8.1) Correlated Random Effects (CRE)

Vitor Kamada

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Reference

Wooldridge (2010). **Econometric Analysis of Cross Section and Panel Data.** Ch 10.7

https://ebookcentral.proquest.com/lib/wayne/detail.action?docID=3339196&

Vella and Verbeek (1998)

$$Log(wage)_{it} = \beta_0 + \beta_1 Union_{it} + X_{it} + u_{it}$$

```
import pandas as pd
file="https://github.com/VitorKamada/ECO7110/raw/master/Data/wa
data = pd.read_stata(file)
data[1:10]
```

	nr	year	agric	black	bus
1	13	1981	0	0	0
2	13	1982	0	0	1
3	13	1983	0	0	1
4	13	1984	0	0	0

Set Index

```
year = pd.Categorical(data.year)
nr = pd.Categorical(data.nr)
data = data.set_index(['nr', 'year'])
data['year'] = year
data['nr'] = nr
```

		agric	black	bus
nr	year			
13	1981	0	0	0
	1982	0	0	1
	1983	0	0	1
	1984	0	0	0

year	nr
1981	13
1982	13
1983	13
1984	13

Compare OLS, RE, and FE

```python
from linearmodels.panel import PooledOLS
import statsmodels.api as sm
exog_vars = ['black','hisp','exper','expersq',
             'married', 'educ', 'union', 'year']
exog = sm.add_constant(data[exog_vars])
OLS = PooledOLS(data.lwage,
 exog).fit(cov_type='clustered', cluster_entity=True)
```

```python
from linearmodels.panel import RandomEffects
RE = RandomEffects(data.lwage,
 exog).fit(cov_type='clustered', cluster_entity=True)
```

```python
from linearmodels.panel import PanelOLS
FE = PanelOLS(data.lwage, exog, entity_effects=True,
 drop_absorbed=True).fit(cov_type='clustered', cluster_entity=True)
```

```python
from linearmodels.panel import compare
print(compare({'OLS':OLS,'RE': RE, 'FE': FE}))
```

	FE	OLS	RE
exper	0.1321	0.0672	0.1058
	(11.014)	(3.4338)	(6.4674)
expersq	-0.0052	-0.0024	-0.0047
	(-6.4051)	(-2.3543)	(-5.9780)
married	0.0467	0.1083	0.0638
	(2.2243)	(4.1615)	(3.3651)
union	0.0800	0.1825	0.1059
	(3.5205)	(6.6540)	(5.0813)
black		-0.1392	-0.1394
		(-2.7580)	(-2.7390)
hisp		0.0160	0.0217
		(0.4103)	(0.5453)
educ		0.0913	0.0919
		(8.2496)	(8.2501)
year.1987		0.1738	0.1348
		(2.0418)	(1.5901)

Hausman Test (1978)

$$H = (\hat{\delta}_{FE} - \hat{\delta}_{RE})'[Avar(\hat{\delta}_{FE}) - Avar(\hat{\delta}_{RE})]^{-1}(\hat{\delta}_{FE} - \hat{\delta}_{RE})$$

$H \sim \chi^2_M$, where M is the vector of regressors varying across i and t

Conventional Hausman Test has no power under violation of assumption homoscedasticity

hausman FE RE

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
exper	.1321464	.1057545	.0263919	.
expersq	-.0051855	-.0047239	-.0004616	.0001443
married	.0466804	.063986	-.0173057	.0073414
union	.0800019	.1061344	-.0261326	.0073572
year				
1981	.0190448	.040462	-.0214172	.
1982	-.011322	.0309212	-.0422431	.
1983	-.0419955	.0202806	-.0622762	.
1984	-.0384709	.0431187	-.0815896	.
1985	-.0432498	.0578155	-.1010653	.
1986	-.0273819	.0919476	-.1193295	.

```
                         b = consistent under Ho and Ha; obtained from xtreg
          B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

            chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                     =       31.71
          Prob>chi2 =       0.0004
```

Correlated Random Effects - Mundlak (1978)

$$y_{it} = x_{it}\beta + c_i + u_{it}$$

$$x_{it}\beta = z_i\gamma + w_{it}\delta$$

$$c_i = \psi + \bar{w}_i\xi + \alpha_i$$

$$y_{it} = x_{it}\beta + \bar{w}_i\xi + \alpha_i + u_{it}$$

$$\hat{\beta}_{CRE} = \hat{\beta}_{FE}$$

```python
data['experbar'] = data.groupby(nr)['exper'].transform('mean')
data['expersqbar'] = data.groupby(nr)['expersq'].transform('mean')
data['marriedbar'] = data.groupby(nr)['married'].transform('mean')
data['unionbar'] = data.groupby(nr)['union'].transform('mean')
```

nr	year	experbar	expersqbar	marriedbar	unionbar
13	1981	4.5	25.5	0.0	0.125
	1982	4.5	25.5	0.0	0.125
	1983	4.5	25.5	0.0	0.125
	1984	4.5	25.5	0.0	0.125
	1985	4.5	25.5	0.0	0.125
	1986	4.5	25.5	0.0	0.125
	1987	4.5	25.5	0.0	0.125
17	1980	7.5	61.5	0.0	0.000
	1981	7.5	61.5	0.0	0.000

```python
CRE = RandomEffects(data.lwage,
    Exog).fit(cov_type='clustered', cluster_entity=True)
```

	Parameter	Std. Err.	T-stat	P-value
const	0.5102	0.2255	2.2624	0.0237
black	-0.1388	0.0505	-2.7513	0.0060
hisp	0.0048	0.0386	0.1237	0.9016
exper	0.1321	0.0120	11.005	0.0000
expersq	-0.0052	0.0008	-6.3999	0.0000
married	0.0467	0.0210	2.2225	0.0263
educ	0.0946	0.0112	8.4107	0.0000
union	0.0800	0.0227	3.5176	0.0004
experbar	-0.1826	0.0467	-3.9091	0.0001
expersqbar	0.0103	0.0028	3.6211	0.0003
marriedbar	0.0970	0.0448	2.1658	0.0304
unionbar	0.1907	0.0474	4.0200	0.0001