ANALYSIS OF PANEL DATA

Fixed-Effect and Random-Effect Models

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Fixed-Effect Model

Remarks on Fixed-Effect Models

- This is incorrect, because for each of the cross-sectional unit i, we lose one df when doing the time-demeaning: for each i, the demeaned errors ϵ_{it} add up to zero when summed across t, so one df is lost. This is taken care off in modern regression packages that have fixed effect estimation function. If, however, we do the time-demeaning and then pooled OLS manually, we will have to adjust the degree of freedom.

Consider one of the datasets that come with the plm package.

```
library(plm)
data("Grunfeld", package="plm")
head(Grunfeld)
```

	firm	year	inv	value	capital
1	1	1935	317.6	3078.5	2.8
2	1	1936	391.8	4661.7	52.6
3	1	1937	410.6	5387.1	156.9
4	1	1938	257.7	2792.2	209.2
5	1	1939	330.8	4313.2	203.4
6	1	1940	461.2	4643.9	207.2
7	1	1941	512.0	4551.2	255.2
8	1	1942	448.0	3244.1	303.7
9	1	1943	499.6	4053.7	264.1
10	1	1944	547.5	4379.3	201.6
11	1	1945	561.2	4840.9	265.0
12	1	1946	688.1	4900.9	402.2
13	1	1947	568.9	3526.5	761.5
14	1	1948	529.2	3254.7	922.4
15	1	1949	555.1	3700.2	1020.1
16	1	1950	642.9	3755.6	1099.0
17	1	1951	755.9	4833.0	1207.7
18	1	1952	891.2	4924.9	1430.5
19	1	1953	1304.4	6241.7	1777.3
20	1	1954	1486.7	5593.6	2226.3
21	2	1935	209.9	1362.4	53.8
22	2	1936	355.3	1807.1	50.5
23	2	1937	469.9	2676.3	118.1
24	2	1938	262.3	1801.9	260.2
25	2	1939	230.4	1957.3	312.7

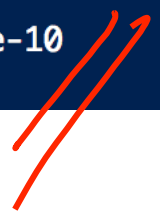
```
'data.frame':   471 obs. of  30 variables:
 $ year    : int  1987 1988 1989 1987 1988 1989 1987 1988 1989 1987 ...
 $ fcode   : num  410032 410032 410032 410440 410440 ...
 $ employ  : int  100 131 123 12 13 14 20 25 24 200 ...
 $ sales   : num  47000000 43000000 49000000 1560000 1970000 ...
 $ avgsal  : num  35000 37000 39000 10500 11000 ...
 $ scrap   : num  NA NA NA NA NA NA NA NA NA NA ...
 $ rework  : num  NA NA NA NA NA NA NA NA NA NA ...
 $ tothrs  : int  12 8 8 12 12 10 50 50 50 0 ...
 $ union   : int  0 0 0 0 0 0 0 0 0 0 ...
 $ grant   : int  0 0 0 0 0 0 0 0 0 0 ...
 $ d89     : int  0 0 1 0 0 1 0 0 1 0 ...
 $ d88     : int  0 1 0 0 1 0 0 1 0 0 ...
 $ totrain : int  100 50 50 12 13 14 15 10 20 0 ...
 $ hrsemp  : num  12 3.05 3.25 12 12 ...
 $ lscrap  : num  NA NA NA NA NA NA NA NA NA NA ...
 $ lemploy : num  4.61 4.88 4.81 2.48 2.56 ...
 $ lsales  : num  17.7 17.6 17.7 14.3 14.5 ...
 $ lrework : num  NA NA NA NA NA NA NA NA NA NA ...
 $ lhrsemp : num  2.56 1.4 1.45 2.56 2.56 ...
 $ lscrap_1: num  NA NA NA NA NA NA NA NA NA NA ...
 $ grant_1 : int  0 0 0 0 0 0 0 0 0 0 ...
 $ clscrap : num  NA NA NA NA NA NA NA NA NA NA ...
 $ cgrant  : int  0 0 0 0 0 0 0 0 0 0 ...
 $ clemploy: num  NA 0.27 -0.063 NA 0.08 ...
 $ clsales : num  NA -0.0889 0.1306 NA 0.2333 ...
 $ lavgsal : num  10.46 10.52 10.57 9.26 9.31 ...
 $ clavgsal: num  NA 0.0556 0.0526 NA 0.0465 ...
 $ cgrant_1: int  NA 0 0 NA 0 0 NA 0 0 NA ...
 $ chrsemp : num  NA -8.947 0.199 NA 0 ...
 $ clhrsemp: num  NA -1.1654 0.0478 NA 0 ...
```

Tests of Poolability

```
> znp <- pvcm(inv~value+capital,data=Grunfeld, model="within")
> zplm<- plm(inv~value+capital,data=Grunfeld)
> pooltest(zplm,znp)

        F statistic

data:  inv ~ value + capital
F = 5.7805, df1 = 18, df2 = 170, p-value = 1.219e-10
alternative hypothesis: unstability
```



```
> pooltest(inv~value+capital, data=Grunfeld, model="within")

        F statistic

data:  inv ~ value + capital
F = 5.7805, df1 = 18, df2 = 170, p-value = 1.219e-10
alternative hypothesis: unstability
```

Test for Serial Correlation

```
# Breusch-Godfrey and Durbin-Watson Test
# This test shares their OLS counterparts and allows for higher-order serial
correlation

# As a function, it is simply a wrapper of the bgtest and dwtest. So, all the
arguments from these two tests apply and may be passed on through `...`
operator.

pbgtest(grun.fe,order=2)
```

```
> pbgtest(grun.fe,order=2)

        Breusch-Godfrey/Wooldridge test for serial correlation in panel models

data:  inv ~ value + capital
chisq = 42.587, df = 2, p-value = 5.655e-10
alternative hypothesis: serial correlation in idiosyncratic errors
```

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