BACHELOR OF ECONOMICS
THAMMASAT UNIVERSITY

Answer Sheet Cover Page
Midterm Examination Semester 2/2020

(Readable handwriting and printed version are acceptable)

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Course ID EE 4266 Course Title Econometrics 2

Lecturer Assoc. Prof. Dr Tatre Jantarakolica

Exam date 29/3/21 Time 9.00-15.00

Total pages 22

***Students are responsible for checking the number of pages before submitting the answer sheets. Incomplete submissions caused by carelessness will not be accepted as an excuse for resubmission**

Student Signature

Date 29/3/21

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(1)

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                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /    ____/   /    ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis

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Notes:
      1.  Unicode is supported; see help unicode_advice.
      2.  More than 2 billion observations are allowed; see help obs_advice.
      3.  Maximum number of variables is set to 5000; see help set_maxvar.

1 . use "C:\Users\com\Downloads\04\Midterm_q1_4.dta", clear
(1980 Census housing data)

2 . log using "C:\Users\com\Downloads\04\ee426_q1.smcl"
-------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\ee426_q1.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 09:23:14
```

With OLS the estimators will be biased, Inconsist, and inefficient

(a)

```
3 . reg y1 y2 x3

      Source |       SS           df       MS      Number of obs   =        50
-------------+----------------------------------   F(2, 47)        =    108.06
       Model |  53701.8594         2  26850.9297   Prob > F        =    0.0000
    Residual |  11678.5606        47  248.480013   R-squared       =    0.8214
-------------+----------------------------------   Adj R-squared   =    0.8138
       Total |    65380.42        49  1334.29429   Root MSE        =    15.763

------------------------------------------------------------------------------
          y1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          y2 |   .0009745   .0001932     5.04   0.000     .0005858    .0013632
          x3 |   .0073336   .0010819     6.78   0.000      .005157    .0095101
       _cons |   44.21682   16.45559     2.69   0.010     11.11245    77.32119
------------------------------------------------------------------------------

4 . reg y2 y1 x1 x2

      Source |       SS           df       MS      Number of obs   =        50
-------------+----------------------------------   F(3, 46)        =     31.72
       Model |  8.2479e+09         3  2.7493e+09   Prob > F        =    0.0000
    Residual |  3.9872e+09        46    86678794   R-squared       =    0.6741
-------------+----------------------------------   Adj R-squared   =    0.6529
       Total |  1.2235e+10        49   249695445   Root MSE        =    9310.1

------------------------------------------------------------------------------
          y2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          y1 |   302.0238   45.88109     6.58   0.000       209.67    394.3776
          x1 |    239.351   130.6043     1.83   0.073    -23.54177    502.2437
          x2 |  -.0004897   .0003274    -1.50   0.142    -.0011488    .0001694
       _cons |   -36028.9    8783.98    -4.10   0.000    -53710.14   -18347.67
------------------------------------------------------------------------------
```

```
5 . reg3 (y1 y2 x3) (y2 y1 x1 x2),2sls inst(x1 x2 x3)

Two-stage least-squares regression
```

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
y1	**50**	**2**	**16.1045**	**0.8136**	**94.38**	**0.0000**
y2	**50**	**3**	**9316.633**	**0.6737**	**25.29**	**0.0000**

4.)

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y1						
y2	.0012516	.000508	2.46	0.016	.0002429	.0022604
x3	.0062856	.0020867	3.01	0.003	.0021419	.0104294
_cons	51.21041	20.54627	2.49	0.014	10.40958	92.01123
y2						
y1	290.4038	59.13173	4.91	0.000	172.9799	407.8277
x1	259.0293	145.1328	1.78	0.078	-29.17563	547.2343
x2	-.0005039	.0003308	-1.52	0.131	-.0011608	.000153
_cons	-34552.04	9984.793	-3.46	0.001	-54379.86	-14724.22

```
Endogenous variables:  y1 y2
Exogenous variables:   x1 x2 x3
```

6 Reduced form : $y_{1t} : \tilde{\pi}_{10} + \tilde{\pi}_{11} x_{1t} + \tilde{\pi}_{12} x_{2t} + \tilde{\pi}_{13} x_{3t} + w_{1t}$

$y_{2t} : \tilde{\pi}_{20} + \tilde{\pi}_{21} x_{1t} + \tilde{\pi}_{22} x_{2t} + \tilde{\pi}_{23} x_{3t} + w_{2t}$

```
7 . ivregress 2sls y1 x3 (y2= x1 x2 x3)

Instrumental variables (2SLS) regression          Number of obs   =         50
                                                  Wald chi2(2)    =     200.81
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.8136
                                                  Root MSE        =     15.614
```

y1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
y2	.0012516	.0004925	2.54	0.011	.0002863	.0022169
x3	.0062856	.0020231	3.11	0.002	.0023204	.0102509
_cons	51.21041	19.92035	2.57	0.010	12.16724	90.25357

```
Instrumented:  y2
Instruments:   x3 x1 x2

8 . ivregress 2sls y2 x1 x2 (y1= x1 x2 x3)

Instrumental variables (2SLS) regression          Number of obs   =         50
                                                  Wald chi2(3)    =      82.47
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.6737
                                                  Root MSE        =     8936.2
```

y2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
y1	290.4038	56.71716	5.12	0.000	179.2402	401.5674
x1	259.0293	139.2065	1.86	0.063	-13.81037	531.8691
x2	-.0005039	.0003173	-1.59	0.112	-.0011258	.000118
_cons	-34552.04	9577.077	-3.61	0.000	-53322.76	-15781.31

Instrumented: y1
Instruments: x1 x2 x3

```
9 . reg y1 x1 x2 x3
```

Source	SS	df	MS		
				Number of obs	= 50
				F(3, 46)	= 45.97
Model	49028.5831	3	16342.861	Prob > F	= 0.0000
Residual	16351.8369	46	355.474716	R-squared	= 0.7499
				Adj R-squared	= 0.7336
Total	65380.42	49	1334.29429	Root MSE	= 18.854

y1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
x1	.5447944	.2531595	2.15	0.037	.0352108	1.054378
x2	-6.27e-07	6.57e-07	-0.95	0.345	-1.95e-06	6.96e-07
x3	.0096631	.0011563	8.36	0.000	.0073355	.0119906
_cons	12.59677	19.09739	0.66	0.513	-25.84429	51.03783

```
10 . predict y1hat, xb

11 . reg y2 x1 x2 x3
```

Source	SS	df	MS		
				Number of obs	= 50
				F(3, 46)	= 17.87
Model	6.5854e+09	3	2.1951e+09	Prob > F	= 0.0000
Residual	5.6497e+09	46	122819623	R-squared	= 0.5382
				Adj R-squared	= 0.5081
Total	1.2235e+10	49	249695445	Root MSE	= 11082

y2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
x1	417.2397	148.8071	2.80	0.007	117.7065	716.773
x2	-.0006859	.0003863	-1.78	0.082	-.0014635	.0000916
x3	2.806191	.6796891	4.13	0.000	1.438048	4.174334
_cons	-30893.89	11225.45	-2.75	0.008	-53489.54	-8298.235

```
12 . predict y2hat, xb

13 . reg y1 y2hat x3
```

Source	SS	df	MS		
				Number of obs	= 50
				F(2, 47)	= 70.05
Model	48956.6738	2	24478.3369	Prob > F	= 0.0000
Residual	16423.7462	47	349.441408	R-squared	= 0.7488
				Adj R-squared	= 0.7381
Total	65380.42	49	1334.29429	Root MSE	= 18.693

y1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y2hat	.0012516	.0005896	2.12	0.039	.0000654	.0024379
x3	.0062856	.0024221	2.60	0.013	.0014129	.0111583
_cons	51.21041	23.84915	2.15	0.037	3.232101	99.18871

14 . reg y2 y1hat x1 x2

Source	SS	df	MS		
Model	6.5854e+09	3	2.1951e+09	Number of obs	= 50
Residual	5.6497e+09	46	122819634	F(3, 46)	= 17.87
				Prob > F	= 0.0000
Total	1.2235e+10	49	249695445	R-squared	= 0.5382
				Adj R-squared	= 0.5081
				Root MSE	= 11082

y2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y1hat	290.4038	70.33888	4.13	0.000	148.8189	431.9886
x1	259.0294	172.6396	1.50	0.140	-88.47608	606.535
x2	-.0005039	.0003935	-1.28	0.207	-.001296	.0002882
_cons	-34552.03	11877.2	-2.91	0.006	-58459.58	-10644.47

C.

15 . reg3 (y1 y2 x3) (y2 y1 x1 x2), 3sls inst(x1 x2 x3)

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
y1	50	2	15.61389	0.8136	200.81	0.0000
y2	50	3	8954.393	0.6723	82.71	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
y1						
y2	.0012516	.0004925	2.54	0.011	.0002863	.0022169
x3	.0062856	.0020231	3.11	0.002	.0023204	.0102509
_cons	51.21041	19.92035	2.57	0.010	12.16724	90.25357
y2						
y1	285.0294	55.84722	5.10	0.000	175.5709	394.488
x1	270.6433	137.5542	1.97	0.049	1.042027	540.2445
x2	-.0004181	.0002751	-1.52	0.129	-.0009573	.0001212
_cons	-34463.42	9575.687	-3.60	0.000	-53231.42	-15695.42

Endogenous variables: y1 y2
Exogenous variables: x1 x2 x3

16 . Single equation

2SLS Advantage : More consistent and asymptotically efficient compared to OLS

disadvantage : Misspecified model can leas to unreasonable estimation

System equations

3SLS advantage : More consistent and asymptotically efficient compared to 2SLS

disadvantage : Misspecified model can leas to unreasonable estimation

OLS → OLS

2SLS → OLS + IV

3SLS → OLS + IV + FGLS

} with endogeneity exists ⇒ All estimators will be biased but with 2SLS and 3SLS Asymptotic property both will be consistent and Asymptotic efficient

Notes:
1. Unicode is supported; see help unicode_advice.
2. More than 2 billion observations are allowed; see help obs_advice.
3. Maximum number of variables is set to 5000; see help set_maxvar.

```
1 . use "C:\Users\com\Downloads\04\Midterm_q2_4.dta", clear

2 . log using "C:\Users\com\Downloads\04\ee426_q2.smcl"
-------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\ee426_q2.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 09:42:23

3 .


4 .
5 .


6

7 . nl (lnC = {lnramda}-({beta}/{alpha})*ln({theta}*R^(-{alpha})+(1-{theta})*W^(-{alpha}))), init
> (lnramda 1 theta 0.5 beta 0.5 alpha -0.5)
(obs = 250)

Iteration 0:  residual SS =  315.7594
Iteration 1:  residual SS =  298.0254
Iteration 2:  residual SS =  297.5135
Iteration 3:  residual SS =  297.5127
Iteration 4:  residual SS =  297.5127
Iteration 5:  residual SS =  297.5127
Iteration 6:  residual SS =  297.5127
Iteration 7:  residual SS =  297.5127

      Source |       SS           df       MS      Number of obs =       250
-------------+----------------------------------   R-squared     =    0.1310
       Model |  44.833222          3  14.9444072   Adj R-squared =    0.1204
    Residual |  297.51272        246  1.20940131   Root MSE      =  1.099728
-------------+----------------------------------   Res. dev.     =  752.9683
       Total |  342.34594        249  1.37488331
```

lnC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/lnramda	2.150055	.7760475	2.77	0.006	.6215102	3.678601
/beta	.8120362	.1479719	5.49	0.000	.5205828	1.10349
/alpha	-1.070749	.7145536	-1.50	0.135	-2.478172	.3366745
/theta	.225971	.2422622	0.93	0.352	-.2512017	.7031437

Parameter lnramda taken as constant term in model & ANOVA table

```
8 . est store lognls1

9 .  sca sigma=1/(1-(_b[/theta]))

10 . sca list sigma
     sigma =  1.2919413

11 . test (_b[/theta]=0) (_b[/alpha]=0) (_b[/beta]=0)

 ( 1)  [theta]_cons = 0
 ( 2)  [alpha]_cons = 0
 ( 3)  [beta]_cons = 0

       F(  3,   246) =   37.78
            Prob > F =    0.0000
```

$\hat{\lambda}$: 2.150055 $\hat{\beta}$: .8120362
$\hat{\theta}$: .225971 $\hat{\alpha}$: -1.070749
$\hat{\delta}$: 1.2919413

< 0.05 H_0 rejected $\theta \neq 0$ $\alpha \neq 0$ $\beta \neq 0$

6.)

```
12 .  nl (lnC = {lnramda}-({beta}/{alpha})*ln({theta}*R^(-{alpha})+(1-{theta})*W^(-{alpha}))), ini
   > t(lnramda 0.5 theta 0.1 beta 0.1 alpha -0.1)
   (obs = 250)

Iteration 0:  residual SS =  4522.524
Iteration 1:  residual SS =  2782.494
Iteration 2:  residual SS =  499.7826
Iteration 3:  residual SS =  492.9609
Iteration 4:  residual SS =  333.3437
Iteration 5:  residual SS =  299.3888
Iteration 6:  residual SS =  297.9689
Iteration 7:  residual SS =  297.5269
Iteration 8:  residual SS =  297.5129
Iteration 9:  residual SS =  297.5127
Iteration 10:  residual SS =  297.5127
Iteration 11:  residual SS =  297.5127
Iteration 12:  residual SS =  297.5127
Iteration 13:  residual SS =  297.5127
```

Source	SS	df	MS
Model	44.833222	3	14.9444072
Residual	297.51272	246	1.20940131
Total	342.34594	249	1.37488331

Number of obs =	250
R-squared =	0.1310
Adj R-squared =	0.1204
Root MSE =	1.099728
Res. dev. =	752.9683

lnC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/lnramda	2.150055	.7760475	2.77	0.006	.6215102	3.678601
/beta	.8120362	.1479719	5.49	0.000	.5205828	1.10349
/alpha	-1.070749	.7145523	-1.50	0.135	-2.47817	.3366723
/theta	.2259711	.2422623	0.93	0.352	-.2512019	.7031441

Parameter lnramda taken as constant term in model & ANOVA table

Different sets at initial values can give different estimates results

c,

```
13 .  nl (lnC = {lnramda}-({beta}/{alpha})*ln({theta}*R^(-{alpha})+(1-{theta})*W^(-{alpha}))), ini
> t(lnramda 1 theta 0.5 beta 0.5 alpha -0.5) eps(1e-1)
(obs = 250)

Iteration 0:  residual SS =  315.7594
Iteration 1:  residual SS =  298.0254
Iteration 2:  residual SS =  297.5135
```

Source	SS	df	MS		
Model	44.832469	3	14.9441564	Number of obs =	250
Residual	297.51347	246	1.20940437	R-squared =	0.1310
				Adj R-squared =	0.1204
Total	342.34594	249	1.37488331	Root MSE =	1.099729
				Res. dev. =	752.9689

lnC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/lnramda	2.150245	.7760538	2.77	0.006	.6216872	3.678802
/beta	.8119886	.1478579	5.49	0.000	.5207596	1.103218
/alpha	-1.066218	.679886	-1.57	0.118	-2.405358	.2729223
/theta	.2263338	.2278233	0.99	0.321	-.2223993	.675067

Parameter beta taken as constant term in model & ANOVA table

```
14 .  nl (lnC = {lnramda}-({beta}/{alpha})*ln({theta}*R^(-{alpha})+(1-{theta})*W^(-{alpha}))), ini
> t(lnramda 1 theta 0.5 beta 0.5 alpha -0.5) eps(1e-15) iter(40)
(obs = 250)

Iteration 0:  residual SS =  315.7594
Iteration 1:  residual SS =  298.0254
Iteration 2:  residual SS =  297.5135
Iteration 3:  residual SS =  297.5127
Iteration 4:  residual SS =  297.5127
Iteration 5:  residual SS =  297.5127
Iteration 6:  residual SS =  297.5127
Iteration 7:  residual SS =  297.5127
Iteration 8:  residual SS =  297.5127
Iteration 9:  residual SS =  297.5127
Iteration 10:  residual SS =  297.5127
Iteration 11:  residual SS =  297.5127
Iteration 12:  residual SS =  297.5127
Iteration 13:  residual SS =  297.5127
Iteration 14:  residual SS =  297.5127
Iteration 15:  residual SS =  297.5127
Iteration 16:  residual SS =  297.5127
Iteration 17:  residual SS =  297.5127
```

Source	SS	df	MS		
Model	11566.902	4	2891.72555	Number of obs =	250
Residual	297.51272	246	1.20940131	R-squared =	0.9749
				Adj R-squared =	0.9745
Total	11864.415	250	47.4576596	Root MSE =	1.099728
				Res. dev. =	752.9683

lnC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/lnramda	2.150055	.7760475	2.77	0.006	.6215102	3.678601
/beta	.8120362	.1479719	5.49	0.000	.5205828	1.10349
/alpha	-1.070749	.7145544	-1.50	0.135	-2.478174	.3366759
/theta	.2259709	.2422621	0.93	0.352	-.2512016	.7031435

With different convergence value can give the different estimated results

15 .

d.) With log form the estimated result will be easier to computes and more robust

(R)
Statistics/Data Analysis

(R)
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Notes:
1. Unicode is supported; see help unicode_advice.
2. More than 2 billion observations are allowed; see help obs_advice.
3. Maximum number of variables is set to 5000; see help set_maxvar.

```
1 . use "C:\Users\com\Downloads\04\Midterm_q3_4.dta", clear

2 . log using "C:\Users\com\Downloads\04\ee426_q3.smcl"
```

```
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\ee426_q3.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 10:59:04

3 . do "C:\Users\com\Downloads\04\Midterm_q3 - ml_logit.do"

4 . program ml_logit
  1.    args lnf theta
  2.    quietly replace `lnf'=ln(1/(1+exp(-`theta'))) if $ML_y1==1
  3.    quietly replace `lnf'=ln(1-(1/(1+exp(-`theta')))) if $ML_y1==0
  4. end

5 .
end of do-file

6 . ml model lf ml_logit (y=x1 x2 x3)

7 . ml maximize

initial:       log likelihood = -277.25887
alternative:   log likelihood = -266.63079
rescale:       log likelihood = -266.63079
Iteration 0:   log likelihood = -266.63079
Iteration 1:   log likelihood = -218.78011
Iteration 2:   log likelihood = -217.46841
Iteration 3:   log likelihood = -217.46691
Iteration 4:   log likelihood = -217.46691

                                                Number of obs     =        400
                                                Wald chi2(3)      =      68.29
Log likelihood = -217.46691                     Prob > chi2       =     0.0000
```

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.2808583	.1167717	2.41	0.016	.0519899	.5097267
x2	-.5823592	.0721582	-8.07	0.000	-.7237868	-.4409317
x3	-.2448167	.1282455	-1.91	0.056	-.4961733	.0065399
_cons	.2458087	.1949767	1.26	0.207	-.1363385	.627956

```
 8 . est store ur

 9 . ml model lf ml_logit (y=x*), tech(bhhh)

10 . ml maximize

initial:       log likelihood = -277.25887
alternative:   log likelihood = -266.63079
rescale:       log likelihood = -266.63079
Iteration 0:   log likelihood = -266.63079
Iteration 1:   log likelihood = -218.31365
Iteration 2:   log likelihood = -217.47308
Iteration 3:   log likelihood = -217.46697
Iteration 4:   log likelihood = -217.46691
Iteration 5:   log likelihood = -217.46691

                                                Number of obs     =        400
                                                Wald chi2(3)      =      66.57
Log likelihood = -217.46691                     Prob > chi2       =     0.0000
```

y	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.2808443	.1189786	2.36	0.018	.0476505	.5140381
x2	-.5823674	.0740101	-7.87	0.000	-.7274246	-.4373102
x3	-.2448195	.1221053	-2.00	0.045	-.4841415	-.0054974
_cons	.2458228	.1962393	1.25	0.210	-.1387992	.6304448

```
11 . est store bhhh

12 . ml model lf ml_logit (y=x), tech(bfgs)
x ambiguous abbreviation
r(111);

13 . ml model lf ml_logit (y=x*), tech(bfgs)

14 . ml maximize

initial:       log likelihood = -277.25887
alternative:   log likelihood = -266.63079
rescale:       log likelihood = -266.63079
Iteration 0:   log likelihood = -266.63079
Iteration 1:   log likelihood = -258.52576  (backed up)
Iteration 2:   log likelihood = -254.22702  (backed up)
Iteration 3:   log likelihood = -250.56611
Iteration 4:   log likelihood = -249.60074
Iteration 5:   log likelihood = -228.08779
Iteration 6:   log likelihood = -218.74128
Iteration 7:   log likelihood = -217.47501
Iteration 8:   log likelihood = -217.46735
Iteration 9:   log likelihood = -217.46693
Iteration 10:  log likelihood = -217.46691

                                                Number of obs     =        400
                                                Wald chi2(3)      =      68.30
Log likelihood = -217.46691                     Prob > chi2       =     0.0000
```

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.2809273	.1167753	2.41	0.016	.0520519	.5098026
x2	-.5824227	.0721628	-8.07	0.000	-.7238592	-.4409862
x3	-.2448659	.1282494	-1.91	0.056	-.4962301	.0064983
_cons	.2458029	.1949809	1.26	0.207	-.1363527	.6279584

```
15 . est store bfgs

16 . est table ur bhhh bfgs, star(.1 .05 .01) stat(N ll chi2 p)
```

Variable	ur	bhhh	bfgs
x1	.28085833**	.28084432**	.28092727**
x2	-.58235923***	-.5823674***	-.58242267***
x3	-.2448167*	-.24481947**	-.24486589*
_cons	.2458087	.24582284	.24580287
N	400	400	400
ll	-217.46691	-217.46691	-217.46691
chi2	68.290298	66.569347	68.297136
p	9.915e-15	2.315e-14	9.882e-15

legend: * p<.1; ** p<.05; *** p<.01

Using different algorithm will estimates a different results because of different computation function.

```
17 . do "C:\Users\com\Downloads\04\Midterm_q3 - ml_probit.do"

18 . program ml_probit
     1.    args lnf theta
     2.    tempvar z
     3.    quietly g double `z'=`theta'
     4.    quietly replace `lnf'=ln(normal(`z')) if $ML_y1==1
     5.    quietly replace `lnf'=ln(1-normal(`z')) if $ML_y1==0
     6. end

19 .
end of do-file

20 . ml model lf ml_probit (y=x1 x2)

21 . ml maximize

initial:       log likelihood = -277.25887
alternative:   log likelihood = -271.85123
rescale:       log likelihood = -266.80559
Iteration 0:   log likelihood = -266.80559
Iteration 1:   log likelihood = -219.83398
Iteration 2:   log likelihood = -219.35724
Iteration 3:   log likelihood = -219.35696
Iteration 4:   log likelihood = -219.35696

                                                Number of obs     =        400
                                                Wald chi2(2)      =      76.45
Log likelihood = -219.35696                     Prob > chi2       =     0.0000
```

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.1585088	.069309	2.29	0.022	.0226656	.294352
x2	-.3350693	.039372	-8.51	0.000	-.412237	-.2579016
_cons	.1398805	.1162269	1.20	0.229	-.08792	.3676809

b.) LR test is more preferable because this method used a optimization which give more accurate results.

c.) Because, MLE distribution is χ^2 And F have different distribution

```
22 . do "C:\Users\com\Downloads\04\Midterm_q3 - ml_probit_het.do"

23 . program ml_probit_het
     1.    args lnf theta sigma
     2.    tempvar z s
     3.    quietly g double `s'=exp(`sigma')
     4.    quietly g double `z'=`theta'/`s'
     5.    quietly replace `lnf'=ln(normal(`z')) if $ML_y1==1
     6.    quietly replace `lnf'=ln(1-normal(`z')) if $ML_y1==0
     7. end

24 .
   end of do-file

25 .



26 . ml model lf ml_probit_het (y=x1 x2) (x3, noconstant)

27 . ml maximize

   initial:       log likelihood = -277.25887
   alternative:   log likelihood =   -271.834
   rescale:       log likelihood =  -266.8011
   rescale eq:    log likelihood = -266.61459
   Iteration 0:   log likelihood = -266.61459
   Iteration 1:   log likelihood = -241.98721
   Iteration 2:   log likelihood = -233.69206
   Iteration 3:   log likelihood = -219.04695
   Iteration 4:   log likelihood = -217.26474
   Iteration 5:   log likelihood = -217.02239
   Iteration 6:   log likelihood = -217.02113
   Iteration 7:   log likelihood = -217.02113

                                                 Number of obs     =        400
                                                 Wald chi2(2)      =      74.28
   Log likelihood = -217.02113                   Prob > chi2       =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
eq1          |
          x1 |   .1744698   .0664826     2.62   0.009     .0441662    .3047733
          x2 |  -.3334951   .0399312    -8.35   0.000    -.4117589   -.2552314
       _cons |   .0952407   .1122231     0.85   0.396    -.1247127     .315194
-------------+----------------------------------------------------------------
eq2          |
          x3 |  -.2116171   .0998641    -2.12   0.034     -.407347   -.0158872
------------------------------------------------------------------------------

28 .
```

```
29 . est store hetprob

30 . do "C:\Users\com\Downloads\04\Midterm_q3 - ml_probit.do"

31 . program ml_probit
program ml_probit already defined
r(110);

end of do-file

r(110);

32 . ml model lf ml_probit (y=x1 x2)

33 . ml maximize

initial:       log likelihood = -277.25887
alternative:   log likelihood = -271.85123
rescale:       log likelihood = -266.80559
Iteration 0:   log likelihood = -266.80559
Iteration 1:   log likelihood = -219.83398
Iteration 2:   log likelihood = -219.35724
Iteration 3:   log likelihood = -219.35696
Iteration 4:   log likelihood = -219.35696

                                                Number of obs     =        400
                                                Wald chi2(2)      =      76.45
Log likelihood = -219.35696                     Prob > chi2       =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .1585088    .069309     2.29   0.022     .0226656    .294352
          x2 |  -.3350693    .039372    -8.51   0.000     -.412237   -.2579016
       _cons |   .1398805   .1162269     1.20   0.229      -.08792    .3676809
------------------------------------------------------------------------------

34 . est store probit

35 . lr test hetprob probit
command lr is unrecognized
r(199);

36 . lrtest hetprob probit

Likelihood-ratio test                           LR chi2(1)  =      4.67
(Assumption: probit nested in hetprob)          Prob > chi2 =    0.0307

37 .
```

d.) < 0.05 H_0 rejects

There exists heteroskedasticity in this case.

e.) Z-test is used because of the asymptotic distribution that gives a normal distribution so Z can be applies. We don't know χ^2 because of non-linear property. L-likelihood should be employed.

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis

      ___  ____  ____  ____  ____ (R)
     /__    /   ____/   /   ____/
    ___/   /   /___/   /   /___/   14.0   Copyright 1985-2015 StataCorp LP
      Statistics/Data Analysis             StataCorp
                                           4905 Lakeway Drive
          MP - Parallel Edition            College Station, Texas 77845 USA
                                           800-STATA-PC        http://www.stata.com
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  Notes:
        1.  Unicode is supported; see help unicode_advice.
        2.  More than 2 billion observations are allowed; see help obs_advice.
        3.  Maximum number of variables is set to 5000; see help set_maxvar.

1 . use "C:\Users\com\Downloads\04\Midterm_q4-1_4.dta", clear

2 . log using "C:\Users\com\Downloads\04\Untitled.smcl", replace
------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\Untitled.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 14:36:45

3 . tsset time
        time variable:  time, 1 to 1326
                delta:  1 unit

4 . gen dr=f.r-r
  (1 missing value generated)

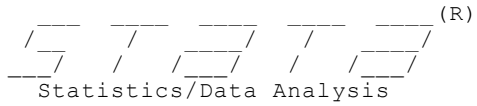
5 . gmm (dr-{alpha}-{beta}*r) ((dr-{alpha}-{beta}*r)*r) ((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamm
  > a})) (((dr-{alpha}-{beta}*r)^2-{sigma2}*r^(2*{gamma}))*r) winitial(identity)
  note: 1 missing value returned for equation 1 at initial values
  note: 1 missing value returned for equation 2 at initial values
  note: 1 missing value returned for equation 3 at initial values
  note: 1 missing value returned for equation 4 at initial values

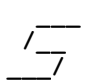
  Step 1
  numerical derivatives are approximate
  flat or discontinuous region encountered
  Iteration 0:   GMM criterion Q(b) =  .00001285
  Iteration 1:   GMM criterion Q(b) =  9.555e-06  (backed up)
  Iteration 2:   GMM criterion Q(b) =  6.114e-06  (not concave)
  Iteration 3:   GMM criterion Q(b) =  5.940e-06  (backed up)
  Iteration 4:   GMM criterion Q(b) =  5.935e-06  (backed up)

  Step 2
  Iteration 0:   GMM criterion Q(b) =  .00875867
  could not calculate numerical derivatives -- flat or discontinuous region encountered
  could not calculate numerical derivatives -- flat or discontinuous region encountered
  r(430);

6 .
```

9 c.) with endogeneity Q_2 will be biased inconsistent and inefficient





Statistics/Data Analysis **14.0**

MP - Parallel Edition

StataCorp
4905 Lakeway Drive
College Station, Texas 77845 USA
800-STATA-PC http://www.stata.com
979-696-4600 stata@stata.com
979-696-4601 (fax)

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Notes:
1. Unicode is supported; see help unicode_advice.
2. More than 2 billion observations are allowed; see help obs_advice.
3. Maximum number of variables is set to 5000; see help set_maxvar.

```
1 . use "C:\Users\com\Downloads\04\Midterm_q5_4.dta", clear

2 . log using "C:\Users\com\Downloads\04\ee426_q5.smcl"
```

```
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\ee426_q5.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 11:31:29

3 . findit fitstat

4 . logit y x1 x2 x3

Iteration 0:   log likelihood = -115.39801
Iteration 1:   log likelihood = -108.82885
Iteration 2:   log likelihood = -108.51434
Iteration 3:   log likelihood = -108.51329
Iteration 4:   log likelihood = -108.51329

Logistic regression                             Number of obs     =        215
                                                LR chi2(3)        =      13.77
                                                Prob > chi2       =     0.0032
Log likelihood = -108.51329                     Pseudo R2         =     0.0597
```

Overall test is significant

Used for comparison

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.006117	.0026021	2.35	0.019	.001017	.0112169
x2	.0195677	.0154868	1.26	0.206	-.0107858	.0499212
x3	.1721685	.0801424	2.15	0.032	.0150924	.3292447
_cons	.7341525	.20264	3.62	0.000	.3369854	1.13132

To individual test

```
5 . fitstat

Measures of Fit for logit of y
```

Log-Lik Intercept Only:	-115.398	Log-Lik Full Model:	-108.513
D(211):	217.027	LR(3):	13.769
		Prob > LR:	0.003
McFadden's R2:	0.060	McFadden's Adj R2:	0.025
Maximum Likelihood R2:	0.062	Cragg & Uhler's R2:	0.094
McKelvey and Zavoina's R2:	0.137	Efron's R2:	0.056
Variance of y*:	3.814	Variance of error:	3.290
Count R2:	0.772	Adj Count R2:	0.000
AIC:	1.047	AIC*n:	225.027
BIC:	-916.178	BIC':	2.342

6 . probit y x1 x2 x3

```
Iteration 0:   log likelihood = -115.39801
Iteration 1:   log likelihood = -108.55308
Iteration 2:   log likelihood = -108.46762
Iteration 3:   log likelihood = -108.46758
Iteration 4:   log likelihood = -108.46758
```

Probit regression — Number of obs = 215; LR chi2(3) = 13.86; Prob > chi2 = 0.0031; Log likelihood = -108.46758; Pseudo R2 = 0.0601

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.0035049	.0014387	2.44	0.015	.0006852	.0063246
x2	.0102078	.0082103	1.24	0.214	-.005884	.0262996
x3	.0948062	.0427046	2.22	0.026	.0111068	.1785057
_cons	.4573707	.1225489	3.73	0.000	.2171792	.6975622

we cannot compare the estimated coefficients because of the difference in distribution

7 . fitstat

Measures of Fit for **probit** of **y**

Log-Lik Intercept Only:	-115.398	Log-Lik Full Model:	-108.468
D(211):	216.935	LR(3):	13.861
		Prob > LR:	0.003
McFadden's R2:	0.060	McFadden's Adj R2:	0.025
Maximum Likelihood R2:	0.062	Cragg & Uhler's R2:	0.095
McKelvey and Zavoina's R2:	0.141	Efron's R2:	0.056
Variance of y*:	1.165	Variance of error:	1.000
Count R2:	0.772	Adj Count R2:	0.000
AIC:	1.046	AIC*n:	224.935
BIC:	-916.269	BIC':	2.251

b.)

8 . mfx

Marginal effects after probit
y = Pr(y) (predict)
= .79072583

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
x1	.0010081	.00041	2.49	0.013	.000213	.001803	60.8632
x2	.0029359	.00234	1.25	0.210	-.001654	.007526	-1.60773
x3	.0272677	.01206	2.26	0.024	.003632	.050904	1.63138

Change in X_{11} by 1 unit (From 60.8632 to 61.8632) $\hat{P}(y=1)$ will increase by .001 or 0.1 % holding X_2, X_3 constant.

```
 9 . mfx, at(median)

Marginal effects after probit
      y  = Pr(y) (predict)
         =  .68501037
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
x1	.001245	.00055	2.27	0.023	.00017	.00232	.753216
x2	.0036261	.00293	1.24	0.216	-.002121	.009374	.54305
x3	.0336783	.01576	2.14	0.033	.002788	.064568	.170897

c.)

```
10 . qui logit y x1 x2 x3

11 . test x1 x2 x3

 ( 1)  [y]x1 = 0
 ( 2)  [y]x2 = 0
 ( 3)  [y]x3 = 0

           chi2(  3) =   10.78
         Prob > chi2 =    0.0130

12 . qui probit y x1 x2 x3

13 . test x1 x2 x3

 ( 1)  [y]x1 = 0
 ( 2)  [y]x2 = 0
 ( 3)  [y]x3 = 0

           chi2(  3) =   12.04
         Prob > chi2 =    0.0073

14 . test (x1=x2)

 ( 1)  [y]x1 - [y]x2 = 0

           chi2(  1) =    0.70
         Prob > chi2 =    0.4044 > 0.05

15 . qui logit y x1 x2 x3

16 . test (x1=x2)

 ( 1)  [y]x1 - [y]x2 = 0

           chi2(  1) =    0.81
         Prob > chi2 =    0.3679 > 0.05

17 . log close
       name:  <unnamed>
        log:  C:\Users\com\Downloads\04\ee426_q5.smcl
   log type:  smcl
  closed on:  21 Mar 2021, 11:56:24
```

Fails to reject H_0 then is, $\beta_1 = \beta_2$

```
18 .
```

d.) Because the change in threshold can lead to different interpret when it is $\hat{y}:1 \geq 0.5$ or < 0.5. And it will change the value of Counted R^2 with different computation.

6.

```
                                                  ___  ____  ____  ____  ____(R)
                                                 /__    /   ____/   /   ____/
                                                ___/   /   /___/   /   /___/
                                                  Statistics/Data Analysis

      ___  ____  ____  ____  ____ (R)
     /__    /   ____/   /   ____/
    ___/   /   /___/   /   /___/   14.0   Copyright 1985-2015 StataCorp LP
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  Notes:
        1.  Unicode is supported; see help unicode_advice.
        2.  More than 2 billion observations are allowed; see help obs_advice.
        3.  Maximum number of variables is set to 5000; see help set_maxvar.

1 . use "C:\Users\com\Downloads\04\Midterm_q6_4.dta", clear

2 . log using "C:\Users\com\Downloads\04\ee426_q6.smcl"
-------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\com\Downloads\04\ee426_q6.smcl
  log type:  smcl
 opened on:  21 Mar 2021, 11:57:47

3 .



4 . xtset id
        panel variable:  id (balanced)

5 . xtset id t
        panel variable:  id (strongly balanced)
         time variable:  t, 1 to 12
                 delta:  1 unit

6 . xtgls y x1 x2 x3

  Cross-sectional time-series FGLS regression

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

  Estimated covariances      =         1          Number of obs      =      1,200
  Estimated autocorrelations =         0          Number of groups   =        100
  Estimated coefficients     =         4          Time periods       =         12
                                                  Wald chi2(3)       =   29882.41
  Log likelihood             =  -6211.29          Prob > chi2        =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .3183087   .0109146    29.16   0.000     .2969164    .3397011
          x2 |   1.320714   .0149495    88.34   0.000     1.291413    1.350014
          x3 |  -.4642183    .011884   -39.06   0.000    -.4875104   -.4409262
       _cons |  -136.2145   6.645908   -20.50   0.000    -149.2402   -123.1887
------------------------------------------------------------------------------
```

```
7 . xtgls y x1 x2 x3, igls panels(heteroskedastic)
  Iteration 1: tolerance = .00590371
  Iteration 2: tolerance = .00177471
  Iteration 3: tolerance = .00055434
  Iteration 4: tolerance = .000177
  Iteration 5: tolerance = .00005721
  Iteration 6: tolerance = .00001862
  Iteration 7: tolerance = 6.085e-06
  Iteration 8: tolerance = 1.993e-06
  Iteration 9: tolerance = 6.534e-07
  Iteration 10: tolerance = 2.144e-07
  Iteration 11: tolerance = 7.040e-08


  Cross-sectional time-series FGLS regression

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

  Estimated covariances      =       100          Number of obs     =      1,200
  Estimated autocorrelations =         0          Number of groups  =        100
  Estimated coefficients     =         4          Time periods      =         12
                                                  Wald chi2(3)      =   33298.40
  Log likelihood             = -6165.009          Prob > chi2       =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .3168738   .0100633    31.49   0.000     .2971501    .3365975
          x2 |   1.311977   .0139878    93.79   0.000     1.284562    1.339393
          x3 |  -.4630102    .011065   -41.84   0.000    -.4846972   -.4413232
       _cons |  -132.2058   6.140582   -21.53   0.000    -144.2411   -120.1705
------------------------------------------------------------------------------

8 . est store panelhet

9 . xtgls y x1 x2 x3

  Cross-sectional time-series FGLS regression

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

  Estimated covariances      =         1          Number of obs     =      1,200
  Estimated autocorrelations =         0          Number of groups  =        100
  Estimated coefficients     =         4          Time periods      =         12
                                                  Wald chi2(3)      =   29882.41
  Log likelihood             =  -6211.29          Prob > chi2       =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .3183087   .0109146    29.16   0.000     .2969164    .3397011
          x2 |   1.320714   .0149495    88.34   0.000     1.291413    1.350014
          x3 |  -.4642183    .011884   -39.06   0.000    -.4875104   -.4409262
       _cons |  -136.2145   6.645908   -20.50   0.000    -149.2402   -123.1887
------------------------------------------------------------------------------
```

Heteroskedasticity exists, as this cause the model to be inefficient

```
10 . eststore panel
command eststore is unrecognized
r(199);

11 . est store panel

12 . local df=e(N_g)-1

13 . lrtest panelhet, df(`df')

Likelihood-ratio test                                 LR chi2(99) =      92.56
(Assumption: panel nested in panelhet)                Prob > chi2 =     0.6629
```

>0.05

b.)

```
14 . xtreg y x1 x2 x3, fe

Fixed-effects (within) regression               Number of obs      =     1,200
Group variable: id                              Number of groups   =       100

R-sq:                                           Obs per group:
     within  = 0.9502                                         min =        12
     between = 0.9848                                         avg =      12.0
     overall = 0.8846                                         max =        12

                                                F(3,1097)          =   6980.72
corr(u_i, Xb)  = 0.8057                         Prob > F           =    0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .1014426   .0044866    22.61   0.000     .0926393    .1102459
          x2 |    .6951028   .0085422    81.37   0.000      .678342    .7118637
          x3 |   -.4953168   .0041895  -118.23   0.000    -.5035372   -.4870965
       _cons |     208.659   4.373144    47.71   0.000     200.0784    217.2397
-------------+----------------------------------------------------------------
     sigma_u |  123.46108
     sigma_e |  14.376737
         rho |  .98662139   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(99, 1097) = 96.47                     Prob > F = 0.0000

15 . est store fe

16 . xtreg y x1 x2 x3, re

Random-effects GLS regression                   Number of obs      =     1,200
Group variable: id                              Number of groups   =       100

R-sq:                                           Obs per group:
     within  = 0.8956                                         min =        12
     between = 0.9953                                         avg =      12.0
     overall = 0.9543                                         max =        12

                                                Wald chi2(3)       =   8707.50
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .2162513   .0090869    23.80   0.000     .1984414    .2340613
          x2 |    1.028607   .0152844    67.30   0.000     .9986503    1.058564
          x3 |   -.4779339   .0091412   -52.28   0.000    -.4958503   -.4600176
       _cons |    25.24251   8.000206     3.16   0.002     9.562392    40.92262
-------------+----------------------------------------------------------------
     sigma_u |  12.351151
     sigma_e |  14.376737
         rho |  .42464732   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
17 . est store re

18 . hausman fe re

                 ---- Coefficients ----
                |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                |       fe           re          Difference          S.E.
----------------+----------------------------------------------------------------
             x1 |    .1014426     .2162513      -.1148087               .
             x2 |    .6951028     1.028607      -.3335042               .
             x3 |   -.4953168    -.4779339      -.0173829               .
----------------------------------------------------------------------------------
                          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(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          = -1451.21     chi2<0 ==> model fitted on these
                                         data fails to meet the asymptotic
                                         assumptions of the Hausman test;
                                         see suest for a generalized test

19 . log close
       name:  <unnamed>
        log:  C:\Users\com\Downloads\04\ee426_q6.smcl
   log type:  smcl
  closed on:  21 Mar 2021, 12:12:55
```

20 . H_0 ; $\beta_{FE} : \beta_{RE}$

H_a ; $\beta_{FE} \neq \beta_{RE}$

H_0 is rejected So, Fixed effects is applied, So more appropriates model would be FE model

c.) The difference between fixed effects and first difference is than fixed effects will use mean to be fixed and compared with any period but for first period it uses only 1 and 1-1 periods to compared

Fixed effects and Random effects differences with the fact they for fixes effect unobserves α correlated with X_i but Random effects is not

d.)