.midwest
97.5 %        0.06256403        0.04531735        0.05426542          0.05367082
      FGLS_Robust.west Change..Intercept. Change.educ Change.exper Change.I.exper.2.
97.5 %       0.05687199             wider       wider        wider             wider
      Change.female Change.black Change.metro Change.south Change.midwest Change.west
97.5 %      narrower     narrower     narrower         wider       narrower       wider
```

(g) FGLS. Because it has narrower estimate interval, heteroskedasticity exists