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.

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

(a).

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

POLS

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

```
3 . xtgls y x1 x2 x3 x4 x5 x6 x7, igls panels(heteroskedastic) nolog
```

PGLS

Cross-sectional time-series FGLS regression

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

```
4 . est store het

5 . 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

```
6 . est store pgls

7 . local df=e(N_g)-1

8 . lrtest het, df(`df')

Likelihood-ratio test                          LR chi2(254)=    619.86
(Assumption: pgls nested in het)               Prob > chi2 =    0.0000

9 .
```

; reject H_0

∴ There is significant heteroskedasticity problem

(b). 10 . xtreg y x1 x2 x3 x4 x5 x6 x7, fe Fixed effect model

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)				

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

11 . est store fixed

12 . predict y_fe, xbu

13 . predict ai, u

14 . tab;e crossid, c(mean ai)
; invalid name
r(198);

15 . table crossid, c(mean ai)

CROSSID	mean(ai)
1	.1179877
2	-.0688583
3	-.3076372
4	-.3847394
5	.1860881
6	-.0691241
7	.2993367
8	-.1167426
9	-.3042506
10	.2812602
11	.0625951
12	.3002143
13	.0591167
14	.0947033
15	.3564131
16	-.2273619
17	-.2720726
18	.1593111
19	.2946341

$H_0: \alpha_1 = \alpha_2 = \dots = \alpha_{255} = 0$

Prob > F = 0.0000 < 0.05

So, reject H_0 and fixed effects exist

```
  -.3028748
  -.5444298
   -.075842
  -.0552248
   .3965797
   .0508951
  -.3491979
  -.1875699
   .2317366
  -.3023256
  -.1073962
     .283464
   .0178973
   .0863213
  -.2098946
   .1166871
  -.0564318
   .2353057
    -.33442
   .1985804
  -.1262242
   .1992234
  -.1025281
  -.0903486
  -.0511456
  -.1374054
   .2790801
  -.0331355
   .1874332
   .2953667
   .2069916
   .0622689
  -.1173871
   .0328878
  -.3170947
   .2136027
  -.2469867
  -.0802104
   -.273037
   .0832633
  -.2707515
  -.1536239
   .1868865
   -.168611
   .2368186
  -.1493501
  -.1689323
   .2323093
   .1366055
   -.205924
     .11148
   -.213541
  -.2123275
   .2610708
   .1955792
   .0374835
   .2456527
  -.4317304
  -.0296581
  -.0558108
   -.131119
   .0754021
   .1839097
   -.294273
   .1697147
```

```
 85  -.0818064
 86   .3012981
 87  -.2370235
 88  -.2421173
 89   .1993015
 90    .079109
 91    .274037
 92   .2844306
 93   .3790213
 94   .1146499
 95   .2125908
 96   .0073188
 97   .1857645
 98   .0545105
 99    .312327
100  -.2591561
101   .1572106
102  -.1645625
103   .0935633
104  -.1274652
105  -.0243396
106  -.2275865
107  -.0841879
108   .1616827
109  -.0303212
110   .1971905
111  -.0024535
112   -.308773
113  -.0417285
114   .2486805
115  -.1324236
116  -.3823357
117  -.1857197
118  -.4836546
119  -.0487107
120   .0721546
121  -.1197235
122   .0883395
123   .2009159
124  -.0237417
125   .2038743
126   -.034487
127   .0909755
128  -.0223108
129   .1242109
130   .3631682
131   .4055254
132   .1665071
133  -.0159082
134  -.0216812
135   -.046606
136   .4397194
137   .2802401
138   .2728052
139   .0933884
140   -.334188
141  -.1277287
142   .0729046
143   .0990436
144   .2362383
145  -.4735954
146   .0178514
147  -.0200448
148   .0625943
149   .1971359
```

```
  150 |   .0645117
  151 |   .0182246
  152 |   .1665388
  153 |    .254573
  154 |   .3451733
  155 |   .2273609
  156 |  -.0581791
  157 |   -.079919
  158 |   -.119292
  159 |    .064468
  160 |   .1471561
  161 |   .0785254
  162 |  -.0450562
  163 |  -.3095208
  164 |   .0483383
  165 |   .0960483
  166 |    .492102
  167 |   .0187869
  168 |  -.2272806
  169 |  -.2576004
  170 |   .1824461
  171 |   .3723981
  172 |   .1678091
  173 |  -.1965343
  174 |   .0848485
  175 |   .0646448
  176 |   -.064675
  177 |   .1916314
  178 |  -.0401438
  179 |   .2753257
  180 |   .2018917
  181 |   .1524691
  182 |   .2037826
  183 |  -.0652892
  184 |   .2111544
  185 |   .2679104
  186 |   .1341272
  187 |  -.1363719
  188 |  -.3761334
  189 |   .0196812
  190 |   .0639722
  191 |  -.2928044
  192 |  -.3454445
  193 |   -.278348
  194 |   .0767552
  195 |   .0375085
  196 |  -.0312761
  197 |      .07977
  198 |  -.1913502
  199 |  -.2867734
  200 |   .1707745
  201 |  -.3870632
  202 |  -.2563513
  203 |  -.0922752
  204 |  -.1404833
  205 |  -.3388946
  206 |   .2703579
  207 |  -.2208357
  208 |  -.0263273
  209 |   .0639384
  210 |  -.3288249
  211 |  -.3156894
  212 |  -.4391288
  213 |  -.0343149
  214 |  -.5958523
```

215	-.2798052
216	-.1075037
217	-.1778713
218	-.4965972
219	-.0763658
220	-.0142669
221	-.2349915
222	-.2612036
223	.1426281
224	-.3496795
225	.0822377
226	.4187857
227	.1919504
228	-.5135269
229	.1946076
230	-.0813862
231	-.5152081
232	.7889794
233	-.3993402
234	.1302106
235	-.2250371
236	.2266397
237	.378013
238	.0690148
239	-.0715341
240	-.1565461
241	.191928
242	-.0200206
243	.0779399
244	-.1765512
245	-.0967001
246	-.1063667
247	-.0097393
248	.1739514
249	.3129217
250	.0874324
251	-.0805677
252	.0997599
253	-.0563064
254	.3276982
255	.3049391

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

random effect model

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

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

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

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

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

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)				

```
17 . est store random

18 . predict y_re, xbu

19 . predict ri, u

20 . tabulate crossid, c(mean ri)
option c() not allowed
r(198);

21 . table crossid, c(mean ri)
```

CROSSID	mean(ri)
1	.0887309
2	-.0772131
3	-.2941025
4	-.303993
5	.0610583
6	-.0480735
7	.2847414
8	-.1467772
9	-.260304
10	.201722
11	.0745034
12	.2322129
13	.0547399
14	.0730161
15	.252516
16	-.257033
17	-.1992955
18	.1135974
19	.2556412
20	-.2162569
21	-.2778253
22	-.0108889
23	-.0615342
24	.3087698
25	.0889791
26	-.2690791
27	-.1575273
28	.2083569
29	-.2559611
30	-.0877486
31	.3198622
32	-.0570609
33	.0730698

```
34  -.2145337
35   .0939902
36  -.1165269
37   .1571742
38  -.2387038
39   .1382089
40  -.1337869
41   .1664483
42  -.0111363
43  -.0141485
44  -.0459966
45  -.1249762
46   .2338298
47   -.090727
48   .1380407
49   .2966444
50   .2396441
51   .0526386
52  -.0607271
53   .0199196
54  -.2447201
55   .1139673
56  -.2098732
57  -.0690802
58  -.2788376
59   .0695586
60  -.2229899
61  -.1054854
62   .1915002
63  -.0901907
64   .2032366
65  -.1564789
66  -.1570447
67   .1733939
68   .1737497
69  -.1739035
70     .087604
71  -.1790737
72  -.1524394
73   .2465263
74   .1560543
75   -.008872
76   .2641704
77  -.3190178
78      .01083
79  -.0367801
80  -.1300188
81    .064486
82    .111428
83  -.2496971
84   .1209326
85  -.0871061
86   .2722191
87  -.1932432
88  -.2245077
89   .1724562
90   .0451844
91   .2262525
92   .1218001
93   .2781525
94   .1512118
95    .234661
96   .0258916
97    .046972
98  -.0115294
```

```
 99 |  .1273077
100 | -.2486487
101 |  .0704314
102 | -.1069269
103 |  .0613136
104 | -.0672899
105 | -.1041363
106 | -.1469192
107 | -.0109335
108 |  .1395624
109 | -.0113743
110 |   .137117
111 |  .0099068
112 | -.2021984
113 |  .0039555
114 |  .1883977
115 | -.0660144
116 | -.2832918
117 | -.0990658
118 | -.3787253
119 | -.0584207
120 |  .0718256
121 | -.0921068
122 |  .0855275
123 |  .0911205
124 | -.1083447
125 |  .1828887
126 |  -.041798
127 |  .0115437
128 |  .0032933
129 |  .1001256
130 |  .1884265
131 |  .3509527
132 |  .1213398
133 | -.0267641
134 | -.0187087
135 |  -.054906
136 |  .3379354
137 |  .1794541
138 |  .2017993
139 |  .0752595
140 | -.2359992
141 | -.1066319
142 |  .0789554
143 |  .0294092
144 |  .2110179
145 | -.3121997
146 | -.0773436
147 | -.0128643
148 |  .0647492
149 |  .1715278
150 |  .0713629
151 |  .0262807
152 |  .1045906
153 |   .171277
154 |  .3557077
155 |  .1521361
156 | -.0366046
157 | -.0340266
158 | -.0461098
159 |  .0354666
160 |  .1034293
161 |  .0037919
162 | -.0035091
163 | -.2110045
```

```
  164 |   .0941578
  165 |   .0552175
  166 |   .2534954
  167 |    .048703
  168 |  -.2103911
  169 |  -.2087771
  170 |   .1503265
  171 |   .1031911
  172 |    .043863
  173 |  -.2131911
  174 |   .1286456
  175 |    .002796
  176 |  -.1227492
  177 |   .0373377
  178 |  -.0730118
  179 |   .2775249
  180 |   .1301143
  181 |   .0770061
  182 |     .06309
  183 |   .0266525
  184 |   .1051872
  185 |   .2179077
  186 |   .1328993
  187 |   -.106024
  188 |  -.3074846
  189 |   .0261331
  190 |   .0611958
  191 |   -.183354
  192 |   -.214559
  193 |  -.1583034
  194 |   .1654267
  195 |    .057943
  196 |  -.0241249
  197 |   .0377754
  198 |  -.1176052
  199 |  -.2192102
  200 |   .1644883
  201 |  -.2546277
  202 |    -.19455
  203 |  -.0874069
  204 |  -.0766507
  205 |  -.2753781
  206 |   .3576378
  207 |  -.1686609
  208 |  -.0172088
  209 |    .041629
  210 |  -.2293983
  211 |  -.1570497
  212 |  -.3441758
  213 |   .0033839
  214 |  -.4100606
  215 |  -.2284046
  216 |  -.0372125
  217 |  -.1090696
  218 |  -.3476793
  219 |  -.0446954
  220 |   .0474905
  221 |  -.1589897
  222 |  -.1895518
  223 |   .1637635
  224 |  -.2935108
  225 |   .1355649
  226 |   .3506207
  227 |    .188049
  228 |  -.2811113
```

```
    229 |   .1710765
    230 |  -.0902586
    231 |  -.3310963
    232 |   .5411432
    233 |  -.2459162
    234 |   .1235347
    235 |  -.0996545
    236 |   .0914115
    237 |   .2921195
    238 |  -.0506965
    239 |  -.0214294
    240 |  -.0964207
    241 |   .1652538
    242 |  -.0308394
    243 |    .003913
    244 |  -.1854613
    245 |   -.141938
    246 |  -.0311122
    247 |   -.061996
    248 |   .1524523
    249 |   .2552815
    250 |   .0917869
    251 |  -.0467202
    252 |   .0263516
    253 |  -.1062188
    254 |   .1740169
    255 |   .1925889
```

22 . 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

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

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

There exists high correlation of fixed effects and independent variables.

∴ So, FE model should be used.

23 . log close
      name: <unnamed>
       log: C:\Users\a\Desktop\426.a7.smcl
  log type: smcl
 closed on: 17 Mar 2021, 19:55:33

24 .