HW0512
313707049 俞懷蘋

15.6 Using the NLS panel data on $N = 716$ young women, we consider only years 1987 and 1988. We are interested in the relationship between ln(*WAGE*) and experience, its square, and indicator variables for living in the south and union membership. Some estimation results are in Table 15.10.

TABLE 15.10 Estimation Results for Exercise 15.6

	(1) OLS 1987	(2) OLS 1988	(3) FE	(4) FE Robust	(5) RE
C	0.9348	0.8993	1.5468	1.5468	1.1497
	(0.2010)	(0.2407)	(0.2522)	(0.2688)	(0.1597)
EXPER	0.1270	0.1265	0.0575	0.0575	0.0986
	(0.0295)	(0.0323)	(0.0330)	(0.0328)	(0.0220)
$EXPER^2$	−0.0033	−0.0031	−0.0012	−0.0012	−0.0023
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0007)
SOUTH	−0.2128	−0.2384	−0.3261	−0.3261	−0.2326
	(0.0338)	(0.0344)	(0.1258)	(0.2495)	(0.0317)
UNION	0.1445	0.1102	0.0822	0.0822	0.1027
	(0.0382)	(0.0387)	(0.0312)	(0.0367)	(0.0245)
N	716	716	1432	1432	1432

(standard errors in parentheses)

a. The OLS estimates of the ln(*WAGE*) model for each of the years 1987 and 1988 are reported in columns (1) and (2). How do the results compare? For these individual year estimations, what are you assuming about the regression parameter values across individuals (heterogeneity)?

b. The ln(*WAGE*) equation specified as a panel data regression model is

$$\ln(WAGE_{it}) = \beta_1 + \beta_2 EXPER_{it} + \beta_3 EXPER_{it}^2 + \beta_4 SOUTH_{it} + \beta_5 UNION_{it} + (u_i + e_{it}) \quad \text{(XR15.6)}$$

Explain any differences in assumptions between this model and the models in part (a).

c. Column (3) contains the estimated fixed effects model specified in part (b). Compare these estimates with the OLS estimates. Which coefficients, apart from the intercepts, show the most difference?

d. The *F*-statistic for the null hypothesis that there are no individual differences, equation (15.20), is 11.68. What are the degrees of freedom of the *F*-distribution if the null hypothesis (15.19) is true? What is the 1% level of significance critical value for the test? What do you conclude about the null hypothesis.

e. Column (4) contains the fixed effects estimates with cluster-robust standard errors. In the context of this sample, explain the different assumptions you are making when you estimate with and without cluster-robust standard errors. Compare the standard errors with those in column (3). Which ones are substantially different? Are the robust ones larger or smaller?

a. 估計差異不大 ⇒ 無異質性

b. 加入隨時間變化 (t) 但誤差 u_i 不隨時間變化。

c. South, from −0.2384 → −0.3261

d. $F = 11.68 > F_{0.01}(715, 711) \approx 1.32$ ⇒ reject H_0, we should use FE model

e. column (4) 的 SE 普遍↑ within transformation $\tilde{e}_{it} = e_{it} - \bar{e}_i$

15.17 The data file *liquor* contains observations on annual expenditure on liquor (*LIQUOR*) and annual income (*INCOME*) (both in thousands of dollars) for 40 randomly selected households for three consecutive years.

a. Create the first-differenced observations on *LIQUOR* and *INCOME*. Call these new variables *LIQUORD* and *INCOMED*. Using OLS regress *LIQUORD* on *INCOMED* without a constant term. Construct a 95% interval estimate of the coefficient.

```
Call:
lm(formula = LIQUORD ~ INCOMED, data = data_diff)

Residuals:
    Min      1Q  Median      3Q     Max
-3.5012 -0.8399  0.0298  1.0077  3.5049

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.40287    0.40600  -0.992    0.324
INCOMED      0.09815    0.07487   1.311    0.194

Residual standard error: 1.417 on 78 degrees of freedom
Multiple R-squared:  0.02156,   Adjusted R-squared:  0.009012
F-statistic: 1.718 on 1 and 78 DF,  p-value: 0.1937

> # 計算 95% 信賴區間
> conf_interval <- confint(model, level = 0.95)
> print(conf_interval)
                 2.5 %    97.5 %
(Intercept) -1.21116108 0.4054114
INCOMED     -0.05090933 0.2472087
```

15.20 This exercise uses data from the STAR experiment introduced to illustrate fixed and random effects for grouped data. In the STAR experiment, children were randomly assigned within schools into three types of classes: small classes with 13–17 students, regular-sized classes with 22–25 students, and regular-sized classes with a full-time teacher aide to assist the teacher. Student scores on achievement tests were recorded as well as some information about the students, teachers, and schools. Data for the kindergarten classes are contained in the data file *star*.

a. Estimate a regression equation (with no fixed or random effects) where *READSCORE* is related to *SMALL*, *AIDE*, *TCHEXPER*, *BOY*, *WHITE_ASIAN*, and *FREELUNCH*. Discuss the results. Do students perform better in reading when they are in small classes? Does a teacher's aide improve scores? Do the students of more experienced teachers score higher on reading tests? Does the student's sex or race make a difference?

b. Reestimate the model in part (a) with school fixed effects. Compare the results with those in part (a). Have any of your conclusions changed? [*Hint*: specify *SCHID* as the cross-section identifier and *ID* as the "time" identifier.]

c. Test for the significance of the school fixed effects. Under what conditions would we expect the inclusion of significant fixed effects to have little influence on the coefficient estimates of the remaining variables?

a.

```
Call:
lm(formula = readscore ~ small + aide + tchexper + white_asian +
    freelunch, data = star)

Residuals:
    Min      1Q  Median      3Q     Max
-110.05  -20.27   -4.02   14.45  189.12

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 434.52072    1.28572 337.958  < 2e-16 ***
small         5.81416    0.99437   5.847 5.28e-09 ***
aide          0.79682    0.95784   0.832    0.406
tchexper      0.51286    0.06986   7.341 2.41e-13 ***
white_asian   3.74427    0.95823   3.907 9.43e-05 ***
freelunch   -14.75206    0.89478 -16.487  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 30.34 on 5760 degrees of freedom
  (因為不存在，20 個觀察量被刪除了)
Multiple R-squared:  0.08748,   Adjusted R-squared:  0.08668
F-statistic: 110.4 on 5 and 5760 DF,  p-value: < 2.2e-16
```

b.

```
> # 比較兩個模型的係數
> summary(model_a)$coefficients
               Estimate Std. Error     t value     Pr(>|t|)
(Intercept) 434.5207225 1.28572307 337.9582536 0.000000e+00
small         5.8141611 0.99436939   5.8470837 5.277351e-09
aide          0.7968162 0.95784135   0.8318875 4.055069e-01
tchexper      0.5128553 0.06985898   7.3412937 2.408842e-13
white_asian   3.7442696 0.95823207   3.9074768 9.433391e-05
freelunch   -14.7520583 0.89477693 -16.4868560 1.045669e-59
> summary(model_b)$coefficients
                    Estimate Std. Error     t value     Pr(>|t|)
(Intercept)        407.4698192  4.1186586  98.9326520 0.000000e+00
small                6.4814512  0.9173873   7.0651197 1.797342e-12
aide                 0.9869604  0.8859669   1.1139924 2.653296e-01
tchexper             0.3000867  0.0711614   4.2169874 2.514345e-05
white_asian          7.9348573  1.5430510   5.1423169 2.804640e-07
freelunch          -14.5737713  0.8842691 -16.4811504 1.192945e-59
factor(schid)123056  12.9971165  5.4677187   2.3770639 1.748398e-02
factor(schid)128068  16.3555461  5.3942056   3.0320583 2.439879e-03
factor(schid)128076   5.2778131  5.3273831   0.9906952 3.218766e-01
factor(schid)128079  14.6145399  5.2786239   2.7686269 5.647556e-03
factor(schid)130085   9.1420904  5.0832286   1.7984811 7.215386e-02
factor(schid)159171  48.1164507  4.7525317  10.1243829 6.861405e-24
factor(schid)161176   6.2762620  4.9889947   1.2580214 2.084357e-01
factor(schid)161183  34.5113179  4.6964027   7.3484580 2.288415e-13
factor(schid)162184  16.8560395  5.2851203   3.1893389 1.433732e-03
factor(schid)164198  26.9716363  5.3935829   5.0006900 5.884146e-07
factor(schid)165199  42.4468120  5.4747470   7.7532007 1.054785e-14
factor(schid)166203  15.2038846  5.1371617   2.9595885 3.093221e-03
factor(schid)168211  18.3812639  4.8096562   3.8217418 1.339280e-04
factor(schid)168214  32.7594827  5.3778141   6.0915982 1.191227e-09
factor(schid)169219  36.5559376  5.5723463   6.5602415 5.847608e-11
factor(schid)169229  34.6394065  4.5305216   7.6457877 2.423457e-14
factor(schid)169231   6.2898399  5.3900679   1.1669315 2.432870e-01
factor(schid)169280  32.8707555  5.4160577   6.0691295 1.369181e-09
factor(schid)170295  34.4091651  5.1828527   6.6390397 3.450757e-11
factor(schid)173312  65.7613248  5.3294090  12.3393278 1.535214e-34
factor(schid)176329  38.8846623  5.1512687   7.5485603 5.097143e-14
factor(schid)180344  25.6324180  4.8201184   5.3177984 1.090457e-07
factor(schid)189378  11.9739483  5.1094126   2.3435078 1.913765e-02
factor(schid)189382  28.8218821  5.2190549   5.5224332 3.491730e-08
factor(schid)189396   9.1453922  5.2541681   1.7405976 8.180828e-02
factor(schid)191411  35.4219788  5.6805325   6.2356793 4.822422e-10
factor(schid)193422  34.8484768  5.3110368   6.5615205 5.798034e-11
factor(schid)193423  22.1658016  5.0426504   4.3956650 1.124462e-05
factor(schid)201449  37.2982361  4.6603703   8.0032774 1.457320e-15
factor(schid)203452  25.4093431  4.8533249   5.2354506 1.705002e-07
factor(schid)203457  44.3355808  5.7863275   7.6621277 2.136906e-14
factor(schid)205488  23.2771012  5.4282276   4.2881587 1.831449e-05
factor(schid)205489  30.7663913  5.4719401   5.6225745 1.970968e-08
factor(schid)205490   6.4954316  5.2947092   1.2267778 2.195569e-01
factor(schid)205491  15.6315044  5.1503261   3.0350514 2.415834e-03
factor(schid)205492  40.6713881  5.0259204   8.0923264 7.099252e-16
factor(schid)208501  18.1771196  5.2246280   3.4791222 5.068337e-04
factor(schid)208503   3.4118982  5.2972590   0.6440875 5.195447e-01
factor(schid)209510  17.4450062  4.8495953   3.5972087 3.243853e-04
factor(schid)212522  24.2528145  5.1758855   4.6857324 2.854658e-06
factor(schid)215533  33.2689050  4.6350949   7.1776103 8.002919e-13
factor(schid)216536  15.4698752  4.7841716   3.2335536 1.229592e-03
factor(schid)221571  -2.4874498  4.7572947  -0.5228706 6.010847e-01
factor(schid)221574   7.9433788  5.2559367   1.5113156 1.307637e-01
factor(schid)225585   9.3133206  5.0043286   1.8610530 6.278831e-02
factor(schid)228606  25.1873275  4.9943158   5.0431988 4.720278e-07
factor(schid)230612  37.3483909  5.3152710   7.0266202 2.364195e-12
factor(schid)231616  25.5365306  5.3466744   4.7761522 1.831689e-06
factor(schid)234628  25.3500568  4.7911896   5.2909735 1.262267e-07
factor(schid)244697  19.8043353  4.8349267   4.0960984 4.260126e-05
factor(schid)244708  15.8529640  4.7830315   3.3144177 9.240941e-04
factor(schid)244723  14.6253602  4.7635990   3.0702333 2.149017e-03
factor(schid)244727  29.0919502  5.0295372   5.7842201 7.673473e-09
factor(schid)244728  20.9973701  5.5623952   3.7748792 1.617173e-04
factor(schid)244736  40.6869904  5.5445274   7.3382251 2.468546e-13
factor(schid)244745  33.1918081  4.9836854   6.6600930 2.994171e-11
factor(schid)244746  37.0830974  5.4509820   6.8030123 1.129748e-11
factor(schid)244755  34.2067304  4.6104187   7.4194412 1.349193e-13
factor(schid)244764  30.3011111  6.1615320   4.9177884 8.999056e-07
factor(schid)244774  32.4623231  4.8414874   6.7050310 2.208488e-11
factor(schid)244776  28.7668981  4.6163681   6.2315000 4.951974e-10
factor(schid)244780  62.1744538  5.3341578  11.6559083 4.818126e-31
factor(schid)244796  24.3003432  5.4009565   4.4992666 6.954732e-06
factor(schid)244799  18.9021398  5.2549821   3.5969941 3.246523e-04
factor(schid)244801  14.3262493  5.0537755   2.8347617 4.602178e-03
factor(schid)244806  53.1768970  4.5916370  11.5812503 1.131195e-30
factor(schid)244818  17.0108540  4.9560518   3.4323398 6.026659e-04
factor(schid)244831  18.2578786  5.3289756   3.4261517 6.165363e-04
factor(schid)244839  35.0783007  5.0666664   6.9233492 4.897683e-12
factor(schid)252885  29.2500471  5.1390368   5.6917372 1.320434e-08
factor(schid)253888  18.4332424  5.8788169   3.1355361 1.724155e-03
factor(schid)257899  13.2616174  4.7567693   2.7879463 5.321966e-03
factor(schid)257905  41.1168032  4.6199316   8.8998727 7.400564e-19
factor(schid)259915  15.2066172  5.3288522   2.8536384 4.337801e-03
factor(schid)261927  22.0613092  4.9457738   4.4606385 8.329120e-06
factor(schid)262937  46.2394311  5.1727585   8.9390276 5.222171e-19
factor(schid)264945  30.4659105  4.8264407   6.3122935 2.957466e-10
```

c.

```
Analysis of Variance Table

Model 1: readscore ~ small + aide + tchexper + white_asian + freelunch
Model 2: readscore ~ small + aide + tchexper + white_asian + freelunch +
    factor(schid)
  Res.Df     RSS Df Sum of Sq      F    Pr(>F)
1   5760 5302072
2   5682 4311147 78    990925 16.744 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
```