Q15. 6. a

The coefficient of T=1987, T=1988 seems quite the same on both point estimates and standard errors. However, estimating each model seperately implicitly assumes no unobserved heterogenous time effect. We still need furthur F test to find the heterogeneity across time.

Q15. 6. b

Part a shows cross-sectional regression of T=1987 & 88
The panel data regression assumes and models individual effect in the regression (heterogeneity) which is not considered in part a.

Q15. 6. c

The most different coefficient is shown in South variable, meaning there's a big unobserved heterogeneity accross n=716 individuals.

Q15.6.d

N-1 NT-N-(k-1)

$F = 11.68 > 1.19 = F_{0.01}(716-1, 716\times2-716-4)$

Reject H_0, and the individual fix effect do exist.

Q15.6.e

Cluster Robust SE is larger because it controlled for heteroskedasticity and autocorrelation within a cluster, and thus more conservative.

Q15.20.a

Other than being a teacher's aide, all factors brings significant impact on reading ability if we use pooled data and assume no heteroskedastiviy accross school, individual or time.

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

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
small         5.82282    0.98933   5.886 4.19e-09
aide          0.81784    0.95299   0.858    0.391
tchexper      0.49247    0.06956   7.080 1.61e-12
boy          -6.15642    0.79613  -7.733 1.23e-14
white_asian   3.90581    0.95361   4.096 4.26e-05
freelunch   -14.77134    0.89025 -16.592  < 2e-16

(Intercept) ***
small       ***
aide
tchexper    ***
boy         ***
white_asian ***
freelunch   ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Q15.20.b

After controlling for school fix effect, the significance of the variables becomes even larger.

```
Call:
plm(formula = readscore ~ small + aide + tchexper + b
oy + white_asian +
    freelunch, data = pdata, method = "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
small        6.490231   0.912962   7.1090
aide         0.996087   0.881693   1.1297
tchexper     0.285567   0.070845   4.0309
boy         -5.455941   0.727589  -7.4987
white_asian  8.028019   1.535656   5.2277
freelunch  -14.593572   0.880006 -16.5835
              Pr(>|t|)
small       1.313e-12 ***
aide           0.2586
tchexper    5.629e-05 ***
boy         7.440e-14 ***
white_asian 1.777e-07 ***
freelunch   < 2.2e-16 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Q15.20.c

Using partial F test, we reject the null and support that there exist a school fix effect

```
> pFtest(modfe, modpooled)

        F test for individual effects

data:  readscore ~ small + aide + tchexper + boy + wh
ite_asian + freelunch
F = 16.698, df1 = 78, df2 = 5681, p-value <
2.2e-16
alternative hypothesis: significant effects
```

Q15.17.a

$\beta_{liquor} = -1.7638$

$\beta_{income} = 3.196$

```
Call:
lm(formula = hh ~ 0 + liquor + income, data = liquor)

Residuals:
    Min      1Q  Median      3Q     Max
-20.264  -8.597   4.639  14.819  32.323

Coefficients:
       Estimate Std. Error t value Pr(>|t|)
liquor  -1.7638     1.8379  -0.960    0.343
income   3.1960     0.4637   6.893 3.43e-08 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 16.08 on 38 degrees of freed
om
Multiple R-squared:  0.5564,    Adjusted R-squared:
0.5331
F-statistic: 23.83 on 2 and 38 DF,  p-value: 1.959e-0
```

95% CI for $\beta_{liquor} = [-1.8998, -1.6478]$

95% CI for $\beta_{income} = [3.1668, 3.2253]$

```
> conf
                47.5 %    52.5 %
liquor   -1.879792 -1.647769
income    3.166770  3.225304
```