Assignment 4

1. Estimate model (1) using Panel Least Squares estimation method and PGLS assuming Heteroskedasticity, and test whether there exists Heteroskedasticity problem.

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


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 |

```
. est store het
```

```
. 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 |

```
. est store pgls

. local df=e(N_g)-1

. lrtest het, df('df')

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

As the p-value is lower than 0.05, Ho is then rejected. Therefore, there exists heteroskedasticity.

2. 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.

```
. 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 |

```
. est store pgls

. local df=e(N_g)-1

. lrtest het, df('df')
```

```
. xtreg y x1 x2 x3 x4 x5 x6 x7, fe

Fixed-effects (within) regression               Number of obs      =       1,275
Group variable: crossid                         Number of groups   =         255

R-sq:                                           Obs per group:
     within  = 0.3772                                         min =           5
     between = 0.1103                                         avg =         5.0
     overall = 0.1644                                         max =           5

                                                F(7,1013)          =       87.64
corr(u_i, Xb)  = -0.2003                        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

. est store fixed
```

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

Random-effects GLS regression                   Number of obs     =      1,275
Group variable: crossid                         Number of groups  =        255

R-sq:                                           Obs per group:
     within  = 0.3492                                         min =          5
     between = 0.3404                                         avg =        5.0
     overall = 0.3377                                         max =          5

                                                Wald chi2(7)      =     663.43
corr(u_i, X)   = 0 (assumed)                    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) | | | | |

```
. est store random
```

```
. 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)
```

.

Based on fixed effect, there exists fixed effects as the p-value is lower than 0.05. Then, with regard to Hausman test, ho is rejected as p-value is lower than 0.05. So, the fixed effect model is more appropriated.