Q15.6 (f)

The most different coefficient appear in South

	$b_{FE} - b_{RE}$	$\sqrt{SE(b_{FE})^2 - SE(b_{RE})^2}$	t
EXPER	-0.0411	0.0246	-1.67
$EXPER^2$	0.0011	0.000085	1.294
South	-0.0935	0.12174	-0.7339
Union	-0.0205	0.01932	-0.245

Under 5% level, all factors doesn't show significant difference between b_{FE} & b_{RE}, showing $cov(X_{it}, u_i) = 0$

Ho do not be reject ⇒ RE model #

Q15.20 (d)

使用 RE model 後，除了 aide 以外，其他變數的係數變更加顯著，LM Test reject H_0，顯示 RE 存在。

```
        Lagrange Multiplier Test - (Honda)

data:  readscore ~ small + aide + tchexper + boy + wh
ite_asian + freelunch
normal = 81.715, p-value < 2.2e-16
alternative hypothesis: significant effects
```

```
Call:
plm(formula = readscore ~ small + aide + tchexper + b
oy + white_asian +
    freelunch, data = pdata, model = "random", rando
m.method = "swar")

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

Effects:
                 var std.dev share
idiosyncratic 751.43   27.41 0.829
individual    155.31   12.46 0.171
theta:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 0.6470  0.7225  0.7523  0.7541  0.7831  0.8153

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-97.483 -17.236  -3.282   0.037  12.803 192.346

Coefficients:
             Estimate Std. Error  z-value
(Intercept) 436.126774   2.064782 211.2217
small         6.458722   0.912548   7.0777
aide          0.992146   0.881159   1.1260
tchexper      0.302679   0.070292   4.3060
boy          -5.512081   0.727639  -7.5753
white_asian   7.350477   1.431376   5.1353
freelunch   -14.584332   0.874676 -16.6740
              Pr(>|z|)
(Intercept) < 2.2e-16 ***
small       1.466e-12 ***
aide           0.2602
tchexper    1.662e-05 ***
boy         3.583e-14 ***
white_asian 2.818e-07 ***
freelunch   < 2.2e-16 ***
---
```

(e)

使用 Hausman 檢定的 t 統計時，有些變數回報了 NaN

因 $SE(\beta_{FE})^2 < SE(\beta_{RE})^2$

但 tchexper、boy、freelunch 皆呈顯著，顯示 RE model 不適用於這些變數

```
+ t
(Intercept)       small        aide     tchexper
        NaN         NaN         NaN   -7.951852
        boy white_asian   freelunch
  10.012464         NaN   80.556676
```

(b) Mundlak 檢定顯示統計量達顯著水準，拒絕 Ho. 因此適合用 FE。

```
Linear hypothesis test:
small_avg = 0
aide_avg = 0
tchexper_avg = 0
boy_avg = 0
white_asian_avg = 0
freelunch_avg = 0

Model 1: restricted model
Model 2: readscore ~ small + aide + tchexper + boy +
white_asian + freelunch +
    small_avg + aide_avg + tchexper_avg + boy_avg + w
hite_asian_avg +
    freelunch_avg

  Res.Df Df  Chisq Pr(>Chisq)
1   5759
2   5753  6 126.02  < 2.2e-16 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Q15.17(b)

	47.5 %	52.5 %
(Intercept)	0.93636182	1.0017029
income	0.02613573	0.0270152

(c) by LM test reject Ho. support there exist random effect。

```
        Lagrange Multiplier Test - (Honda)

data:  liquor ~ income
normal = 4.5475, p-value = 2.714e-06
alternative hypothesis: significant effects
```

(d)

The Mundlak test shows we cannot reject the null that the random effect exist.

```
Call:
plm(formula = liquor ~ income + incomem, data = pdat
a, model = "random")

Balanced Panel: n = 40, T = 3, N = 120

Effects:
                 var std.dev share
idiosyncratic 0.9640  0.9819 0.571
individual    0.7251  0.8515 0.429
theta: 0.4459

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-2.300955 -0.703840  0.054992  0.560255  2.257325

Coefficients:
             Estimate Std. Error z-value Pr(>|z|)
(Intercept) 0.9163337  0.5524439  1.6587  0.09718
income      0.0207421  0.0209083  0.9921  0.32117
incomem     0.0065792  0.0222048  0.2963  0.76700

(Intercept) .
income
incomem
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```