Assignment 7
Panel Data

The study on capital structure of Thai companies listed in the stock exchange market of Thailand (SET) employs the following regression models:

1. Panel Data Model

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (1)$$

where:
y_{it} = leverage of firm i in year t
x_{1it} = size of firm determined by log of total revenue
x_{2it} = tangibles asset of the firm determined by log of tangible assets plus inventories divided by total book assets
x_{3it} = profitability index determined by return on assets
x_{4it} = non-debt tax shields determined by depreciation divided by total assets
x_{5it} = growth rate of the firm determined by book value of asset plus market value of equity minus book value of equity then divided by book value of asset
x_{6it} = risk of the firm determined by square of deviation from mean of return on asset at period t
x_{7it} = dividend payment equals to 1 if firm paid dividend at period t or equals to 0 if no dividend paid

2. Fixed Effects Model

$$y_{it} = \alpha_i + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (2)$$

where:
α_i = Cross-sectional fixed effects

3. Random Effects Model

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (3)$$

and $u_{it} = v_i + \varepsilon_{it}$

where: v_i = Cross-section random effects
ε_{it} = residual terms

From the given data set (`assign7.dta`):

a. Estimate model (1) using Panel Least Squares estimation method and PGLS assuming Heteroskedasticity, and test whether there exists Heteroskedasticity problem.
b. Estimate the above three models including Panel Least Squares model, Fixed effects model, and Random-effects model. Perform fixed effects tests and random effects test, also state null hypothesis of the tests. Then, determine the most appropriated model. Also, give explanation of the choosing criterion (perform the tests), and make interpretation of the estimated models.

```
  Iteration 9: tolerance = .00321184
       name:  <unnamed>
        log:  C:\Users\Kriss\OneDrive\เดสก์ท็อป\426\asasasasasasasas7.smcl
   log type:  smcl
  opened on:  17 Mar 2021, 21:06:20

1 . clear

2 . use "C:\Users\Kriss\OneDrive\เดสก์ท็อป\426\assign7.dta"

3 . xtset crossid t
         panel variable:  crossid (strongly balanced)
          time variable:  t, 1 to 5
                  delta:  1 year

4 . xtgls y x1 x2 x3 x4 x5 x6 x7, igls panels(heteroskedastic)
  Iteration 1: tolerance = .08868167
  Iteration 2: tolerance = .05849043
  Iteration 3: tolerance = .03525359
  Iteration 4: tolerance = .02040677
  Iteration 5: tolerance = .01187668
  Iteration 6: tolerance = .00709681
  Iteration 7: tolerance = .00441169
  Iteration 8: tolerance = .00291535
  Iteration 9: tolerance = .00321184
  Iteration 10: tolerance = .00409533
  Iteration 11: tolerance = .00580092
  Iteration 12: tolerance = .00908183
  Iteration 13: tolerance = .01574945
  Iteration 14: tolerance = .02974716
  Iteration 15: tolerance = .05103653
  Iteration 16: tolerance = .04401112
  Iteration 17: tolerance = .00723478
  Iteration 18: tolerance = .00429598
  Iteration 19: tolerance = .0028681
  Iteration 20: tolerance = .00195025
  Iteration 21: tolerance = .00134658
  Iteration 22: tolerance = .00105022
  Iteration 23: tolerance = .00117237
  Iteration 24: tolerance = .00122304
  Iteration 25: tolerance = .00122651
  Iteration 26: tolerance = .00119949
  Iteration 27: tolerance = .00115339
  Iteration 28: tolerance = .00109594
  Iteration 29: tolerance = .00103239
  Iteration 30: tolerance = .00096626
  Iteration 31: tolerance = .00089991
  Iteration 32: tolerance = .0008349
  Iteration 33: tolerance = .00077221
  Iteration 34: tolerance = .00071245
  Iteration 35: tolerance = .00065597
  Iteration 36: tolerance = .00060292
  Iteration 37: tolerance = .00055335
  Iteration 38: tolerance = .00050721
  Iteration 39: tolerance = .0004644
  Iteration 40: tolerance = .00042478
  Iteration 41: tolerance = .0003882
  Iteration 42: tolerance = .00035448
  Iteration 43: tolerance = .00032344
  Iteration 44: tolerance = .00029493
  Iteration 45: tolerance = .00026875
  Iteration 46: tolerance = .00024476
  Iteration 47: tolerance = .00022279
  Iteration 48: tolerance = .00020268
  Iteration 49: tolerance = .0001843
  Iteration 50: tolerance = .00016751
  Iteration 51: tolerance = .00015219
  Iteration 52: tolerance = .00013821
  Iteration 53: tolerance = .00012547
  Iteration 54: tolerance = .00011386
  Iteration 55: tolerance = .0001033
  Iteration 56: tolerance = .00009368
```

Iteration 57: tolerance = **.00008494**
Iteration 58: tolerance = **.00007699**
Iteration 59: tolerance = **.00006977**
Iteration 60: tolerance = **.00006321**
Iteration 61: tolerance = **.00005725**
Iteration 62: tolerance = **.00005184**
Iteration 63: tolerance = **.00004694**
Iteration 64: tolerance = **.00004249**
Iteration 65: tolerance = **.00003846**
Iteration 66: tolerance = **.0000348**
Iteration 67: tolerance = **.00003149**
Iteration 68: tolerance = **.00002849**
Iteration 69: tolerance = **.00002577**
Iteration 70: tolerance = **.00002331**
Iteration 71: tolerance = **.00002108**
Iteration 72: tolerance = **.00001906**
Iteration 73: tolerance = **.00001724**
Iteration 74: tolerance = **.00001559**
Iteration 75: tolerance = **.00001409**
Iteration 76: tolerance = **.00001274**
Iteration 77: tolerance = **.00001151**
Iteration 78: tolerance = **.00001041**
Iteration 79: tolerance = **9.406e-06**
Iteration 80: tolerance = **8.501e-06**
Iteration 81: tolerance = **7.683e-06**
Iteration 82: tolerance = **6.943e-06**
Iteration 83: tolerance = **6.274e-06**
Iteration 84: tolerance = **5.669e-06**
Iteration 85: tolerance = **5.122e-06**
Iteration 86: tolerance = **4.628e-06**
Iteration 87: tolerance = **4.182e-06**
Iteration 88: tolerance = **3.778e-06**
Iteration 89: tolerance = **3.413e-06**
Iteration 90: tolerance = **3.084e-06**
Iteration 91: tolerance = **2.786e-06**
Iteration 92: tolerance = **2.517e-06**
Iteration 93: tolerance = **2.274e-06**
Iteration 94: tolerance = **2.054e-06**
Iteration 95: tolerance = **1.855e-06**
Iteration 96: tolerance = **1.676e-06**
Iteration 97: tolerance = **1.514e-06**
Iteration 98: tolerance = **1.368e-06**
Iteration 99: tolerance = **1.235e-06**
Iteration 100: tolerance = **1.116e-06**
Iteration 101: tolerance = **1.008e-06**
Iteration 102: tolerance = **9.105e-07**
Iteration 103: tolerance = **8.224e-07**
Iteration 104: tolerance = **7.428e-07**
Iteration 105: tolerance = **6.710e-07**
Iteration 106: tolerance = **6.060e-07**
Iteration 107: tolerance = **5.474e-07**
Iteration 108: tolerance = **4.944e-07**
Iteration 109: tolerance = **4.466e-07**
Iteration 110: tolerance = **4.034e-07**
Iteration 111: tolerance = **3.643e-07**
Iteration 112: tolerance = **3.291e-07**
Iteration 113: tolerance = **2.972e-07**
Iteration 114: tolerance = **2.684e-07**
Iteration 115: tolerance = **2.425e-07**
Iteration 116: tolerance = **2.190e-07**
Iteration 117: tolerance = **1.978e-07**
Iteration 118: tolerance = **1.786e-07**
Iteration 119: tolerance = **1.613e-07**
Iteration 120: tolerance = **1.457e-07**
Iteration 121: tolerance = **1.316e-07**
Iteration 122: tolerance = **1.189e-07**
Iteration 123: tolerance = **1.074e-07**
Iteration 124: tolerance = **9.697e-08**

Cross-sectional time-series FGLS regression

a.)

Coefficients: **generalized least squares**
Panels: **heteroskedastic**
Correlation: **no autocorrelation**

Estimated covariances	= 255	Number of obs	= 1,275
Estimated autocorrelations	= 0	Number of groups	= 255
Estimated coefficients	= 8	Time periods	= 5
		Wald chi2(7)	= 3850.64
Log likelihood	= 519.361	Prob > chi2	= 0.0000

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.0834067	.0045748	18.23	0.000	.0744403	.0923732
x2	.0163976	.0032919	4.98	0.000	.0099456	.0228497
x3	-.3631261	.0505673	-7.18	0.000	-.4622362	-.264016
x4	.3191455	.1093883	2.92	0.004	.1047484	.5335426
x5	-.1093301	.0043601	-25.07	0.000	-.1178758	-.1007844
x6	.1361732	.0275038	4.95	0.000	.0822667	.1900797
x7	-.2282655	.0063087	-36.18	0.000	-.2406303	-.2159007
_cons	-.037658	.0426502	-0.88	0.377	-.1212509	.0459349

```
5 . est store hetero

6 . local df = e(N_g) - 1

7 . xtgls y x1 x2 x3 x4 x5 x6 x7
```

Cross-sectional time-series FGLS regression

Coefficients: **generalized least squares**
Panels: **homoskedastic**
Correlation: **no autocorrelation**

Estimated covariances	= 1	Number of obs	= 1,275
Estimated autocorrelations	= 0	Number of groups	= 255
Estimated coefficients	= 8	Time periods	= 5
		Wald chi2(7)	= 899.95
Log likelihood	= 209.4322	Prob > chi2	= 0.0000

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.0794732	.0093881	8.47	0.000	.0610728	.0978735
x2	.0183375	.0051421	3.57	0.000	.0082592	.0284158
x3	.0977707	.0526329	1.86	0.063	-.0053879	.2009293
x4	.0873838	.2186064	0.40	0.689	-.3410767	.5158444
x5	-.1076457	.0069214	-15.55	0.000	-.1212114	-.0940801
x6	-.1432493	.0186811	-7.67	0.000	-.1798637	-.106635
x7	-.2712849	.011995	-22.62	0.000	-.2947946	-.2477753
_cons	-.0107965	.0860341	-0.13	0.900	-.1794201	.1578272

```
8 . est store homo

9 . lrtest hetero ., df(`df')
```

Likelihood-ratio test — LR chi2(254) = 619.86
(Assumption: homo nested in hetero) — Prob > chi2 = 0.0000 < 0.05

reject H_0, heteroskedasticity exists.

10.) 10 . xtreg y x1 x2 x3 x4 x5 x6 x7, fe ✓ Appropriate due to Hausman test

Fixed-effects (within) regression
Group variable: **crossid**

R-sq:
within = **0.3772**
between = **0.1103**
overall = **0.1644**

corr(u_i, Xb) = **-0.2003**

Number of obs = **1,275**
Number of groups = **255**

Obs per group:
min = **5**
avg = **5.0**
max = **5**

F(**7,1013**) = **87.64**
Prob > F = **0.0000**

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
x1	-.1256447	.0180942	-6.94	0.000	-.161151	-.0901384
x2	.0123739	.008023	1.54	0.123	-.0033697	.0281176
x3	.0747825	.039773	1.88	0.060	-.0032643	.1528293
x4	.6493144	.2855092	2.27	0.023	.0890573	1.209572
x5	-.1104883	.0061097	-18.08	0.000	-.1224773	-.0984992
x6	-.1461423	.0141035	-10.36	0.000	-.1738178	-.1184669
x7	-.0951497	.0121853	-7.81	0.000	-.1190611	-.0712383
_cons	1.756067	.1658407	10.59	0.000	1.430636	2.081497
sigma_u	.22676694					
sigma_e	.11725953					
rho	.78902632	(fraction of variance due to u_i)				

FE test F test that all u_i=0: F(**254, 1013**) = **11.40** Prob > F = **0.0000** > 0.05

$H_0: v_1 = v_2 = \dots = v_S = v$

H_0 is rejected, FE exists.

11 . est store fixed

12 . xtreg y x1 x2 x3 x4 x5 x6 x7, re

Random-effects GLS regression
Group variable: **crossid**

R-sq:
within = **0.3492**
between = **0.3404**
overall = **0.3377**

corr(u_i, X) = **0** (assumed)

Number of obs = **1,275**
Number of groups = **255**

Obs per group:
min = **5**
avg = **5.0**
max = **5**

Wald chi2(**7**) = **663.43**
Prob > chi2 = **0.0000**

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	-.0145018	.0133366	-1.09	0.277	-.040641	.0116375
x2	.0146948	.0064463	2.28	0.023	.0020604	.0273292
x3	.0985565	.0399464	2.47	0.014	.020263	.1768501
x4	.4693539	.2493856	1.88	0.060	-.0194329	.9581407
x5	-.1117985	.005959	-18.76	0.000	-.1234779	-.100119
x6	-.1541318	.014125	-10.91	0.000	-.1818163	-.1264472
x7	-.1494529	.0115006	-13.00	0.000	-.1719937	-.1269122
_cons	.7714573	.1226841	6.29	0.000	.5310009	1.011914
sigma_u	.15944933					
sigma_e	.11725953					
rho	.64900604	(fraction of variance due to u_i)				

```
13 . est store random

14 . hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
x1	-.1256447	-.0145018	-.1111429	.0122284
x2	.0123739	.0146948	-.0023208	.0047765
x3	.0747825	.0985565	-.0237741	.
x4	.6493144	.4693539	.1799605	.1390048
x5	-.1104883	-.1117985	.0013102	.0013484
x6	-.1461423	-.1541318	.0079894	.
x7	-.0951497	-.1494529	.0543033	.0040273

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 $H_0: \beta_{RE} = \beta_{FE}$

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 190.39
Prob>chi2 = 0.0000 > 0.05
(V_b-V_B is not positive definite)

H_0 is rejected, the fixed effect is the most appropriated model.

```
15 . log close
      name:  <unnamed>
       log:  C:\Users\Kriss\OneDrive\เดสก์ท็อป\426\asasasasasasasas7.smcl
  log type:  smcl
 closed on:  17 Mar 2021, 21:09:07
```

- If the size of firm determined by log of total revenue increases by 1 percentage point, on the average, the leverage of the ~~each~~ every firm in year t will decrease by 0.1256477 units.
- If the tangibles asset of the firm determined by log of tangible assets plus inventories divided by total book assets increases by 1 units, on the average, the leverage of the every firm in every year will increase by 0.0123739 units.
- If the profitability index determined by return on assets increases by 1 percentage point, on the average, the leverage of the ~~each~~ every firm in year t will increase by 0.0747825 units.

- If X_4 increase by 1 unit, on the average, every y will increase by 0.6493144.
- If X_5 increase by 1 unit, on the average, every y will decrease by 0.1104883.
- If X_6 increase by 1 unit, on the average, every y will decrease by 0.1461423.
- If X_7 increase by 1 unit, on the average, every y will decrease by 0.0951497.