

16.

(a) The difference between 1987 and 1988 is actually small.

→ No heterogeneity across individuals.

(b) Add the index of time and individuals.

Also, add e_{it} , which will vary with time and different individuals.And, add u_i , which correlates with explainable variables but not with time.

(c) FE 95% C.I. —

EXPER = (-0.0085, 0.1235) → Its estimate of OLS is not located in this interval,

EXPER* = (-0.0034, 0.0010) its difference is the most.

SOUTH = (-0.5777, -0.0745)

UNION = (0.0198, 0.1446)

(d) ∵ $F = 11.68 > F_{0.05, 915, 71} = 1.2$ ∴ reject H_0 . Thus, there are individual differences.(e) Standard errors are within transformation: $\tilde{e}_{it} = e_{it} - \bar{e}_{it}$

And, the standard error in column 4 generally get larger.

17.

(a) Call:
`lm(formula = liquor ~ income - 1, data = liquor5_diff)`

Residuals:

Min	1Q	Median	3Q	Max
-3.6852	-0.9196	-0.0323	0.9027	3.3620

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
income	0.02975	0.02922	1.018	0.312

Residual standard error: 1.417 on 79 degrees of freedom

Multiple R-squared: 0.01295, Adjusted R-squared: 0.0004544

F-statistic: 1.036 on 1 and 79 DF, p-value: 0.3118

→ $\hat{LIQUOR}_{it} = 0.02975 INCOME_{it}$

→ 95% C.I. = [-0.0284, 0.0879]

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

Residuals:
    Min       1Q   Median       3Q      Max
-107.220  -20.214   -3.935   14.339  185.956

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  437.76425    1.34622  325.180 < 2e-16 ***
(1) small      5.82282     0.98933   5.886 4.19e-09 ***
(2) aide       0.81784     0.95299   0.858  0.391
(3) tchexper   0.49247     0.06956   7.080 1.61e-12 ***
(4) boy       -6.15642     0.79613  -7.733 1.23e-14 ***
(5) white_asian 3.90581     0.95361   4.096 4.26e-05 ***
(6) freelunch -14.77134     0.89025 -16.592 < 2e-16 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 30.19 on 5759 degrees of freedom
(因為不存在，20 個觀察量被刪除了)
Multiple R-squared:  0.09685, Adjusted R-squared:  0.09591
F-statistic: 102.9 on 6 and 5759 DF, p-value: < 2.2e-16
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- (1) Small — class instruction has a statistically significant positive impact on reading performance.
- (2) There's no evidence that having a teacher's aid significantly improves reading scores.
- (3) More experienced teachers are associated with better student reading outcomes.
- (4) Girls outperform boys in the reading assessment.
- (5) White and Asian students achieve higher average reading scores.
- (6) Economic disadvantage is strongly associated with lower reading performance.

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Call:
plm(formula = readscore ~ small + aide + tchexper + boy + white_asian +
  freelunch, data = pdata, effect = "individual", model = "within")

Unbalanced Panel: n = 79, T = 34-137, N = 5766

Residuals:
    Min.    1st Qu.    Median    3rd Qu.     Max.
-102.6381  -16.7834   -2.8473   12.7591   198.4169

Coefficients:
            Estimate Std. Error t-value Pr(>|t|)
small      6.490231    0.912962   7.1090 1.313e-12 ***
aide       0.996087    0.881693   1.1297  0.2586
tchexper   0.285567    0.070845   4.0309 5.629e-05 ***
boy       -5.455941    0.727589  -7.4987 7.440e-14 ***
white_asian 8.028019    1.535656   5.2277 1.777e-07 ***
freelunch -14.593572    0.880006 -16.5835 < 2.2e-16 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:  4628000
Residual Sum of Squares: 4268900
R-Squared: 0.077592
Adj. R-Squared: 0.063954
F-statistic: 79.6471 on 6 and 5681 DF, p-value: < 2.22e-16
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- ☒ Small class effect (small) remains significant and even larger under fixed effects → the benefit of small classes is not driven by between-school differences.
- ☒ Teacher's aide (aide) stays not significant in both models → no strong evidence it improves reading scores.
- ☒ Teacher experience (tchexper) remains significant, though its effect is reduced under fixed effects → some of its effect was likely explained by school-level factors.
- ☒ Gender (boy) and economic disadvantage (freelunch) continue to have strong, significant negative impacts.
- ☒ Race effect (white_asian) became much larger under fixed effects, suggesting that between-school variation may have masked the true within-school racial differences.

(c)

F test for individual effects

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data: readscore ~ small + aide + tchexper + boy + white_asian + freelunch  
F = 16.698, df1 = 78, df2 = 5681, p-value < 2.2e-16  
alternative hypothesis: significant effects
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$$\because F = 16.698 > F_{crit} = 1.298$$

\therefore reject H_0 , there are no significant differences between schools.

→ Significant fixed effects will have little influence on the coefficient estimates of other variables when those variables are uncorrelated with the fixed effects and when most of their variation comes from within-group (e.g., within-school) differences rather than across-group differences.