BACHELOR OF ECONOMICS
THAMMASAT UNIVERSITY

Answer Sheet Cover Page
Final Examination Semester 2/2020

(Readable handwriting and printed version are acceptable)

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Course ID EE 426 Course Title

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Exam date 28/5/21 Time 09.00 - 15.00

Total pages 45

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Student Signature

Date 28/05/21

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------------------------------------------------------------------------------------
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      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q1 new.log
  log type:  text
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. use "C:\Users\User\Desktop\EE 426 stata\final\Final_q1-1_5.dta", clear

a) . mlogit y x1 x2 x3 x4, base(0) nolog

Multinomial logistic regression                 Number of obs     =        170
                                                LR chi2(8)        =      87.68
                                                Prob > chi2       =     0.0000
Log likelihood = -106.80628                     Pseudo R2         =     0.2910

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |  (base outcome)
-------------+----------------------------------------------------------------
1            |
          x1 |  -.7655058   .6196616    -1.24   0.217     -1.98002    .4490086
          x2 |  -.7651638   .7706137    -0.99   0.321    -2.275539    .7452114
          x3 |  -.4346366   .6129129    -0.71   0.478    -1.635924    .7666506
          x4 |   .5772955    .247649     2.33   0.020     .0919124    1.062679
       _cons |  -6.703481   3.535921    -1.90   0.058    -13.63376    .2267964
-------------+----------------------------------------------------------------
2            |
          x1 |  -.8269588   .6824567    -1.21   0.226    -2.164549    .5106317
          x2 |  -1.698946   .8042347    -2.11   0.035    -3.275217   -.1226749
          x3 |   .7452921   .6636072     1.12   0.261    -.5553541    2.045938
          x4 |   1.779832   .3057578     5.82   0.000     1.180558    2.379107
       _cons |  -25.61276   4.575878    -5.60   0.000    -34.58132   -16.64421
------------------------------------------------------------------------------

. est store m1

. mlogit y x* if y!=2, base(0) nolog

Multinomial logistic regression                 Number of obs     =         63
                                                LR chi2(4)        =       6.49
                                                Prob > chi2       =     0.1655
Log likelihood = -35.324084                     Pseudo R2         =     0.0841

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |  (base outcome)
-------------+----------------------------------------------------------------
```

```
1            |
          x1 |  -.6041432    .601131    -1.01   0.315    -1.782338    .5740519
          x2 |  -.5114184    .754524    -0.68   0.498    -1.990258    .9674213
          x3 |  -.2692158   .6316639    -0.43   0.670    -1.507254    .9688226
          x4 |   .5338047   .2465122     2.17   0.030     .0506496     1.01696
       _cons |    -6.4123   3.664639    -1.75   0.080    -13.59486    .7702618
------------------------------------------------------------------------------

. est store m2

. hausman m1 m2, alleqs constant

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       m1           m2         Difference          S.E.
-------------+----------------------------------------------------------------
          x1 |   -.7655058    -.6041432       -.1613626        .1504061
          x2 |   -.7651638    -.5114184       -.2537454        .1566497
          x3 |   -.4346366    -.2692158       -.1654207               .
          x4 |    .5772955     .5338047        .0434908        .0237006
       _cons |   -6.703481      -6.4123       -.2911813               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from mlogit
            B = inconsistent under Ha, efficient under Ho; obtained from mlogit

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.78
                Prob>chi2 =      0.9784
                (V_b-V_B is not positive definite)
```

- Null hypothesis is rejected at 5% level, IIA is not violated. Multinomial Logit is appropriate in this case.
- IIA is importance because if it doesn't hold, then the comparison of the base case and other case will not exist.
- Multinomial Logit is inappropriate because it is an ordered data.

B)

```
. oprobit y x*, nolog

Ordered probit regression                       Number of obs     =        170
                                                LR chi2(4)        =      80.75
                                                Prob > chi2       =     0.0000
Log likelihood = -110.26907                     Pseudo R2         =     0.2680

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
          x1 |   -.181094   .2298593    -0.79   0.431      -.63161     .269422
          x2 |  -.5267477   .2384676    -2.21   0.027    -.9941357   -.0593597
          x3 |   .5032115   .2162944     2.33   0.020     .0792822    .9271408
          x4 |   .6737916    .092192     7.31   0.000     .4930986    .8544846
-------------+----------------------------------------------------------------
       /cut1 |   9.217215   1.403268                      6.466861    11.96757
       /cut2 |   10.51401   1.455687                      7.660915     13.3671
------------------------------------------------------------------------------

. tab y

          y |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |         19       11.18       11.18
          1 |         44       25.88       37.06
          2 |        107       62.94      100.00
------------+-----------------------------------
      Total |        170      100.00

. q y01=y>0
invalid syntax
r(198);

. g y01=y>0

. g y1=y>1

. g y12=y1

. tab y y01

           |          y01
         y |         0          1 |     Total
-----------+----------------------+----------
         0 |        19          0 |        19
         1 |         0         44 |        44
         2 |         0        107 |       107
-----------+----------------------+----------
     Total |        19        151 |       170


. tab y y12

           |          y12
         y |         0          1 |     Total
-----------+----------------------+----------
         0 |        19          0 |        19
         1 |        44          0 |        44
         2 |         0        107 |       107
```

```
-----------+----------------------+----------
     Total |        63        107 |       170


. probit y01 x1 x2, nolog

Probit regression                               Number of obs     =        170
                                                LR chi2(2)        =       1.44
                                                Prob > chi2       =     0.4857
Log likelihood = -58.809916                     Pseudo R2         =     0.0121

------------------------------------------------------------------------------
         y01 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .1344467   .2763582     0.49   0.627    -.4072055    .6760989
          x2 |  -.3273367   .2948985    -1.11   0.267    -.9053272    .2506538
       _cons |   1.398929   .2705189     5.17   0.000     .8687213    1.929136
------------------------------------------------------------------------------

. est store probit01

. probit y12 x1 x2, nolog

Probit regression                               Number of obs     =        170
                                                LR chi2(2)        =       9.07
                                                Prob > chi2       =     0.0107
Log likelihood =   -107.541                     Pseudo R2         =     0.0405

------------------------------------------------------------------------------
         y12 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .530468   .2151251     2.47   0.014     .1088305    .9521055
          x2 |   -.436707   .2205912    -1.98   0.048    -.8690579   -.0043562
       _cons |   .4179719   .1950014     2.14   0.032     .0357761    .8001677
------------------------------------------------------------------------------

. est store 12
12 invalid name
r(7);

. est store probit12

. suest probit01 probit12

Simultaneous results for probit01, probit12

                                                Number of obs     =        170

------------------------------------------------------------------------------
             |               Robust
```

```
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
probit01_y01 |
          x1 |   .1344467   .2920309     0.46   0.645    -.4379233    .7068168
          x2 |  -.3273367   .3002285    -1.09   0.276    -.9157737    .2611002
       _cons |   1.398929   .2628876     5.32   0.000     .8836785    1.914179
-------------+----------------------------------------------------------------
probit12_y12 |
          x1 |    .530468   .2284481     2.32   0.020     .0827179    .9782181
          x2 |   -.436707    .224271    -1.95   0.052    -.8762702    .0028561
       _cons |   .4179719   .1967748     2.12   0.034     .0323004    .8036434
------------------------------------------------------------------------------

. test [probit01_y01]x1-[probit12_y12]x1 = 0

 ( 1)  [probit01_y01]x1 - [probit12_y12]x1 = 0

           chi2(  1) =    2.05
         Prob > chi2 =    0.1520

. test [probit01_y01]x2-[probit12_y12]x2 = 0

 ( 1)  [probit01_y01]x2 - [probit12_y12]x2 = 0

           chi2(  1) =    0.16
         Prob > chi2 =    0.6919

According to the tesst, order logit model is inappropriated.


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```

c)

```
. probit y1 x*, nolog

Probit regression                               Number of obs     =        550
                                                LR chi2(4)        =      31.01
                                                Prob > chi2       =     0.0000
Log likelihood = -363.62871                     Pseudo R2         =     0.0409

------------------------------------------------------------------------------
          y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.445385   .4022585     3.59   0.000      .656973    2.233797
          x2 |  -.8344805   .3854499    -2.16   0.030    -1.589949   -.0790125
          x3 |   .6171441   .1770221     3.49   0.000     .2701872    .9641011
          x4 |   .2509839   .1871514     1.34   0.180     -.115826    .6177939
       _cons |  -.8416628   .3033931    -2.77   0.006    -1.436302   -.2470233
------------------------------------------------------------------------------

. probit y2 x*, nolog
```

```
Probit regression                                 Number of obs     =        550
                                                  LR chi2(4)        =      15.15
                                                  Prob > chi2       =     0.0044
Log likelihood = -359.55689                       Pseudo R2         =     0.0206

------------------------------------------------------------------------------
          y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.7662468   .3800725    -2.02   0.044    -1.511175   -.0213183
          x2 |  -.5804844   .3723882    -1.56   0.119    -1.310352     .149383
          x3 |  -.2515698   .1761122    -1.43   0.153    -.5967435    .0936038
          x4 |   .6177622   .1929058     3.20   0.001     .2396738    .9958506
       _cons |   .3797781   .3020394     1.26   0.209    -.2122082    .9717644
------------------------------------------------------------------------------

. probit y3 x*, nolog

Probit regression                                 Number of obs     =        550
                                                  LR chi2(4)        =      11.15
                                                  Prob > chi2       =     0.0250
Log likelihood = -327.82122                       Pseudo R2         =     0.0167

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.5002966   .3908157    -1.28   0.200    -1.266281     .265688
          x2 |   .7581937   .3864579     1.96   0.050     .0007502    1.515637
          x3 |  -.3823911   .1975719    -1.94   0.053    -.7696248    .0048427
          x4 |  -.3040029   .1853188    -1.64   0.101    -.6672211    .0592152
       _cons |  -.4916926   .3164181    -1.55   0.120    -1.111861    .1284755
------------------------------------------------------------------------------
```

- Since the correlation between the disturbance term is not zero, then these three separate probit models is inappropriated.

D)

```
. mvprobit (y1 x*) (y2 x*) (y3 x*), nolog

Multivariate probit (SML, # draws = 5)              Number of obs     =        550
                                                    Wald chi2(12)     =      42.56
Log likelihood = -929.29773                         Prob > chi2       =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y1           |
          x1 |   1.290919   .3922353     3.29   0.001     .5221516    2.059686
          x2 |  -.7035317   .3795373    -1.85   0.064    -1.447411    .0403477
          x3 |   .6018757   .1779435     3.38   0.001     .2531129    .9506384
```

```
          x4 |   .2327184   .1863713     1.25   0.212    -.1325626    .5979995
       _cons |  -.7750348   .3054595    -2.54   0.011    -1.373724   -.1763452
-------------+----------------------------------------------------------------
y2           |
          x1 |  -.8300746   .3752998    -2.21   0.027    -1.565649   -.0945005
          x2 |  -.4851346   .3706422    -1.31   0.191     -1.21158    .2413108
          x3 |  -.2658067   .1777109    -1.50   0.135    -.6141137    .0825004
          x4 |   .5833341   .1925894     3.03   0.002     .2058659    .9608023
       _cons |   .4042966   .3002835     1.35   0.178    -.1842483    .9928416
-------------+----------------------------------------------------------------
y3           |
          x1 |  -.4512174   .3845637    -1.17   0.241    -1.204949    .3025136
          x2 |   .6247652   .3814577     1.64   0.101    -.1228781    1.372409
          x3 |  -.2616852    .186518    -1.40   0.161    -.6272538    .1038833
          x4 |  -.2790318   .1887714    -1.48   0.139    -.6490169    .0909534
       _cons |  -.4577304   .3188262    -1.44   0.151    -1.082618    .1671574
-------------+----------------------------------------------------------------
    /atrho21 |  -.6112249   .0745649    -8.20   0.000    -.7573693   -.4650804
-------------+----------------------------------------------------------------
    /atrho31 |  -.4256823   .0740828    -5.75   0.000    -.5708819   -.2804828
-------------+----------------------------------------------------------------
    /atrho32 |  -.3164979    .070872    -4.47   0.000    -.4554044   -.1775913
-------------+----------------------------------------------------------------
       rho21 |  -.5449888   .0524182   -10.40   0.000    -.6395248   -.4342158
-------------+----------------------------------------------------------------
       rho31 |  -.4017067   .0621282    -6.47   0.000    -.5160066   -.2733519
-------------+----------------------------------------------------------------
       rho32 |  -.3063368   .0642212    -4.77   0.000    -.4263313   -.1757475
------------------------------------------------------------------------------
Likelihood ratio test of  rho21 = rho31 = rho32 = 0:
             chi2(3) =  243.418   Prob > chi2 = 0.0000

MVprobit is appropriate due to the test that null hypothesis is rejected at 5%
level. Since the correlation amoung the disturbance terms are existed, MVprobit is
more appropriated

. log close
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q1 new.log
  log type:  text
 closed on:  28 May 2021, 13:21:55
------------------------------------------------------------------------------------
------------------------------------------------------
```

Q2)

```
-------------------------------------------------------------------------------------
-------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q2.log
  log type:  text
 opened on:  28 May 2021, 09:41:02
```

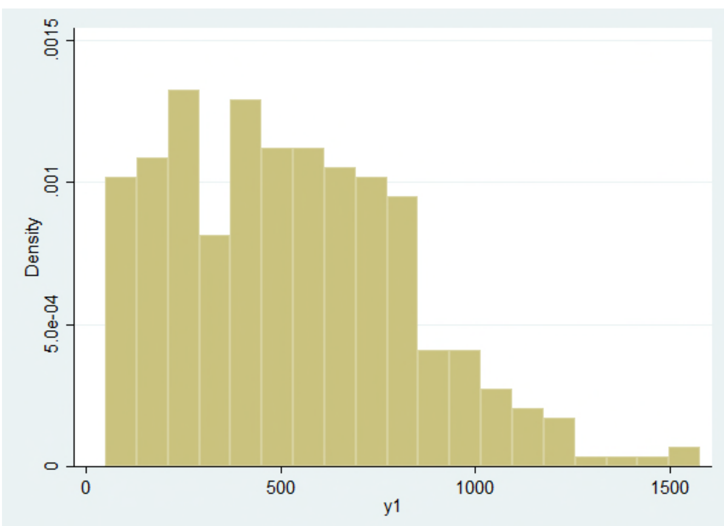
a)

```
. use "C:\Users\User\Desktop\EE 426 stata\final\Final_q2_5.dta", clear

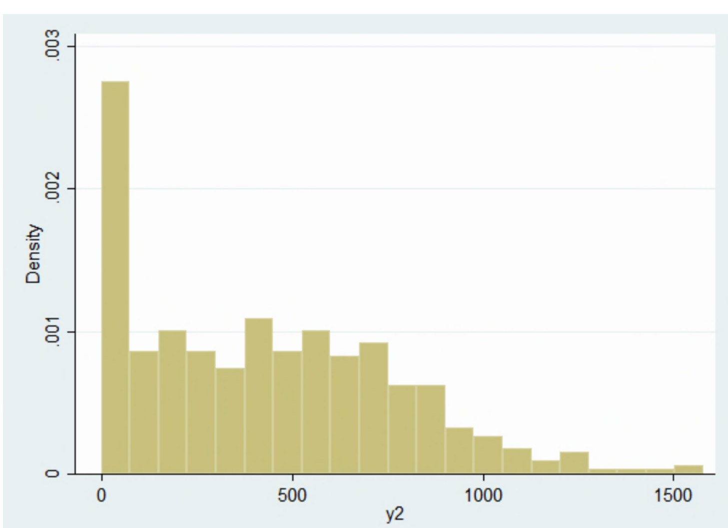
. sum y1 y2 y3

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          y1 |        366    526.8888    302.9263   50.21759    1578.51
          y2 |        450    429.5406    340.6001          0    1578.51
          y3 |        450    3459.331    14741.52  -466.0042   98951.63

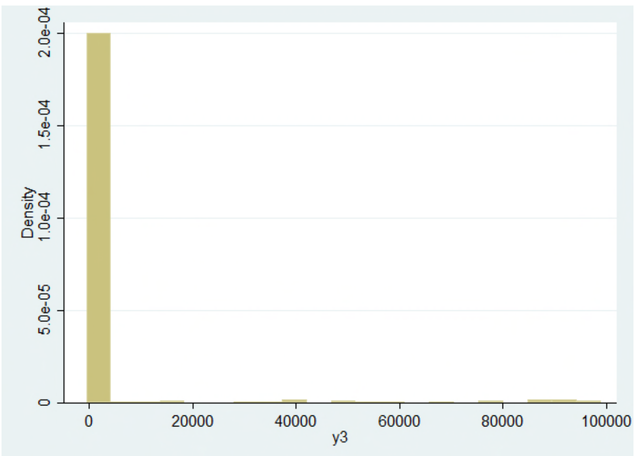
. histogram y1
(bin=19, start=50.217594, width=80.436449)
```

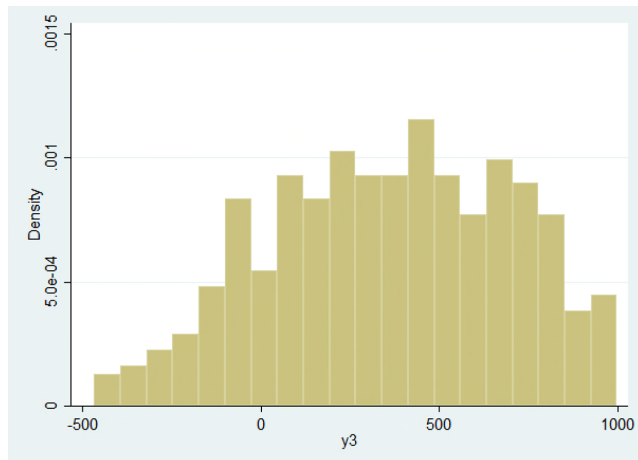



```
. histogram y2
(bin=21, start=0, width=75.167149)
```



```
. histogram y3
(bin=21, start=-466.00415, width=4734.1732)
```






```
. histogram y3 if y3<2000
(bin=20, start=-466.00415, width=73.209753)
```

- According to data summarize and histogram, it might be conclude that y1 has truncated problem at approximately 50, y2 has cencered problem at 0, y3has outlier problem

b)
```
. reg y1 x

      Source |       SS           df       MS      Number of obs   =       366
-------------+----------------------------------   F(1, 364)       =    138.34
       Model |  9223755.7         1   9223755.7   Prob > F        =    0.0000
    Residual |  24270234.4       364  66676.468   R-squared       =    0.2754
-------------+----------------------------------   Adj R-squared   =    0.2734
       Total |  33493990.1       365  91764.3563   Root MSE        =    258.22

------------------------------------------------------------------------------
          y1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   165.8019   14.09684    11.76   0.000     138.0804    193.5234
       _cons |  -6.366052   47.30493    -0.13   0.893    -99.39132    86.65922
------------------------------------------------------------------------------

. est store olsy1
```

```
. sum y1

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          y1 |        366    526.8888    302.9263   50.21759    1578.51

. scalar miny=round(r(min))

. scalar list miny
      miny =         50

. truncreg y1 x, ll(miny) nolog
(note: 0 obs. truncated)

Truncated regression
Limit:   lower =         50                     Number of obs     =        366
         upper =       +inf                     Wald chi2(1)      =     105.05
Log likelihood = -2516.5699                     Prob > chi2       =     0.0000

------------------------------------------------------------------------------
          y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   231.6383   22.60014    10.25   0.000     187.3428    275.9338
       _cons |  -297.2026    86.1017    -3.45   0.001    -465.9588   -128.4463
-------------+----------------------------------------------------------------
      /sigma |   306.6324   16.90108    18.14   0.000     273.5069    339.7579
------------------------------------------------------------------------------

. predict truncated, e(50,.)

. est store ty1

. lrtest olsy1 ty1, force

Likelihood-ratio test                                 LR chi2(1)  =     68.90
(Assumption: olsy1 nested in ty1)                     Prob > chi2 =    0.0000
```

- According to significant LR-test between linear regression model and truncated model, it can be conclude that truncated regression model is more appropriated since null hypothesis of LR test is rejected. The major problem caused by sample is based only on value of y which will make OLS estimator be bias.

c)
```
. reg y2 x

      Source |       SS           df       MS      Number of obs   =       450
-------------+----------------------------------   F(1, 448)       =    264.34
       Model |  19329293.7         1  19329293.7   Prob > F        =    0.0000
    Residual |  32758500.4       448  73121.6526   R-squared       =    0.3711
-------------+----------------------------------   Adj R-squared   =    0.3697
```

```
       Total |    52087794       449   116008.45   Root MSE        =    270.41

------------------------------------------------------------------------------
          y2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   199.6428   12.27916    16.26   0.000     175.5109    223.7747
       _cons |  -169.6945   38.99849    -4.35   0.000    -246.3372   -93.05177
------------------------------------------------------------------------------

. est store olsy2

. sum y2

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          y2 |        450    429.5406    340.6001          0    1578.51

. tobit y2 x, ll(0)

Tobit regression                                Number of obs     =        450
                                                LR chi2(1)        =     219.10
                                                Prob > chi2       =     0.0000
Log likelihood = -2785.1721                     Pseudo R2         =     0.0378

------------------------------------------------------------------------------
          y2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |    237.076   14.69501    16.13   0.000     208.1965    265.9556
       _cons |  -313.2426   47.51378    -6.59   0.000    -406.6196   -219.8656
-------------+----------------------------------------------------------------
      /sigma |   303.3979   11.25655                      281.2759      325.52
------------------------------------------------------------------------------
            68  left-censored observations at y2 <= 0
           382     uncensored observations
             0 right-censored observations

. est store tby2

. lrtest olsy2 tby2, force

Likelihood-ratio test                                 LR chi2(1)  =    744.64
(Assumption: olsy2 nested in tby2)                    Prob > chi2 =    0.0000
```

According to significant LR-test between linear regression model and tobit model, it can be conclude that tobit regression model is more appropriated since null hypothesis of LR test is rejected. The major problem caused by sample is cencored based only on value of y which will make OLS estimator be bias.

D)

```
. reg y3 x
```

```
      Source |       SS           df       MS      Number of obs   =       450
-------------+----------------------------------   F(1, 448)       =     40.27
       Model |  8.0481e+09         1  8.0481e+09   Prob > F        =    0.0000
    Residual |  8.9525e+10       448   199833170   R-squared       =    0.0825
-------------+----------------------------------   Adj R-squared   =    0.0804
       Total |  9.7573e+10       449   217312520   Root MSE        =     14136

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   4073.721   641.9178     6.35   0.000     2812.177    5335.264
       _cons |   -8768.09   2038.725    -4.30   0.000    -12774.74   -4761.438
------------------------------------------------------------------------------

. reg y3 x if y3<1000

      Source |       SS           df       MS      Number of obs   =       426
-------------+----------------------------------   F(1, 424)       =    202.22
       Model |  15508914.9         1  15508914.9   Prob > F        =    0.0000
    Residual |  32517971.8       424  76693.3298   R-squared       =    0.3229
-------------+----------------------------------   Adj R-squared   =    0.3213
       Total |  48026886.7       425  113004.439   Root MSE        =    276.94

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   193.1476   13.58243    14.22   0.000     166.4503    219.8449
       _cons |  -203.3899    41.8601    -4.86   0.000    -285.6691   -121.1108
------------------------------------------------------------------------------

. reg y3 x

      Source |       SS           df       MS      Number of obs   =       450
-------------+----------------------------------   F(1, 448)       =     40.27
       Model |  8.0481e+09         1  8.0481e+09   Prob > F        =    0.0000
    Residual |  8.9525e+10       448   199833170   R-squared       =    0.0825
-------------+----------------------------------   Adj R-squared   =    0.0804
       Total |  9.7573e+10       449   217312520   Root MSE        =     14136

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   4073.721   641.9178     6.35   0.000     2812.177    5335.264
       _cons |   -8768.09   2038.725    -4.30   0.000    -12774.74   -4761.438
------------------------------------------------------------------------------

. est store olsy3

. sum y3
```

```
    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          y3 |        450    3459.331    14741.52  -466.0042   98951.63

. tobit  y3 x, ul(1000) nolog

Tobit regression                                Number of obs     =        450
                                                LR chi2(1)        =     219.81
                                                Prob > chi2       =     0.0000
Log likelihood = -3049.2422                     Pseudo R2         =     0.0348

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   225.3074   13.60203    16.56   0.000     198.5759     252.039
       _cons |  -272.8349   42.84203    -6.37   0.000    -357.0307   -188.6391
-------------+----------------------------------------------------------------
      /sigma |   293.0897   10.14415                      273.1537    313.0256
------------------------------------------------------------------------------
             0  left-censored observations
           426     uncensored observations
            24 right-censored observations at y3 >= 1000

. est store tby3

. lrtest olsy3 tby3, force

Likelihood-ratio test                                 LR chi2(1)  =   3777.40
(Assumption: olsy3 nested in tby3)                    Prob > chi2 =    0.0000


According to significant LR-test between linear regression model and tobit model, it
can be conclude that tobit regression model is more appropriated since null
hypothesis of LR test is rejected. The major problem caused by sample is exist an
outlier which will make OLS estimator be bias.

. log close
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q2.log
  log type:  text
 closed on:  28 May 2021, 09:42:36
-------------------------------------------------------------------------------------
-------------------------------------------------------
```

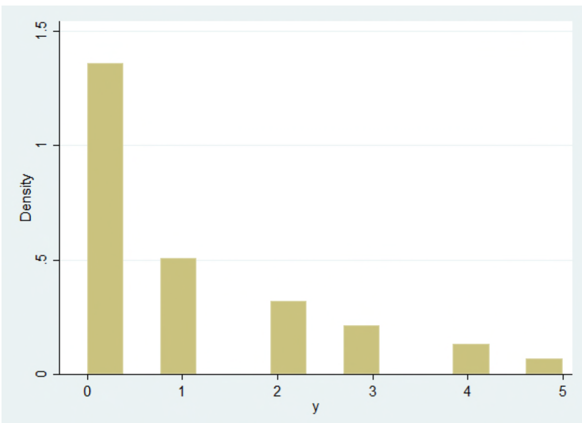
Q3)

```
--------------------------------------------------------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q3.log
  log type:  text
 opened on:  28 May 2021, 09:53:13
```

a)

```
. use "C:\Users\User\Desktop\EE 426 stata\final\Final_q3_5.dta", clear

. histogram y
(bin=13, start=0, width=.38461538)
```



- According to histogram, it exist that the distribution of dependent variable follows Possion distribution which is non-negative and also discrete, thus, Poissin regression model shold be applied.

```
. reg y x1 x2 x3 x4

      Source |       SS           df       MS      Number of obs   =       195
-------------+----------------------------------   F(4, 190)       =      5.68
       Model |  38.4431604         4   9.6107901   Prob > F        =    0.0002
    Residual |  321.474788       190  1.69197257   R-squared       =    0.1068
-------------+----------------------------------   Adj R-squared   =    0.0880
       Total |  359.917949       194  1.85524716   Root MSE        =    1.3008

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .0971247   .0451219     2.15   0.033     .0081205     .186129
          x2 |   .1395925   .0479669     2.91   0.004     .0449765    .2342085
          x3 |   .2021471   .0685933     2.95   0.004      .066845    .3374493
          x4 |  -.0408543   .0488395    -0.84   0.404    -.1371916     .055483
       _cons |   .9619949   .1101297     8.74   0.000     .7447609    1.179229
------------------------------------------------------------------------------
```

```
. est store olsy

. poisson y x1 x2 x3 x4, nolog
```

b)

```
Poisson regression                              Number of obs     =        195
                                                LR chi2(4)        =      38.14
                                                Prob > chi2       =     0.0000
Log likelihood = -276.91085                     Pseudo R2         =     0.0644

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .0938557   .0338186     2.78   0.006     .0275723     .160139
          x2 |   .1362419   .0360021     3.78   0.000     .0656792    .2068047
          x3 |   .2098668   .0540778     3.88   0.000     .1038763    .3158573
          x4 |   -.040898   .0370102    -1.11   0.269    -.1134367    .0316407
       _cons |  -.1317629   .0920147    -1.43   0.152    -.3121084    .0485826
------------------------------------------------------------------------------

. estat gof

         Deviance goodness-of-fit =  317.1627
         Prob > chi2(190)         =    0.0000

         Pearson goodness-of-fit  =  327.5988
         Prob > chi2(190)         =    0.0000
```

- According to GOF test, null hypothesis of the test was rejected, thus, Poisson model is inappropriated.

```
. poisson y x1 x2 x3 x4, ir nolog

Poisson regression                              Number of obs     =        195
                                                LR chi2(4)        =      38.14
                                                Prob > chi2       =     0.0000
Log likelihood = -276.91085                     Pseudo R2         =     0.0644

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.098401   .0371464     2.78   0.006     1.027956    1.173674
          x2 |   1.145959   .0412569     3.78   0.000     1.067884    1.229742
          x3 |   1.233514   .0667057     3.88   0.000     1.109463    1.371435
          x4 |    .959927   .0355271    -1.11   0.269     .8927607    1.032147
       _cons |   .8765488   .0806554    -1.43   0.152     .7319022    1.049782
------------------------------------------------------------------------------
```

```
. est store psy

. mfx

Marginal effects after poisson
      y  = Predicted number of events (predict)
         =  .9256095
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1 |   .0868737      .03082    2.82   0.005   .026468  .147279  -.302817
      x2 |   .1261068      .03236    3.90   0.000   .062684  .189529   .832297
      x3 |   .1942547      .04821    4.03   0.000   .099762  .288747  -.297057
      x4 |  -.0378556      .03416   -1.11   0.268  -.104802  .029091  -.778271
------------------------------------------------------------------------------
```

According to the above estimated result, interpretation can be made concerning: sign and meaning of the estimated coefficient - positive mfx sign and irr>1 for x1, x2, and x3, and negative mfx sign and irr<1 for x4. Overall test LR-Chi-ssquared-test-significant, Pseudo R-squared 0.0644-not quite fit the data, Individual z-test- all significant except x4.

c)

```
. nbreg y x1 x2 x3 x4, nolog

Negative binomial regression                    Number of obs     =        195
                                                LR chi2(4)        =      20.99
Dispersion     = mean                           Prob > chi2       =     0.0003
Log likelihood = -262.50146                     Pseudo R2         =     0.0384

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .123127   .0518823     2.37   0.018     .0214396    .2248144
          x2 |   .1561944   .0516737     3.02   0.003     .0549158    .2574731
          x3 |    .202838   .0698301     2.90   0.004     .0659735    .3397026
          x4 |  -.0418786   .0496397    -0.84   0.399    -.1391705    .0554134
       _cons |  -.1515219    .120795    -1.25   0.210    -.3882757    .0852318
-------------+----------------------------------------------------------------
    /lnalpha |  -.2312574   .2930315                     -.8055886    .3430738
-------------+----------------------------------------------------------------
       alpha |   .7935352   .2325308                      .4468249    1.409273
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) =   28.82 Prob>=chibar2 = 0.000
```

According to LR test of alpha, null hypothesis of the test was rejected indicating that the distribution of dependent variable follows Negative Binomial regression model is more appropriated than Poisson regression model.

```
. nbreg y x1 x2 x3 x4, ir nolog

Negative binomial regression                    Number of obs     =        195
                                                LR chi2(4)        =      20.99
Dispersion     = mean                           Prob > chi2       =     0.0003
Log likelihood = -262.50146                     Pseudo R2         =     0.0384

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.131028   .0586803     2.37   0.018     1.021671     1.25209
          x2 |   1.169054   .0604094     3.02   0.003     1.056452    1.293657
          x3 |   1.224874   .0855331     2.90   0.004     1.068198     1.40453
          x4 |   .9589862   .0476038    -0.84   0.399     .8700796    1.056977
       _cons |    .859399   .1038111    -1.25   0.210     .6782253    1.088969
-------------+----------------------------------------------------------------
    /lnalpha |  -.2312574   .2930315                     -.8055886    .3430738
-------------+----------------------------------------------------------------
       alpha |   .7935352   .2325308                      .4468249    1.409273
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) =   28.82 Prob>=chibar2 = 0.000

. est store nby

. mfx

Marginal effects after nbreg
      y  = Predicted number of events (predict)
         =  .91716472
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1 |   .1129277       .0474    2.38   0.017   .020018  .205837  -.302817
      x2 |    .143256       .04717    3.04   0.002   .050805  .235707   .832297
      x3 |   .1860359       .06371    2.92   0.003   .061174  .310898  -.297057
      x4 |  -.0384096       .04552   -0.84   0.399  -.127622  .050803  -.778271
------------------------------------------------------------------------------
```

-According to the above estimated result, interpretation can be made concerning: sign and meaning of the estimated coefficient - positive mfx sign and irr>1 for x1, x2, and x3, and negative mfx sign and irr<1 for x4. Overall test LR-Chi-ssquared-test-significant, Pseudo R-squared 0.0384-not quite fit the data, Individual z-test- all significant except x4.

d)
```
. zip y x1 x2 x3, inflate(x4) vuong nolog
```

```
Zero-inflated Poisson regression                 Number of obs     =        195
                                                 Nonzero obs       =         93
                                                 Zero obs          =        102

Inflation model = logit                          LR chi2(3)        =      15.87
Log likelihood  =  -261.385                      Prob > chi2       =     0.0012

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y            |
          x1 |   .1022734   .0428335     2.39   0.017     .0183214    .1862255
          x2 |   .1240459   .0402747     3.08   0.002      .045109    .2029829
          x3 |    .151463   .0553266     2.74   0.006     .0430249    .2599011
       _cons |   .3327101   .1144229     2.91   0.004     .1084454    .5569748
-------------+----------------------------------------------------------------
inflate      |
          x4 |   .0468225   .1036519     0.45   0.651    -.1563315    .2499765
       _cons |  -.5777237   .2634859    -2.19   0.028    -1.094147   -.0613008
------------------------------------------------------------------------------
Vuong test of zip vs. standard Poisson:            z =     2.52  Pr>z = 0.0058
```

According to Vuong test, null hypothesis of the test was rejected, thus, Zero inflated poisson model is more appropriated than Poisson regression model

```
. mfx

Marginal effects after zip
      y  = Predicted number of events (predict)
         =  .93006399
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1 |   .0951208      .03949    2.41   0.016   .017732   .17251  -.302817
      x2 |   .1153707      .03673    3.14   0.002   .043389  .187353   .832297
      x3 |   .1408703      .05036    2.80   0.005   .042167  .239573  -.297057
      x4 |  -.0152901      .03403   -0.45   0.653  -.081982  .051402  -.778271
------------------------------------------------------------------------------
```

According to the above estimated result, interpretation can be made concerning: sign and meaning of the estimated coefficient - positive mfx sign and irr>1 for x1, x2, and x3, and negative mfx sign and irr<1 for x4. Overall test LR-Chi-ssquared-test-significant, Individual z-test- all significant except x4.

-According to GOF test, null hypothesis of the test was rejected, thus, Poisson regression model is more appropriated than linear regression model
-According to LR test of alpha, null hypothesis of the test was rejected indicating that the distribution of dependent variable follows Negative Binomial regression

model is more appropriated than Poisson regression model.
-According to Vuong test, null hypothesis of the test was rejected, thus, Zero inflated poisson model is more appropriated than Poisson regression model
-Also, histogram illustrate zero inflated distribution of dependent variable, therefore, Zero inflated regression model should be applied in this case

```
. log close
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q3.log
  log type:  text
 closed on:  28 May 2021, 09:53:48
-----------------------------------------------------------------------------------
-------------------------------------------------------
```

Q.4

```
------------------------------------------------------------------------------------
-------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q4.log
  log type:  text
 opened on:  28 May 2021, 12:57:36

. clear

. use "C:\Users\User\Desktop\EE 426 stata\final\Final_q4_5.dta", clear
```

a)

```
. tsset t
        time variable:  t, 1 to 500
                delta:  1 unit

. dfuller y, trend lag(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =       498

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -15.041            -3.980            -3.420            -3.130
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D.y          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |  -.9741483   .0647646   -15.04   0.000    -1.101396   -.8469002
         LD. |  -.0596799   .0449893    -1.33   0.185    -.1480738    .0287141
      _trend |   .0016069   .0021098     0.76   0.447    -.0025384    .0057521
       _cons |    .847649   .6115603     1.39   0.166    -.3539311    2.049229
------------------------------------------------------------------------------

. dfuller x, trend lag(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =       498

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -15.196            -3.980            -3.420            -3.130
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
```

```
D.x          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |
         L1. |  -.9858092   .0648745   -15.20   0.000    -1.113273   -.8583452
         LD. |  -.0507006   .0449955    -1.13   0.260    -.1391069    .0377056
      _trend |   .0025677   .0030127     0.85   0.394    -.0033516     .008487
       _cons |   .4416065   .8696308     0.51   0.612    -1.267025    2.150238
------------------------------------------------------------------------------
```

X~I(0) and Y~I(0), then both are stationary.

The Unit root test is testing of the variable be stationary or nonstationary, which if the data be stationary->OLS still be used but if the data be nonstationary then the OLS eestimator will be biased. Stationary is important to time-series due to the fact than most of the time-series data which is high frequency is a nonstationary which will lead to OLS estimator occur to be biased.

b)

```
. qui arima y, arima(1,0,1) nolog

. est store arima101

. qui arima y, arima(1,0,2) nolog

. est store arima102

. qui arima y, arima(1,0,3) nolog

. est store arima103

. qui arima y, arima(1,0,4) nolog

. est store arima104

. qui arima y, arima(2,0,1) nolog

. est store arima201

. qui arima y, arima(2,0,2) nolog

. est store arima202

. qui arima y, arima(2,0,3) nolog

. est store arima203

. qui arima y, arima(2,0,4) nolog
```

```
. est store arima20

. drop _est_arima20

. est store arima204

. qui arima y, arima(3,0,1) nolog

. est store arima301

. qui arima y, arima(3,0,2) nolog

. est store arima302

. qui arima y, arima(3,0,3) nolog

. est store arima303

. qui arima y, arima(3,0,4) nolog

. est store arima304

. qui arima y, arima(4,0,1) nolog

. est store arima401

. qui arima y, arima(4,0,2) nolog

. est store arima40

. drop _est_arima40

. est store arima402

. qui arima y, arima(4,0,3) nolog

. est store arima403

. qui arima y, arima(4,0,4) nolog

. est store arima404

. est table arima10*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

-----------------------------------------------------------------------------
    Variable |   arima101       arima102       arima103       arima104
-------------+---------------------------------------------------------------
y            |
       _cons |  1.2874023***   1.2902715***    1.288291***   1.2886347***
```

```
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. | -.85541374***    .81345909***   -.85721355***   -.81881647***
             |
          ma |
         L1. |  .81268327***   -.85066462***    .82433636***    .78640022***
         L2. |                  .07159677       .02829955       .02739884
         L3. |                                  .01974742       .05074721
         L4. |                                                  .04792866
-------------+----------------------------------------------------------------
sigma        |
       _cons |     6.7336***    6.7340175***    6.7316818***    6.7247573***
-------------+----------------------------------------------------------------
Statistics   |
           N |        500             500             500             500
          ll | -1663.0396       -1663.057      -1662.8937      -1662.3693
        chi2 |  51.568958       21.559155       51.944637       43.761226
         aic |  3334.0792       3336.1139       3337.7874       3338.7386
         bic |  3350.9376        3357.187        3363.075       3368.2408
------------------------------------------------------------------------------
                                          legend: * p<.1; ** p<.05; *** p<.01

. est table arima20*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

------------------------------------------------------------------------------------
----------
    Variable |   arima201        arima202        arima203        arima20
arima204
-------------+----------------------------------------------------------------------
----------
y            |
       _cons |  1.2902918***    1.2905493***    1.2903492***    1.2906628***
1.2906628***
-------------+----------------------------------------------------------------------
----------
ARMA         |
          ar |
         L1. |    .724438***     .0260208      -.01537063      -.02929012
-.02929012
         L2. |  .07630296       .72460303***    .72266798***    .68437402**
.68437402**
             |
          ma |
         L1. | -.76405932***   -.04781212       -.0199575       -.0051159
-.0051159
         L2. |                -.65697586**     -.6564224**    -.63145367*
-.63145367*
         L3. |                                  .02428282       .02361024
.02361024
```

```
         L4. |                                                  .02339928
.02339928
-------------+--------------------------------------------------------------------
----------
sigma        |
       _cons |  6.7331327***    6.7224701***    6.7209864***    6.7194516***
6.7194516***
-------------+--------------------------------------------------------------------
----------
Statistics   |

           N |        500             500             500             500
 500
          ll | -1662.9972       -1662.217      -1662.1009      -1661.9957
-1661.9957
        chi2 |   18.56475       20.402998       21.511795       20.357788
20.357788
         aic |  3335.9943        3336.434       3338.2018       3339.9915
3339.9915
         bic |  3357.0674       3361.7216        3367.704       3373.7083
3373.7083
----------------------------------------------------------------------------------
----------
                                                            legend: * p<.1; ** p<.05;
*** p<.01

. est table arima30*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

------------------------------------------------------------------------------
    Variable |   arima301        arima302        arima303        arima304
-------------+----------------------------------------------------------------
y            |
       _cons |  1.2881807***    1.2906021***    1.3062418***    1.3062245***
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. | -.84882318***   -.04672649       1.068269***     1.0679434***
         L2. |  .03145816       .72386838***    .64967944**      .6503497*
         L3. |  .02166601       .02497534     -.83388217***    -.8342446***
             |
          ma |
         L1. |  .81759708**       .012316       -1.125611       -1.1255938
         L2. |                 -.65836104**    -.55267624      -.55315898
         L3. |                                  .80446399       .80533897
         L4. |                                                 -.00044313
-------------+----------------------------------------------------------------
sigma        |
       _cons |  6.7317069***    6.7209909***    6.6390975       6.6390876
-------------+----------------------------------------------------------------
Statistics   |
```

```
           N |        500            500            500            500
          ll | -1662.8808     -1662.1086     -1658.0395     -1658.0395
        chi2 |  53.494077      22.105695      51255.011      51321.092
         aic |  3337.7617      3338.2172       3330.079      3332.0789
         bic |  3363.0493      3367.7194      3359.5813      3365.7958
------------------------------------------------------------------------------
                                           legend: * p<.1; ** p<.05; *** p<.01

. est table arima40*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

-----------------------------------------------------------------------------------
----------
    Variable |   arima401        arima40        arima402        arima403
arima404
-------------+---------------------------------------------------------------------
----------
y            |
       _cons |  1.2890523***     1.290403***     1.290403***    1.3062081***
1.2914098***
-------------+---------------------------------------------------------------------
----------
ARMA         |
          ar |
         L1. | -.77921781**    -.06563608      -.06563608       1.0673878***
.07395155
         L2. |  .03192593       .65062881*      .65062881*      .65094806
-.23344034
         L3. |  .05331952       .02604046       .02604046      -.83389345***
-.05226883
         L4. |  .04926943        .0253664        .0253664      -.00045793
.70203058***
             |
          ma |
         L1. |  .74692793**     .03081332       .03081332      -1.1250374
-.11013446
         L2. |                 -.59829892      -.59829892       -.5537899
.31694994
         L3. |                                                  .80504019
.0524378
         L4. |
-.65198176**
-------------+---------------------------------------------------------------------
----------
sigma        |
       _cons |   6.724336***    6.7195655***    6.7195655***    6.6390935
6.6793316***
-------------+---------------------------------------------------------------------
----------
Statistics   |
```

```
           N |        500             500             500             500
 500
          ll | -1662.3498      -1661.9971      -1661.9971      -1658.0395
-1659.2626
        chi2 |  37.266974       19.775625       19.775625       35562.274
1365.0745
         aic |  3338.6996       3339.9943       3339.9943       3332.0789
3338.5252
         bic |  3368.2018       3373.7112       3373.7112       3365.7958
3380.6713
------------------------------------------------------------------------------------
----------
                                                         legend: * p<.1; ** p<.05;
*** p<.01

. qui arima x, arima(1,0,1) nolog

. est store arima101

. qui arima x, arima(1,0,2) nolog

. est store arima102

. qui arima x, arima(1,0,3) nolog

. est store arima103

. qui arima x, arima(1,0,4) nolog

. est store arima104

. qui arima x, arima(2,0,1) nolog

. est store arima201

. qui arima x, arima(2,0,2) nolog

. est store arima202

. qui arima x, arima(2,0,3) nolog

. est store arima203

. qui arima x, arima(2,0,4) nolog

. est store arima204

. qui arima x, arima(3,0,1) nolog

. est store arima301
```

```
. qui arima x, arima(3,0,2) nolog

. est store arima302

. qui arima x, arima(3,0,3) nolog

. est store arima303

. qui arima x, arima(3,0,4) nolog

. est store arima304

. qui arima x, arima(4,0,1) nolog

. est store arima401

. qui arima x, arima(4,0,2) nolog

. est store arima402

. qui arima x, arima(4,0,3) nolog

. est store arima403

. qui arima x, arima(4,0,4) nolog

. est store arima404

. est table arima10*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

------------------------------------------------------------------------------
    Variable |   arima101        arima102        arima103        arima104     
-------------+----------------------------------------------------------------
x            |
       _cons |  1.1040613***    1.1092974**     1.1049174**     1.1060064**   
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. | -.87005301***    .82679948***   -.86901952***    -.8258264***  
             |
          ma |
         L1. |  .82836446***   -.86699209***    .83493892***    .79155671***  
         L2. |                  .07227494        .0178063       .01585736     
         L3. |                                   .0101572       .05004247     
         L4. |                                                  .05978747     
-------------+----------------------------------------------------------------
sigma        |
       _cons |  9.6082122***    9.6106134***    9.6071806***    9.5916364***  
-------------+----------------------------------------------------------------
```

```
Statistics   |
           N |       500          500          500          500
          ll | -1840.7903    -1840.908   -1840.7368    -1839.933
        chi2 |  64.285058     24.42206    63.883066     51.37323
         aic |  3689.5807     3691.816    3693.4737    3693.8659
         bic |  3706.4391    3712.8891    3718.7613    3723.3682
------------------------------------------------------------------------------
                                            legend: * p<.1; ** p<.05; *** p<.01

. est table arima20*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

------------------------------------------------------------------------------------
----------
    Variable |   arima201         arima202         arima203          arima20
arima204
-------------+----------------------------------------------------------------------
----------
x            |
       _cons |  1.1092009**     1.1095437**     1.1086369**
1.109393**
-------------+----------------------------------------------------------------------
----------
ARMA         |
          ar |
         L1. |  .74379709***    .02146868       -.0182115      -.02929012
-.05040519
         L2. |  .07536362       .75489719***    .74841679***    .68437402**
.6873056**
             |
          ma |
         L1. | -.78544691***     -.043393       -.0193752       -.0051159
.01484827
         L2. |                 -.69079951***   -.68527197***   -.63145367*
-.64404225**
         L3. |                                   .0262218       .02361024
.02566103
         L4. |                                                  .02339928
.03406793
-------------+----------------------------------------------------------------------
----------
sigma        |
       _cons |  9.6097788***    9.5933785***    9.5911829***    6.7194516***
9.5868767***
-------------+----------------------------------------------------------------------
----------
y            |
       _cons |                                                  1.2906628***

-------------+----------------------------------------------------------------------
----------
```

```
Statistics   |

           N |       500              500              500              500
 500
          ll | -1840.8739      -1840.0384      -1839.9037      -1661.9957
-1839.6834
        chi2 |  21.660621       24.747731       25.820006       20.357788
23.486668
         aic |  3691.7478       3692.0768       3693.8074       3339.9915
3695.3669
         bic |  3712.8209       3717.3644       3723.3097       3373.7083
3729.0837
--------------------------------------------------------------------------------------
----------
                                                            legend: * p<.1; ** p<.05;
*** p<.01

. est table arima30*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

--------------------------------------------------------------------------------
    Variable |   arima301        arima302        arima303        arima304
-------------+------------------------------------------------------------------
x            |
       _cons |  1.1049615**     1.1086172**     1.1358592**     1.1103101**
-------------+------------------------------------------------------------------
ARMA         |
          ar |
         L1. | -1.0289664***   -.04878782       1.0489249***   -1.0742471***
         L2. |  .01500504       .75016102***    .68178142**     .65221954
         L3. |  .04738783       .02609321      -.84769673***    .80012959***
             |
          ma |
         L1. |  .99318116***    .01254514      -1.1067196       1.0432097***
         L2. |                 -.68774664***   -.58781396      -.64252531
         L3. |                                  .82287465      -.71653656***
         L4. |                                                  .05861813
-------------+------------------------------------------------------------------
sigma        |
       _cons |  9.6156135***     9.591522***    9.4729783       9.560988***
-------------+------------------------------------------------------------------
Statistics   |
           N |       500              500              500              500
          ll | -1841.2093      -1839.9157      -1835.8015      -1838.4431
        chi2 |  5013.9263       26.636776       50650.503       6513.9672
         aic |  3694.4185       3693.8314        3687.603       3694.8862
         bic |  3719.7062       3723.3337       3721.3199       3732.8177
--------------------------------------------------------------------------------
                                            legend: * p<.1; ** p<.05; *** p<.01

. est table arima40*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)
```

Variable	arima401	arima40	arima402	arima403	arima404
x					
_cons	1.1064112**		1.1090475**	1.1103938**	1.1106289**
ARMA					
ar					
L1.	-.78220586***	-.06563608	-.09411863	-1.140674***	.06492152
L2.	.02151636	.65062881*	.63427661*	.58724403	-.21230686
L3.	.05157706	.02604046	.02931802	.85591686***	-.05105028
L4.	.06001502	.0253664	.03802218	.05913088	.72759243***
ma					
L1.	.74835919***	.03081332	.05738537	1.1102674***	-.1029541
L2.		-.59829892	-.59230655*	-.576632	.28993601
L3.				-.77067192***	.05257197
L4.					-.6763714***
sigma					
_cons	9.5918253***	6.7195655***	9.5866556***	9.561108***	9.5314973***
y					
_cons		1.290403***			
Statistics					
N	500	500	500	500	500
ll	-1839.9462	-1661.9971	-1839.673	-1838.4544	-1837.0396

```
        chi2 |  41.898238       19.775625        22.40566       7594.7861
1205.5824
         aic |  3693.8924       3339.9943       3695.3459       3694.9087
3694.0792
         bic |  3723.3946       3373.7112       3729.0628       3732.8402
3736.2253
------------------------------------------------------------------------------------
----------
                                                           legend: * p<.1; ** p<.05;
*** p<.01
```

- The most appropriated order for y is ARIMA(1,0,1)
- The most appropriated order for x is ARIMA(1,0,1)

```
. arima y, arima(1,0,1) nolog

ARIMA regression

Sample:  1 - 500                                Number of obs     =        500
                                                Wald chi2(2)      =      51.57
Log likelihood =  -1663.04                      Prob > chi2       =     0.0000

------------------------------------------------------------------------------
             |                 OPG
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y            |
       _cons |   1.287402   .2962245     4.35   0.000      .706813    1.867992
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. |  -.8554137   .1656713    -5.16   0.000    -1.180124    -.530704
             |
          ma |
         L1. |   .8126833   .1871691     4.34   0.000     .4458385    1.179528
-------------+----------------------------------------------------------------
      /sigma |     6.7336   .2153008    31.28   0.000     6.311618    7.155582
------------------------------------------------------------------------------
Note: The test of the variance against zero is one sided, and the two-sided
      confidence interval is truncated at zero.

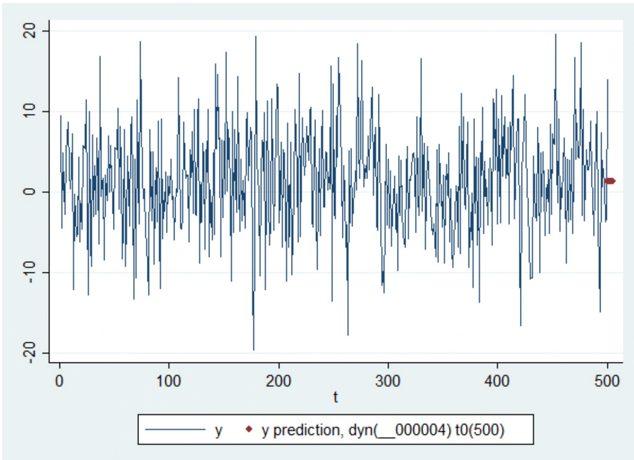
. set obs 505
number of observations (_N) was 500, now 505

. replace t=_n
(5 real changes made)

. predict yhat, y dynamic(.) t0(500)
Note: beginning dynamic predictions in period         3.
```

```
(499 missing values generated)

. twoway (line y t, sort) (scatter yhat t, sort)
```




```
. arima x, arima(2,0,1) nolog

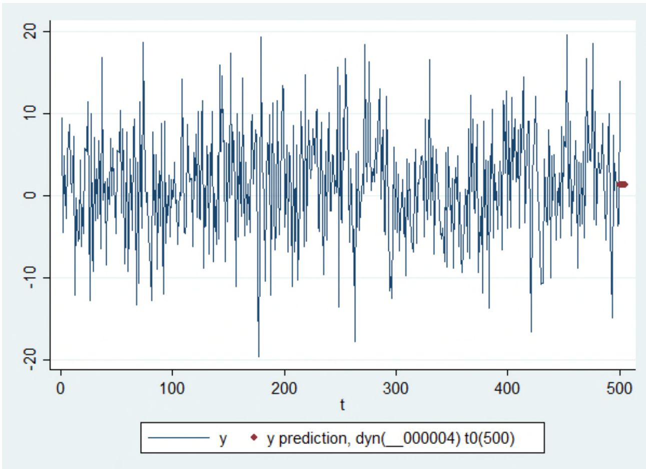
ARIMA regression

Sample:  1 - 500                                Number of obs     =        500
                                                Wald chi2(3)      =      21.66
Log likelihood = -1840.874                      Prob > chi2       =     0.0001

------------------------------------------------------------------------------
             |                 OPG
           x |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
x            |
       _cons |   1.109201   .5194125     2.14   0.033     .0911711    2.127231
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. |   .7437971   .2391062     3.11   0.002     .2751575    1.212437
         L2. |   .0753636   .0483268     1.56   0.119    -.0193552    .1700824
             |
          ma |
         L1. |  -.7854469   .2322608    -3.38   0.001     -1.24067   -.3302241
-------------+----------------------------------------------------------------
      /sigma |   9.609779   .3114793    30.85   0.000     8.999291    10.22027
------------------------------------------------------------------------------
Note: The test of the variance against zero is one sided, and the two-sided
      confidence interval is truncated at zero.

. predict yhat2, y dynamic(.) t0(500)
Note: beginning dynamic predictions in period          4.
(499 missing values generated)
```

```
. twoway (line y t, sort) (scatter yhat2 t, sort)
```



c)

```
. reg y x

      Source |       SS           df       MS      Number of obs   =       500
-------------+----------------------------------   F(1, 498)       =  57437.76
       Model |  22628.5048         1  22628.5048   Prob > F        =    0.0000
    Residual |  196.194895       498  .393965654   R-squared       =    0.9914
-------------+----------------------------------   Adj R-squared   =    0.9914
       Total |  22824.6997       499  45.7408811   Root MSE        =    .62767

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   .6976878   .0029111   239.66   0.000     .6919682    .7034074
       _cons |   .5171209   .0282542    18.30   0.000     .4616089     .572633
------------------------------------------------------------------------------
```

- There exist signifficant ARCH effect since p-value of the ARCHLM-test is less than 0.05. reject the null hypothesis that all of alpha are equal to zero

- This test is classified as LM test because it computed bases on Restricted Model.

```
. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
---------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+-------------------------------------------------------------
       1     |         38.396               1                   0.0000
---------------------------------------------------------------------------
```

```
         H0: no ARCH effects      vs.  H1: ARCH(p) disturbance

. qui arch y, arch(1) garch(1) nolog
flat log likelihood encountered, cannot find uphill direction
r(430);
```

D)

```
. est store  garch11

. qui arch y, arch(1) garch(2) nolog

. est store  garch12

. qui arch y, arch(2) garch(1) nolog

. est store garch21

. qui arch y, arch(2) garch(2) nolog

. est store garch22

. est table garch1*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

----------------------------------------------
    Variable |    garch11         garch12     
-------------+--------------------------------
_            |
    __000003 |
         L1. | -.05379312                     
             |
    __000004 |
         L1. |  .05193467                     
             |
       _cons |  48.435566***                  
-------------+--------------------------------
y            |
       _cons |                  1.4270204***  
-------------+--------------------------------
ARCH         |
        arch |
         L1. |                  .07423885     
             |
       garch |
         L2. |                 -.74120852***  
             |
       _cons |                  76.766592***  
-------------+--------------------------------
Statistics   |
           N |        468             500     
          ll | -2614.3017      -1663.7738     
        chi2 |                          .     
```

```
         aic |  5234.6033       3335.5475
         bic |  5247.0487        3352.406
----------------------------------------------
           legend: * p<.1; ** p<.05; *** p<.01

. est table garch2*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)

----------------------------------------------
    Variable |    garch21         garch22
-------------+--------------------------------
y            |
       _cons |  1.3292787***     1.319949***
-------------+--------------------------------
ARCH         |
        arch |
         L2. |  .05985661       .02556616
             |
       garch |
         L1. | -.70844353***
         L2. |                 -.78691701
             |
       _cons |   75.55465***    80.543337***
-------------+--------------------------------
Statistics   |
           N |        500             500
          ll | -1663.5768      -1664.3588
        chi2 |          .               .
         aic |  3335.1537       3336.7176
         bic |  3352.0121        3353.576
----------------------------------------------
           legend: * p<.1; ** p<.05; *** p<.01

. arch y x, garch(1/2) arch(1/1) nolog

ARCH family regression

Sample: 1 - 500                                 Number of obs    =        500
Distribution: Gaussian                          Wald chi2(1)     =   72465.95
Log likelihood =   -444.17                      Prob > chi2      =     0.0000

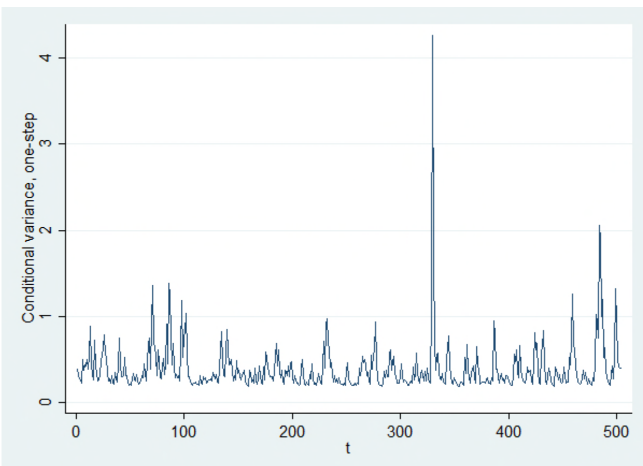
------------------------------------------------------------------------------
             |                 OPG
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y            |
           x |   .6978291   .0025923   269.20   0.000     .6927483    .7029099
       _cons |   .5176582   .0240609    21.51   0.000     .4704996    .5648168
-------------+----------------------------------------------------------------
ARCH         |
        arch |
```

```
         L1. |   .3559144    .073965     4.81   0.000     .2109457    .5008832
             |
       garch |
         L1. |   .3338345   .1730189     1.93   0.054    -.0052763    .6729453
         L2. |  -.0130087   .1374166    -0.09   0.925    -.2823403    .2563229
             |
       _cons |   .1290925   .0382959     3.37   0.001     .0540339    .2041511
------------------------------------------------------------------------------
```

-According to BIC, the most appropriated lags order in this case is GARCH(1,1)

```
. predict sigmahat, v

. line sigmahat t
```



e)- Among three models, the most appropriated in this case is GARCH. GARCH is extended from ARCH and GARCH is an asymmetric GARCH model, we react to shock asymmetrically

```
. log close
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q4.log
  log type:  text
 closed on:  28 May 2021, 13:01:40
--------------------------------------------------------------------------------
---------------------------------------------------
```

Q5

```
------------------------------------------------------------------------------------
-------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\User\Desktop\EE 426 stata\final\q5.log
  log type:  text
 opened on:  28 May 2021, 12:18:52
```

a)

```
. use "C:\Users\User\Desktop\EE 426 stata\final\Final_q5_5.dta", clear

. tsset t
        time variable:  t, 1 to 500
                delta:  1 unit

. varsoc y x, maxlag(5)

   Selection-order criteria
   Sample:  6 - 500                             Number of obs      =       495
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -1363.76                      .854259   5.51823    5.5249   5.53522  |
  |  1 | -1316.78  93.956*   4  0.000  .718084*  5.34458*  5.36459*  5.39555* |
  |  2 | -1315.99  1.5951    4  0.810  .727436   5.35752   5.39087   5.44246  |
  |  3 | -1314.88  2.2106    4  0.697  .735996   5.36922    5.4159   5.48814  |
  |  4 | -1312.72  4.3202    4  0.364  .741491   5.37665   5.43667   5.52955  |
  |  5 | -1311.04  3.3601    4  0.499  .748479   5.38603   5.45939    5.5729  |
  +---------------------------------------------------------------------------+
   Endogenous:  y x
    Exogenous:  _cons
```

-According to SBIC, the most appropriated lag order is 1.

b)

```
. var y x, lag(1/1)

Vector autoregression

Sample:  2 - 500                               Number of obs     =       499
Log likelihood =  -1329.027                    AIC               =  5.350808
FPE            =   .7225668                    HQIC              =  5.370686
Det(Sigma_ml)  =   .7053975                    SBIC              =  5.401461

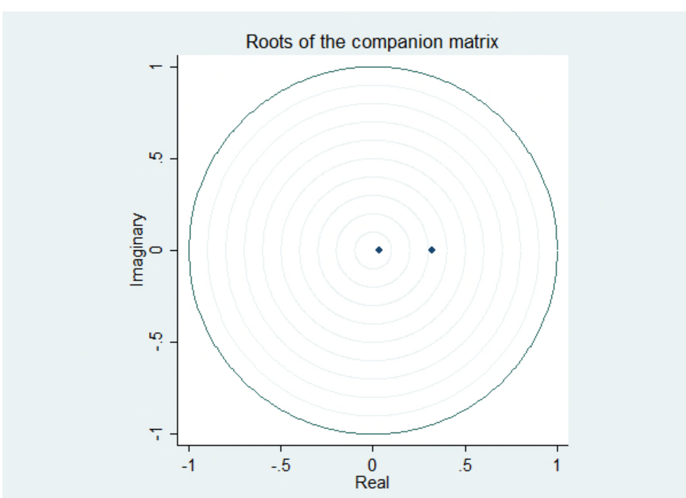
Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
y                     3     .994264   0.0150   7.596793   0.0224
x                     3     .997069   0.0903   49.51793   0.0000
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
y            |
           y |
         L1. |   .1378007   .0500738     2.75   0.006     .0396579    .2359436
             |
           x |
         L1. |   .0541608    .047949     1.13   0.259    -.0398175     .148139
             |
       _cons |   .3370899   .0544641     6.19   0.000     .2303423    .4438375
-------------+----------------------------------------------------------------
x            |
           y |
         L1. |   .3456722   .0502151     6.88   0.000     .2472524    .4440919
             |
           x |
         L1. |   .2145758   .0480842     4.46   0.000     .1203324    .3088191
             |
       _cons |    .121222   .0546177     2.22   0.026     .0141732    .2282708
------------------------------------------------------------------------------

. varstable, graph

   Eigenvalue stability condition
  +----------------------------------------+
  |          Eigenvalue           |  Modulus   |
  |-------------------------------+------------|
  |    .3182991                   |  .318299   |
  |   .03407743                   |  .034077   |
  +----------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```




```
. vargranger
```

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
y	x	1.2759	1	0.259
y	ALL	1.2759	1	0.259
x	y	47.387	1	0.000
x	ALL	47.387	1	0.000

- According to stability test, the system is stable since all the eigenvalue lie inside the inside the unit circle.
- According to Granger exogeneity, x is endogenous since the test is significant, while y is not endonous.
- If the stability assumption is unsatisfied, the IRF won't get back to the equilibrium.

c)

```
. irf create order1, order(y x) step(5) set(irf0001)
(file irf0001.irf now active)

. irf table irf, impulse(y x) response(y x)
```

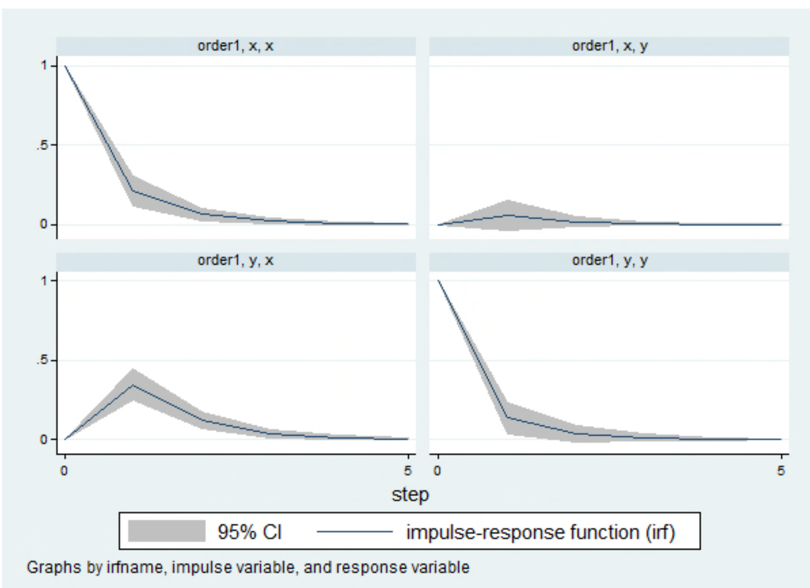
Results from order1

step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper	(3) irf	(3) Lower	(3) Upper
0	1	1	1	0	0	0	0	0	0
1	.137801	.039658	.235944	.345672	.247252	.444092	.054161	-.039817	.148139
2	.037711	-.011172	.086594	.121807	.069923	.17369	.019085	-.014427	.052597
3	.011794	-.008374	.031961	.039172	.01379	.064555	.006138	-.006354	.01863
4	.003747	-.003966	.01146	.012482	.000721	.024244	.001956	-.002677	.006588
5	.001192	-.001672	.004056	.003974	-.001075	.009022	.000623	-.001067	.002312

```
+-------------------------------------------------------------------------------------
---------------------------------+

+-------------------------------------------------+
|          |    (4)          (4)          (4)     |
|  step    |   irf          Lower        Upper    |
|--------+-----------------------------------------|
|0        | 1            1            1           |
|1        | .214576      .120332      .308819     |
|2        | .064765      .026552      .102977     |
|3        | .020494      .002146      .038842     |
|4        | .006519      -.001494     .014533     |
|5        | .002075      -.001191     .005341     |
+-------------------------------------------------+
95% lower and upper bounds reported
(1) irfname = order1, impulse = y, and response = y
(2) irfname = order1, impulse = y, and response = x
(3) irfname = order1, impulse = x, and response = y
(4) irfname = order1, impulse = x, and response = x

. irf graph irf, impulse(y x) response(y x)
```




```
. irf table oirf, impulse(y x) response(y x)

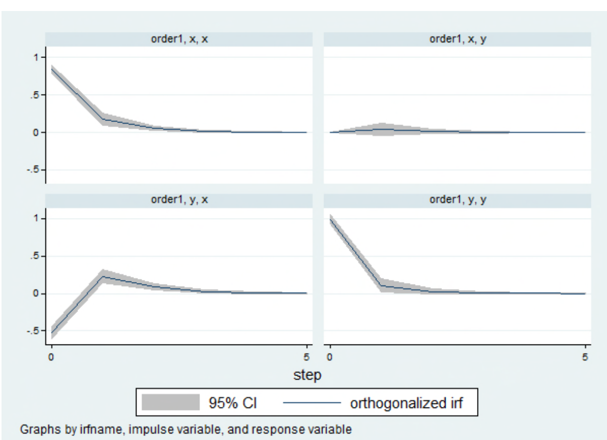
                                                            Results from order1

+-------------------------------------------------------------------------------------
---------------------------------+
|          |    (1)          (1)          (1)     |    (2)          (2)          (2)     |
 (3)          (3)          (3)     |
|  step    |   oirf         Lower        Upper    |   oirf         Lower        Upper    |
oirf         Lower        Upper    |
|--------+-----------------------------------------+-----------------------------------+--
```

```
---------------------------------|
|0       | .991271     .929771     1.05277    | -.519899     -.600935     -.438863   | 0
         0           0          |
|1       | .10844      .021604     .195276    | .231097      .141759      .320435    |
.045889     -.033787     .125565    |
|2       | .027459     -.005139    .060058    | .087072      .047559      .126585    |
.01617      -.012241     .044582    |
|3       | .0085       -.005228    .022228    | .028176      .010461      .04589     |
.0052       -.005389     .015789    |
|4       | .002697     -.002595    .007989    | .008984      .001055      .016913    |
.001657     -.002269     .005584    |
|5       | .000858     -.001116    .002833    | .00286       -.000543     .006263    |
.000528     -.000905     .00196     |
+-------------------------------------------------------------------------------------
---------------------------------+

+----------------------------------------------+
|        |    (4)          (4)          (4)     |
|  step  |   oirf        Lower        Upper    |
|--------+-------------------------------------|
|0       | .847275     .794709     .899842     |
|1       | .181805     .101162     .262448     |
|2       | .054873     .022318     .087429     |
|3       | .017364     .001781     .032947     |
|4       | .005524     -.001275    .012322     |
|5       | .001758     -.001011    .004527     |
+----------------------------------------------+
95% lower and upper bounds reported
(1) irfname = order1, impulse = y, and response = y
(2) irfname = order1, impulse = y, and response = x
(3) irfname = order1, impulse = x, and response = y
(4) irfname = order1, impulse = x, and response = x

. irf graph oirf, impulse(y x) response(y x)
```




```
. irf table coirf, impulse(y x) response(y x)
```

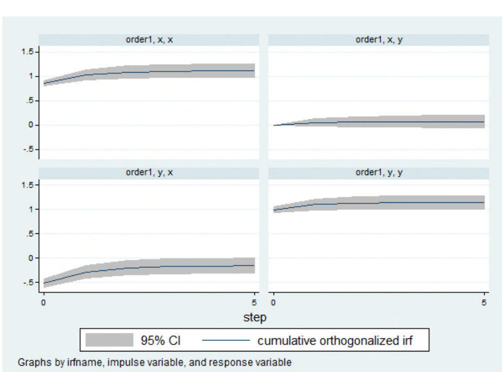
Results from order1

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper	(3) coirf	(3) Lower	(3) Upper
0	.991271	.929771	1.05277	-.519899	-.600935	-.438863	0	0	0
1	1.09971	.989482	1.20994	-.288801	-.415272	-.162331	.045889	-.033787	.125565
2	1.12717	.99869	1.25565	-.201729	-.343749	-.059709	.062059	-.04564	.169759
3	1.13567	.999461	1.27188	-.173553	-.323005	-.024102	.06726	-.050787	.185306
4	1.13837	.999125	1.27761	-.164569	-.317153	-.011986	.068917	-.052936	.190769
5	1.13923	.998861	1.27959	-.161709	-.315521	-.007898	.069444	-.053785	.192674

step	(4) coirf	(4) Lower	(4) Upper
0	.847275	.794709	.899842
1	1.02908	.926844	1.13132
2	1.08395	.959646	1.20826
3	1.10132	.967671	1.23496
4	1.10684	.969381	1.2443
5	1.1086	.96967	1.24753

```
95% lower and upper bounds reported
(1) irfname = order1, impulse = y, and response = y
(2) irfname = order1, impulse = y, and response = x
(3) irfname = order1, impulse = x, and response = y
(4) irfname = order1, impulse = x, and response = x

. irf graph coirf, impulse(y x) response(y x)
```



- According to IRF analysis, y has moore impact on x.

d) . irf table fevd, impulse(y x) response(y x)

Results from order1

step	(1) fevd	(1) Lower	(1) Upper	(2) fevd	(2) Lower	(2) Upper	(3) fevd	(3) Lower	(3) Upper
0	0	0	0	0	0	0	0	0	0
1	1	1	1	.27353	.206858	.340203	0	0	0
2	.997887	.990557	1.00522	.301221	.236432	.366009	.002113	-.005216	.009443
3	.997627	.989406	1.00585	.305267	.24105	.369483	.002373	-.005847	.010594
4	.9976	.989274	1.00593	.30569	.24154	.369839	.0024	-.005926	.010726
5	.997597	.989259	1.00594	.305733	.24159	.369875	.002403	-.005935	.010741

step	(4) fevd	(4) Lower	(4) Upper
0	0	0	0
1	.72647	.659797	.793142
2	.698779	.633991	.763568
3	.694733	.630517	.75895
4	.69431	.630161	.75846
5	.694267	.630125	.75841

95% lower and upper bounds reported
(1) irfname = order1, impulse = y, and response = y
(2) irfname = order1, impulse = y, and response = x
(3) irfname = order1, impulse = x, and response = y

```
(4) irfname = order1, impulse = x, and response = x

According to forecast error variance decomposition, y has more impact on x

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```

e) Yes, because the change in order will reflect in the change in matrix.