Q 15. 6. f

The most different coefficient also appears 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	0.00085	1.294
South	-0.0935	0.12174	-0.7339
Union	-0.0205	0.01932	-0.2245

Under 5% level, $t = 1.96$, all factors doesn't show significant difference between b_{FE} & b_{RE}, showing $cov(X_{kit}, u_i) = 0$ (the null) can't be rejected → RE model is appropriate.

Q 15. 20. d

With RE model, the coefficients become even more significant but aide. The LM test reject the null, and shows the random effect exist

```
        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 ***
---
```

Q15.w.e

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

With Hausement t stats, some reported Nan because $SE(b_{FE})^2 < SE(b_{RE})^2$ However, tchexper, boy, and freelunch all shows significant result, indicating random effect model isn't appropriate for those variables. For Boy, fitting RE leads to biased estimation.

Q15.w.f

The Mundlak test shows significant test stats, rejecting the null that random effect is valid. => FE is appropriate

```
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
```

Q. 15.17. b

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

Q 15.17.c

By LM test, reject the null and support there exist random effect

```
        Lagrange Multiplier Test - (Honda)

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

Q 15.17.d

r isn't significant at 5% level.

The Mundlak test result, therefore, shows that 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
```