C10Q18

(a)

```
percentage of parents have some college education: 4.515272 %
```

(b)

```
                educ mothercoll fathercoll
educ       1.0000000  0.3370171  0.3193212
mothercoll 0.3370171  1.0000000  0.3674532
fathercoll 0.3193212  0.3674532  1.0000000
```

(c)

```
                 Estimate   Std. Error    t value    Pr(>|t|)
(Intercept) -0.1327561301 0.4965325444 -0.2673664 0.789317051
exper        0.0433444070 0.0134135012  3.2314014 0.001327913
I(exper^2)  -0.0008711257 0.0004016741 -2.1687377 0.030657860
educ         0.0760179577 0.0394077245  1.9290116 0.054396520

95% CI: [ -0.001440868 ,  0.1534768 ]
interval width: 0.1549177
```

C10Q18

(d)

```
Linear hypothesis test:
mothercoll = 0

Model 1: restricted model
Model 2: educ ~ exper + I(exper^2) + mothercoll

  Res.Df    RSS Df Sum of Sq      F    Pr(>F)
1    425 2219.2
2    424 1929.9  1    289.32 63.563 1.455e-14 ***
```

=> Reject H0, it suggests that MOTHERCOLL is a strong instrument.

C10Q18

(e)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-0.279081854	0.3922213258	-0.7115418	0.477139860
exper	0.042676124	0.0132950062	3.2099364	0.001428594
I(exper^2)	-0.000848598	0.0003975543	-2.1345464	0.033370976
educ	0.087847654	0.0307807733	2.8539781	0.004529193

```
95% CI: [ 0.02734574 ,  0.1483496 ]
interval width: 0.1210038
```

The 95% CI is narrower than the one in part (c).

C10Q18

(f)

```
Linear hypothesis test:
mothercoll = 0
fathercoll = 0

Model 1: restricted model
Model 2: educ ~ exper + I(exper^2) + mothercoll + fathercoll

  Res.Df    RSS Df Sum of Sq      F    Pr(>F)
1    425 2219.2
2    423 1748.3  2    470.88 56.963 < 2.2e-16 ***
```

=> Reject H0, it suggests that MOTHERCOLL and FATHERCOLL seem adequately strong.

C10Q18

(g)

```
Diagnostic tests:
                 df1 df2 statistic p-value
Weak instruments   2 423    56.963  <2e-16 ***
Wu-Hausman         1 423     0.519   0.472
Sargan             1  NA     0.238   0.626
```

=> In Sargan test, we don't reject H0, it suggests that cov(z,e) = 0, the instruments are valid.

C10Q20

(a)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.003250   0.006036   0.538    0.591
x           1.201840   0.122152   9.839   <2e-16 ***
```

$\beta > 1$, microsoft stock is risky than the market portfolio.

C10Q20

(b)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -7.903e-02  2.195e-03   -36.0   <2e-16 ***
rank         9.067e-04  2.104e-05    43.1   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01467 on 178 degrees of freedom
Multiple R-squared:  0.9126,    Adjusted R-squared:  0.9121
F-statistic:  1858 on 1 and 178 DF,  p-value: < 2.2e-16
```

=> The coefficient of RANK is very significant (t-value = 43.1),

the R-squared = 0.9126.

RANK is a strong IV, since we reject H0 in F-test.

C10Q20

(c)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.003018   0.005984   0.504   0.6146
x            1.278318   0.126749  10.085   <2e-16 ***
fs_resid    -0.874599   0.428626  -2.040   0.0428 *
```

=> Fail to reject H0, it suggests that market return is exogenous.

(d)

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.003018   0.006044   0.499    0.618
x           1.278318   0.128011   9.986   <2e-16 ***
```

=> Yes, it does. The result from IV estimate and OLS are similar, we can expect that the market return is exogenous.

C10Q20

(e)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.0804216  0.0022622  -35.55   <2e-16 ***
rank         0.0009819  0.0000400   24.55   <2e-16 ***
pos         -0.0092762  0.0042156   -2.20   0.0291 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01451 on 177 degrees of freedom
Multiple R-squared:  0.9149,    Adjusted R-squared:  0.9139
F-statistic: 951.3 on 2 and 177 DF,  p-value: < 2.2e-16
```

=> They are strong IVs, since we reject H0 in F-test

the R-squared = 0.9149.

C10Q20

(f)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.003004   0.005972   0.503   0.6157
x            1.283118   0.126344  10.156   <2e-16 ***
fs_resid2   -0.954918   0.433062  -2.205   0.0287 *
```

=> Fail to reject H0, it suggests that market return is exogenous.

C10Q20

(g)

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.003004   0.006044   0.497     0.62
x           1.283118   0.127866  10.035   <2e-16 ***
```

=> Yes, it does. The result from IV estimate and OLS are similar, we can expect that the market return is exogenous.

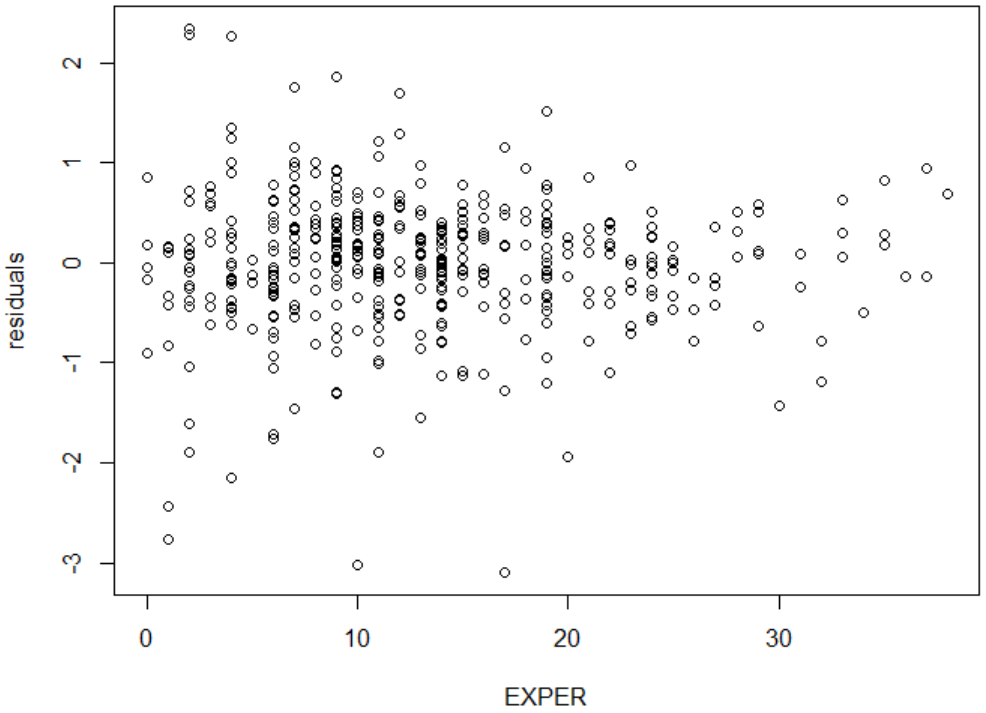
(h)

```
NR2: 0.5584634
critical value: 3.841459
```

=> Fail to reject H0, it suggests that cov(z,e) = 0, the instruments are valid.

C10Q24

(a)



=> Yes, they do. The residuals and EXPER exhibit a clear funnel shape, indicating heteroscedasticity.

C10Q24

(b)

```
NR2: 7.438552
critical value: 3.841459
```

=> Reject H0, it suggests that heteroskedasticity exists.

(c)

```
> baseline_se
 (Intercept)         exper    I(exper^2)          educ
0.4003280773 0.0134324755 0.0004016856 0.0314366956
> robust_se
 (Intercept)         exper    I(exper^2)          educ
0.4337795246 0.0157660508 0.0004390761 0.0336597489
```

Robust standard errors are larger than those for the baseline mode.

```
95% CI: [ -0.004764123 ,  0.09238598 ]
interval width: 0.1323215
```

C10Q24

(d)

```
> baseline_se
 (Intercept)         exper    I(exper^2)          educ
0.4003280773 0.0134324755 0.0004016856 0.0314366956
> robust_se
 (Intercept)         exper    I(exper^2)          educ
0.4337795246 0.0157660508 0.0004390761 0.0336597489
> bootstrap_se
[1] 0.4082143031 0.0163939868 0.0004608973 0.0322380460
```

```
95% CI: [ -0.00196966 ,  0.09362023 ]
interval width: 0.1267326
```