Dissertation Workshop: Panel Data - Problem Set

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Do as much as you can in class, and finish the rest in your own time

More Guns Less Crime

More guns, less crime. This is the claim of an in(famous) book. It shows that violent crime rates in the United States decrease when gun ownership restrictions are relaxed. The data used in Lott's research compares violent crimes, robberies, and murders across 50 states to determine whether the so called "shall" laws that remove discretion from license granting authorities actually decrease crime rates. So far 41 states have passed these "shall" laws where a person applying for a licence to carry a concealed weapon doesn't have to provide justification or "good cause" for requiring a concealed weapon permit.

Load the guns.csv dataset directly into R by running the following line:

```
a <- read.csv("http://philippbroniecki.github.io/philippbroniecki.github.io/assets/data/guns.csv")
```

The data includes the following variables:

- *mur* - Murder rate (incidents per 100,000)
- *shall* - =1 if state has a shall-carry law in effect in that year, 0 otherwise
- *incarc_rate* - Incarceration rate in the state in the previous year (sentenced prisoners per 100,000 residents; value for the previous year)
- *pm1029* - Percent of state population that is male, ages 10 to 29
- *stateid* - ID number of states (Alabama = , Alaska = 2, etc.)
- *year* - Year (1977 - 1999)

a) Estimate the effect of *shall* using a simple linear model and interpret it.

Code:

```
summary(lm(mur~shall+incarc_rate+pm1029,data=a))
```

Answer:

According to our simple linear model, lax gun laws reduce the murder rate. It decreases by roughly 2 incidents per 100,000.

b) Estimate a unit fixed effects model and a random effects model. Are both models consistent. If not which is the appropriate model? Use a consistent model to estimate the effect of the shall laws on the murder rate.

Code:

```
library(plm)

# fixed effects
m.fe <- plm(mur ~ shall + incarc_rate + pm1029,
            data = a,
            index = c("stateid", "year"),
            model = "within",
            effect = "individual")

# random effects
m.re <- plm(mur ~ shall + incarc_rate + pm1029,
            data = a,
            index = c("stateid", "year"),
            model = "random")

# hausman test
phtest(m.fe, m.re)

Hausman Test

data:  mur ~ shall + incarc_rate + pm1029
chisq = 147.59, df = 3, p-value < 2.2e-16
alternative hypothesis: one model is inconsistent

> # effect
> summary(m.fe)
Oneway (individual) effect Within Model

Call:
plm(formula = mur ~ shall + incarc_rate + pm1029, data = a, effect = "individual",
    model = "within", index = c("stateid", "year"))
```

```
Balanced Panel: n = 51, T = 23, N = 1173

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-21.102428  -0.958945   0.016047   1.082008  29.031961

Coefficients:
              Estimate Std. Error t-value  Pr(>|t|)
shall       -1.4513886  0.3154300 -4.6013 4.678e-06 ***
incarc_rate  0.0174551  0.0011261 15.4998 < 2.2e-16 ***
pm1029       0.9582993  0.0859610 11.1481 < 2.2e-16 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

Total Sum of Squares:    12016
Residual Sum of Squares: 9800
R-Squared:      0.18444
Adj. R-Squared: 0.14581
F-statistic: 84.3526 on 3 and 1119 DF, p-value: < 2.22e-16
```

Answer:
The Hausman test shows that we reject the null hypothesis - both random effects model and fixed effects model are consistent. The unique errors u_i are correlated with the regressors. Therefore, we must rely on the fixed effects model.

The effect of the shall laws has decreased slightly but is still significantly related to the murder rate. Lax gun laws reduce the murder rate by 1.45 incidents per 100,000.

c) Think of a theoretical reason to control for time fixed effects (what confounding sources could bias our estimate of the shall laws?). Test for time fixed effects using the appropriate test. If time fixed effects are required, re-estimate the fixed effects model as a twoway fixed effects model and interpret the effect of lax gun laws.

Code:

```
> m.tfe <- plm(mur ~ shall + incarc_rate + pm1029,
+              data = a,
+              index = c("stateid", "year"),
+              model = "within",
```

```
+               effect = "time")
> plmtest(m.tfe, effect = "time")

Lagrange Multiplier Test - time effects (Honda) for balanced panels

data:  mur ~ shall + incarc_rate + pm1029
normal = 16.104, p-value < 2.2e-16
alternative hypothesis: significant effects

> # twoway FE model
> m.2wfe <- plm(mur ~ shall + incarc_rate + pm1029,
+               data = a,
+               index = c("stateid", "year"),
+               model = "within",
+               effect = "twoway")
> # effect
> summary(m.2wfe)
Twoways effects Within Model

Call:
plm(formula = mur ~ shall + incarc_rate + pm1029, data = a, effect = "twoway",
    model = "within", index = c("stateid", "year"))

Balanced Panel: n = 51, T = 23, N = 1173

Residuals:
       Min.     1st Qu.      Median     3rd Qu.        Max.
-19.2097691  -0.9748749  -0.0069663   1.0119176  27.1354552

Coefficients:
              Estimate Std. Error t-value  Pr(>|t|)
shall       -0.5640474  0.3325054 -1.6964 0.0901023 .
incarc_rate  0.0209756  0.0011252 18.6411 < 2.2e-16 ***
pm1029       0.7326357  0.2189770  3.3457 0.0008485 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

Total Sum of Squares:    11263
Residual Sum of Squares: 8519.4
R-Squared:      0.24357
```

```
Adj. R-Squared: 0.19186
F-statistic: 117.746 on 3 and 1097 DF, p-value: < 2.22e-16
```

Answer:

In the 90s, crime rates in inner cities dropped across many Western countries. This trend will have affected U.S. states in a relatively similar way. This source of confounding will be correlated with the murder rate. Such a strong theoretical foundation for confounding should be controlled for using time fixed effects independent of the test for time fixed effects.

We reject the null hypothesis - time fixed effects are insignificant (make no difference). We, therefore, control for time-fixed effects to reduce omitted variable bias from sources that vary over time but are constant across states.

The effect of the shall laws is indistinguishable from zero (at the 0.05 alpha level). We conclude that the shall laws do not increase or decrease the murder rate.

d) Correct the standard errors to account for heteroskedasticity and serial correlation. Does the conclusion regarding the effect of the shall laws change?

Code:

```
m.2wfe.hac <- coeftest(m.2wfe, vcov = vcovBK(m.2wfe, type = "HC3", cluster = "group"))
m.2wfe.hac

t test of coefficients:

              Estimate Std. Error t value  Pr(>|t|)
shall       -0.5640474  0.7662556 -0.7361    0.4618
incarc_rate  0.0209756  0.0028249  7.4253 2.254e-13 ***
pm1029       0.7326357  0.5118496  1.4313    0.1526
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1
```

Answer:

The standard error more than doubled. Our substantive conclusion does not change: The shall laws have no effect on the murder rate in our sample.

e) Test for cross-sectional dependence and if present, use the SSC estimator to correct for heteroskedasticity, serial correlation, and spatial dependence. Does our conclusion regarding the effect of the shall laws change?

Code:

```
> # test for cross-sectional dependence
> pcdtest(m.2wfe)

Pesaran CD test for cross-sectional dependence in panels

data:  mur ~ shall + incarc_rate + pm1029
z = 3.9121, p-value = 9.148e-05
alternative hypothesis: cross-sectional dependence

>
> # correct standard errors
> m.2wfe.scc <- coeftest(m.2wfe, vcov = vcovSCC(m.2wfe, type = "HC3",
                                                 cluster = "group"))
> m.2wfe.scc

t test of coefficients:

             Estimate Std. Error t value Pr(>|t|)
shall       -0.564047   0.542698 -1.0393  0.29888
incarc_rate  0.020976   0.010321  2.0324  0.04236 *
pm1029       0.732636   0.551066  1.3295  0.18396
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1
```

Answer:
The effect of the shall laws remains insignificant. The standard error decreased slightly.