```
  1 . do "/Users/imisiaiyetan/Documents/My Econometrics Assignment 3.do"

  2 .
  3 .  *  Name: Imisi Raphael Aiyetan
  4 .  * Course: Econometrics 512
  5 .  * Topic:Impact of capital accumulation and Human capital on Economic Growth
  6 .
  7 .
  8 .  * Let's load the data from download folder
  9 . clear

 10 . set more off

 11 . webuse auto
    (1978 Automobile Data)

 12 .
 13 . use "/Users/imisiaiyetan/Downloads/Table2_1.dta"
    (Production data for the USA, 2005)

 14 .
 15 . * Problem 1a: Run the multiple regression
 16 .
 17 . reg lnoutput lnlabor lncapital

      Source |       SS       df       MS              Number of obs =      51
-------------+------------------------------           F(  2,    48) =  645.93
       Model |  91.9246133     2  45.9623067           Prob > F      =  0.0000
    Residual |  3.41551772    48  .071156619           R-squared     =  0.9642
-------------+------------------------------           Adj R-squared =  0.9627
       Total |   95.340131    50  1.90680262           Root MSE      =  .26675

------------------------------------------------------------------------------
    lnoutput |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnlabor |   .4683318   .0989259     4.73   0.000      .269428    .6672357
   lncapital |   .5212795    .096887     5.38   0.000      .326475    .7160839
       _cons |   3.887599   .3962281     9.81   0.000     3.090929    4.684269
------------------------------------------------------------------------------

 18 .
 19 . * problem 1b: Regress lnoutput on lncapital to predict the first residual.
 20 . *Similarly, regress  lnlabour on lncapital to predict the second residual
 21 .
 22 . reg lnoutput lncapital

      Source |       SS       df       MS              Number of obs =      51
-------------+------------------------------           F(  1,    49) =  883.41
       Model |  90.3298259     1  90.3298259           Prob > F      =  0.0000
    Residual |   5.0103051    49  .102251124           R-squared     =  0.9474
-------------+------------------------------           Adj R-squared =  0.9464
       Total |   95.340131    50  1.90680262           Root MSE      =  .31977

------------------------------------------------------------------------------
    lnoutput |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lncapital |   .9617962   .0323595    29.72   0.000     .8967674    1.026825
```

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       _cons |   3.391633    .458073     7.40   0.000     2.471101    4.312165
------------------------------------------------------------------------------

23 . predict e1, residuals

24 . 
25 . reg  lnlabor lncapital

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =    582.21
       Model |  86.3937937         1  86.3937937   Prob > F        =    0.0000
    Residual |  7.27102154        49  .148388195   R-squared       =    0.9224
-------------+----------------------------------   Adj R-squared   =    0.9208
       Total |  93.6648153        50  1.87329631   Root MSE        =    .38521

------------------------------------------------------------------------------
     lnlabor |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lncapital |   .9406082   .0389823    24.13   0.000     .8622704    1.018946
       _cons |  -1.059006   .5518237    -1.92   0.061    -2.167937    .0499254
------------------------------------------------------------------------------

26 . predict e2, residuals

27 . 
28 . reg e1 e2

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =     22.88
       Model |  1.59478739         1  1.59478739   Prob > F        =    0.0000
    Residual |  3.41551769        49  .069704443   R-squared       =    0.3183
-------------+----------------------------------   Adj R-squared   =    0.3044
       Total |  5.01030508        50  .100206102   Root MSE        =    .26402

------------------------------------------------------------------------------
          e1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          e2 |   .4683318   .0979112     4.78   0.000     .2715719    .6650918
       _cons |  -9.90e-10   .0369696    -0.00   1.000    -.0742933    .0742933
------------------------------------------------------------------------------

29 . 
30 . 
31 . * problem 1c: The next procedure is to regress lnoutput on the second residual
> 
32 . 
33 . reg lnoutput e2

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =      0.83
       Model |  1.59478745         1  1.59478745   Prob > F        =    0.3657
    Residual |  93.7453436        49  1.91317028   R-squared       =    0.0167
-------------+----------------------------------   Adj R-squared   =   -0.0033
       Total |   95.340131        50  1.90680262   Root MSE        =    1.3832

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

e2	.4683318	.5129548	0.91	0.366	-.5624894	1.499153
_cons	16.94139	.1936831	87.47	0.000	16.55217	17.33061

```
.
.
.
. * problem 2: IV regression
.
.
. * problem 2a: Instrumental Variable regression. lnoutlab is used as an
. *instrument in this regression. In that case, we replace lncapital with
. *lnoutlab and lnoutput is regressed on lnlabor lnoutlab
.
. ivregress gmm lnoutput lnlabor (lncapital = lnoutlab)
```

Instrumental variables (GMM) regression

GMM weight matrix: Robust

Number of obs =	51
Wald chi2(2) =	335.04
Prob > chi2 =	0.0000
R-squared =	0.9048
Root MSE =	.42193

lnoutput	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
lncapital	1.385655	.4317705	3.21	0.001	.5394005	2.23191
lnlabor	-.3792855	.4425238	-0.86	0.391	-1.246616	.4880453
_cons	2.044667	1.018963	2.01	0.045	.0475363	4.041798

Instrumented: lncapital
Instruments: lnlabor lnoutlab

```
.
.
. reg lnoutput lnlabor lnoutlab
```

Source	SS	df	MS
Model	95.340131	2	47.6700655
Residual	2.0810e-11	48	4.3354e-13
Total	95.340131	50	1.90680262

Number of obs =	51
F(2, 48) =	.
Prob > F =	0.0000
R-squared =	1.0000
Adj R-squared =	1.0000
Root MSE =	6.6e-07

lnoutput	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnlabor	1	6.83e-08	1.5e+07	0.000	.9999999	1
lnoutlab	1	2.81e-07	3.6e+06	0.000	.9999996	1.000001
_cons	-6.02e-07	1.64e-06	-0.37	0.715	-3.89e-06	2.69e-06

```
.
. * problem 2b: To perform two stage least squares, predict lncapital_hat
. *and thereafter regress lnoutput on lnlabour and lncapital_hat
.
. predict lncapital_hat
(option xb assumed; fitted values)
```

```
53 .
54 . reg lnoutput lnlabor lncapital_hat

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(2, 48)        =         .
       Model |   95.340131         2  47.6700655   Prob > F        =    0.0000
    Residual |  4.0460e-11        48  8.4292e-13   R-squared       =    1.0000
-------------+----------------------------------   Adj R-squared   =    1.0000
       Total |   95.340131        50  1.90680262   Root MSE        =   9.2e-07

-------------------------------------------------------------------------------
     lnoutput |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+----------------------------------------------------------------
      lnlabor |   2.09e-07   3.96e-07     0.53   0.600    -5.87e-07    1.01e-06
lncapital_hat |   .9999998   3.92e-07  2.5e+06   0.000      .999999    1.000001
        _cons |   1.38e-06   2.28e-06     0.60   0.548    -3.21e-06    5.96e-06
-------------------------------------------------------------------------------

55 .
56 . * problem 2c: Regress lnoutput on lnlabor and lnoutlab and generate the
57 . *first coefficient. Similarly, Regress lncapital on lnlabor and lnoutlab and
58 . *generate the second coefficient
59 .
60 . reg lnoutput lnlabor lnoutlab

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(2, 48)        =         .
       Model |   95.340131         2  47.6700655   Prob > F        =    0.0000
    Residual |  2.0810e-11        48  4.3354e-13   R-squared       =    1.0000
-------------+----------------------------------   Adj R-squared   =    1.0000
       Total |   95.340131        50  1.90680262   Root MSE        =   6.6e-07

------------------------------------------------------------------------------
    lnoutput |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnlabor |          1   6.83e-08  1.5e+07   0.000     .9999999           1
    lnoutlab |          1   2.81e-07  3.6e+06   0.000     .9999996    1.000001
       _cons |  -6.02e-07   1.64e-06    -0.37   0.715    -3.89e-06    2.69e-06
------------------------------------------------------------------------------

61 . mat beta = e(b)

62 . svmat beta, names(matcol)

63 .
64 . reg lncapital lnlabor lnoutlab

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(2, 48)        =    471.62
       Model |  92.9197874         2  46.4598937   Prob > F        =    0.0000
    Residual |  4.72858879        48  .098512266   R-squared       =    0.9516
-------------+----------------------------------   Adj R-squared   =    0.9496
       Total |  97.6483762        50  1.95296752   Root MSE        =    .31387

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

```
     lnlabor |   .9954032   .0325471    30.58   0.000     .9299629    1.060843
    lnoutlab |   .7216804   .1341345     5.38   0.000     .4519849    .9913759
       _cons |  -1.475596   .7796798    -1.89   0.064    -3.043248    .0920548
------------------------------------------------------------------------------

. mat gamma = e(b)

. svmat gamma, names(matcol)

.
. * Take the ratio of the two coefficients derived
.
. scalar alpha_hat1 = betalnoutlab/gammalnoutlab

. display alpha_hat1
1.3856551

.
. * problem 2d: Check using another approach, if we will arrive at the same
. * alpha_hat1. The procedure is as follows
.
. * regress lnoutlab on lnlabor and predict the first residuals
.
. reg lnoutlab lnlabor

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =      0.35
       Model |  .039343945         1  .039343945   Prob > F        =    0.5557
    Residual |  5.47531704        49  .111741164   R-squared       =    0.0071
-------------+----------------------------------   Adj R-squared   =   -0.0131
       Total |  5.51466099        50   .11029322   Root MSE        =    .33428

------------------------------------------------------------------------------
    lnoutlab |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnlabor |  -.0204951   .0345397    -0.59   0.556    -.0899052     .048915
       _cons |   4.999017     .42371    11.80   0.000      4.14754    5.850494
------------------------------------------------------------------------------

. predict e_z, residuals

.
. * regress lnoutput on lnlabor and predict the second residuals
.
. reg lnoutput lnlabor

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =    804.22
       Model |  89.8648125         1  89.8648125   Prob > F        =    0.0000
    Residual |  5.47531855        49  .111741195   R-squared       =    0.9426
-------------+----------------------------------   Adj R-squared   =    0.9414
       Total |   95.340131        50  1.90680262   Root MSE        =    .33428

------------------------------------------------------------------------------
    lnoutput |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnlabor |   .9795049   .0345397    28.36   0.000     .9100948    1.048915
       _cons |   4.999017     .42371    11.80   0.000      4.14754    5.850494
```

```
. predict e_y, residuals

.
. * regress lnoutlab on lnlabor and predict the third residuals
.
. reg lncapital lnlabor

      Source |       SS           df       MS      Number of obs   =        51
-------------+----------------------------------   F(1, 49)        =    582.21
       Model |  90.0681184         1  90.0681184   Prob > F        =    0.0000
    Residual |   7.5802578        49  .154699139   R-squared       =    0.9224
-------------+----------------------------------   Adj R-squared   =    0.9208
       Total |  97.6483762        50  1.95296752   Root MSE        =    .39332

------------------------------------------------------------------------------
   lncapital |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnlabor |   .9806122   .0406402    24.13   0.000     .8989427    1.062282
       _cons |   2.132096   .4985469     4.28   0.000     1.130229    3.133964
------------------------------------------------------------------------------

. predict e_t, residuals

.
. * Estimate the first covariance using the second and the first residuals
.
. corr e_y e_z, covariance
(obs=51)

             |      e_y      e_z
-------------+------------------
         e_y |  .109506
         e_z |  .109506  .109506


. scalar scov1 = r(cov_12)

.
. * Estimate the second covariance using the third and the first residuals
.
. corr e_t e_z, covariance
(obs=51)

             |      e_t      e_z
-------------+------------------
         e_t |  .151605
         e_z |  .079029  .109506


. scalar scov2 = r(cov_12)

.
. * Finally, divide the first covariance by the second covariance.
.
. scalar alpha_hat2 = scov1/scov2
```

```
104 . display alpha_hat2
    1.3856551

105 .
106 .
107 .
    end of do-file

108 .
```