Stata Textbook Examples
Introductory Econometrics: A Modern Approach by Jeffrey M. Wooldridge (1st & 2nd eds.)
Chapter 15 - Instrumental Variables Estimation and Two Stage Least Squares

Example 15.1: Estimating the Return to Education for Married Women

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/MROZ

reg lwage educ

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  1,   426) =   56.93
       Model |  26.3264237     1  26.3264237           Prob > F      =  0.0000
    Residual |  197.001028   426  .462443727           R-squared     =  0.1179
-------------+------------------------------           Adj R-squared =  0.1158
       Total |  223.327451   427  .523015108           Root MSE      =  .68003

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1086487   .0143998     7.55   0.000     .0803451    .1369523
       _cons |  -.1851969   .1852259    -1.00   0.318    -.5492674    .1788735
------------------------------------------------------------------------------

ivreg lwage (educ = fatheduc )
```

educ作为fathedu的工具变量。

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  1,   426) =    2.84
       Model |  20.8673618     1  20.8673618           Prob > F      =  0.0929
    Residual |  202.460089   426  .475258426           R-squared     =  0.0934
-------------+------------------------------           Adj R-squared =  0.0913
       Total |  223.327451   427  .523015108           Root MSE      =  .68939

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0591735   .0351418     1.68   0.093    -.0098994    .1282463
       _cons |   .4411035   .4461018     0.99   0.323    -.4357311    1.317938
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   fatheduc
------------------------------------------------------------------------------
```

Example 15.2: Estimating the Return to Education for Men

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/WAGE2
```

```
ivreg lwage (educ = sibs )

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  1,   933) =   21.59
       Model |  -1.5197389     1  -1.5197389           Prob > F      =  0.0000
    Residual |  167.176033   933  .179181172           R-squared     =       .
-------------+------------------------------           Adj R-squared =       .
       Total |  165.656294   934  .177362199           Root MSE      =   .4233

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1224327   .0263506     4.65   0.000     .0707194    .1741459
       _cons |   5.130026   .3551712    14.44   0.000     4.432999    5.827053
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   sibs
------------------------------------------------------------------------------

reg lwage educ

      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  1,   933) =  100.70
       Model |  16.1377074     1  16.1377074           Prob > F      =  0.0000
    Residual |  149.518587   933   .16025572           R-squared     =  0.0974
-------------+------------------------------           Adj R-squared =  0.0964
       Total |  165.656294   934  .177362199           Root MSE      =  .40032

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0598392   .0059631    10.03   0.000     .0481366    .0715418
       _cons |   5.973062   .0813737    73.40   0.000     5.813366    6.132759
------------------------------------------------------------------------------
```

Example 15.3: Estimating the Effect of Smoking on Birth Weight

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/BWGHT

ivreg lbwght (packs = cigprice ), first

First-stage regressions
-----------------------

      Source |       SS       df       MS              Number of obs =    1388
```

```
-------------+------------------------------           F(  1,  1386) =    0.13
       Model |  .011648626     1  .011648626           Prob > F      =  0.7179
    Residual |  123.684481  1386  .089238442           R-squared     =  0.0001
-------------+------------------------------           Adj R-squared = -0.0006
       Total |  123.696129  1387  .089182501           Root MSE      =  .29873

------------------------------------------------------------------------------
       packs |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    cigprice |   .0002829    .000783     0.36   0.718    -.0012531    .0018188
       _cons |   .0674257   .1025384     0.66   0.511    -.1337215    .2685728
------------------------------------------------------------------------------


Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =    1388
-------------+------------------------------           F(  1,  1386) =    0.12
       Model | -1171.28083     1 -1171.28083           Prob > F      =  0.7312
    Residual |  1221.70115  1386  .881458263           R-squared     =       .
-------------+------------------------------           Adj R-squared =       .
       Total |  50.4203246  1387  .036352073           Root MSE      =  .93886
```

packs即为工具变量。

```
------------------------------------------------------------------------------
      lbwght |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       packs |   2.988674   8.698884     0.34   0.731    -14.07573    20.05307
       _cons |   4.448137   .9081547     4.90   0.000      2.66663    6.229643
------------------------------------------------------------------------------
Instrumented:  packs
Instruments:   cigprice
------------------------------------------------------------------------------
```

Example 15.4: Using College Proximity as an IV for Education

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/CARD

ivreg lwage (educ = nearc4 ) exper expersq black smsa south, first

First-stage regressions
-----------------------
```

educ是工具变量。

```
      Source |       SS       df       MS              Number of obs =    3010
-------------+------------------------------           F(  6,  3003) =  451.87
       Model |  10230.4843     6  1705.08072           Prob > F      =  0.0000
    Residual |  11331.5958  3003  3.77342516           R-squared     =  0.4745
-------------+------------------------------           Adj R-squared =  0.4734
       Total |  21562.0801  3009  7.16586243           Root MSE      =  1.9425
```

```
------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       exper |  -.4100081   .0336939   -12.17   0.000    -.4760735   -.3439427
     expersq |   .0007323   .0016499     0.44   0.657    -.0025029    .0039674
       black |  -1.006138   .0896454   -11.22   0.000    -1.181911   -.8303656
        smsa |   .4038769   .0848872     4.76   0.000     .2374339    .5703199
       south |   -.291464   .0792247    -3.68   0.000    -.4468042   -.1361238
      nearc4 |   .3373208   .0825004     4.09   0.000     .1755577    .4990839
       _cons |   16.65917   .1763889    94.45   0.000     16.31332    17.00503
------------------------------------------------------------------------------


Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =    3010
-------------+------------------------------           F(  6,  3003) =  120.83
       Model |  133.463217     6  22.2438695           Prob > F      =  0.0000
    Residual |  459.178394  3003  .152906558           R-squared     =  0.2252
-------------+------------------------------           Adj R-squared =  0.2237
       Total |  592.641611  3009  .196956335           Root MSE      =  .39103

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1322888   .0492332     2.69   0.007     .0357545     .228823
       exper |    .107498   .0213006     5.05   0.000     .0657327    .1492632
     expersq |  -.0022841   .0003341    -6.84   0.000    -.0029392   -.0016289
       black |   -.130802   .0528723    -2.47   0.013    -.2344716   -.0271324
        smsa |   .1313237   .0301298     4.36   0.000     .0722465    .1904009
       south |  -.1049005   .0230731    -4.55   0.000    -.1501412   -.0596599
       _cons |   3.752783   .8293408     4.53   0.000     2.126649    5.378916
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq black smsa south nearc4
------------------------------------------------------------------------------
```

reg lwage educ exper expersq black smsa south

```
      Source |       SS       df       MS              Number of obs =    3010
-------------+------------------------------           F(  6,  3003) =  204.93
       Model |  172.165615     6  28.6942691           Prob > F      =  0.0000
    Residual |  420.475997  3003  .140018647           R-squared     =  0.2905
-------------+------------------------------           Adj R-squared =  0.2891
       Total |  592.641611  3009  .196956335           Root MSE      =  .37419

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |    .074009   .0035054    21.11   0.000     .0671357    .0808823
```

```
       exper |   .0835958   .0066478    12.57   0.000     .0705612    .0966305
     expersq |  -.0022409   .0003178    -7.05   0.000    -.0028641   -.0016177
       black |  -.1896316   .0176266   -10.76   0.000    -.2241929   -.1550702
        smsa |    .161423   .0155733    10.37   0.000     .1308876    .1919583
       south |  -.1248615   .0151182    -8.26   0.000    -.1545046   -.0952184
       _cons |   4.733664   .0676026    70.02   0.000     4.601112    4.866217
------------------------------------------------------------------------------
```

Example 15.5: Return to Education for Working Women

use http://fmwww.bc.edu/ec-p/data/wooldridge/MROZ

reg educ exper expersq motheduc fatheduc

```
      Source |       SS       df       MS              Number of obs =     753
-------------+------------------------------           F(  4,   748) =   66.52
       Model |  1025.94324     4   256.48581           Prob > F      =  0.0000
    Residual |   2884.0966   748  3.85574412           R-squared     =  0.2624
-------------+------------------------------           Adj R-squared =  0.2584
       Total |  3910.03984   752  5.19952106           Root MSE      =  1.9636

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       exper |    .085378   .0255485     3.34   0.001     .0352228    .1355333
     expersq |  -.0018564   .0008276    -2.24   0.025    -.0034812   -.0002317
    motheduc |   .1856173   .0259869     7.14   0.000     .1346014    .2366331
    fatheduc |   .1845745   .0244979     7.53   0.000     .1364817    .2326674
       _cons |   8.366716   .2667111    31.37   0.000     7.843125    8.890307
------------------------------------------------------------------------------
```

test motheduc fatheduc

```
 ( 1)  motheduc = 0.0
 ( 2)  fatheduc = 0.0

       F(  2,   748) =  124.76
            Prob > F =    0.0000
```

ivreg lwage (educ = motheduc fatheduc) exper expersq

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  3,   424) =    8.14
       Model |  30.3074295     3  10.1024765           Prob > F      =  0.0000
    Residual |  193.020022   424    .4552359           R-squared     =  0.1357
-------------+------------------------------           Adj R-squared =  0.1296
```

```
       Total |  223.327451   427   .523015108           Root MSE      =   .67471

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0613966   .0314367     1.95   0.051    -.0003945    .1231878
       exper |   .0441704   .0134325     3.29   0.001     .0177679    .0705729
     expersq |   -.000899   .0004017    -2.24   0.026    -.0016885   -.0001094
       _cons |   .0481003   .4003281     0.12   0.904    -.7387744     .834975
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq motheduc fatheduc
------------------------------------------------------------------------------
```

Example 15.6: Using Two Test Scores as Indicators of Ability

use http://fmwww.bc.edu/ec-p/data/wooldridge/WAGE2

ivreg lwage educ exper tenure married south urban black (IQ =KWW)

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     935
-------------+------------------------------           F(  8,   926) =   36.96
       Model |  31.4665073     8  3.93331341           Prob > F      =  0.0000
    Residual |  134.189787   926  .144913377           R-squared     =  0.1900
-------------+------------------------------           Adj R-squared =  0.1830
       Total |  165.656294   934  .177362199           Root MSE      =  .38067

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IQ |   .0130473   .0049341     2.64   0.008     .0033641    .0227305
        educ |   .0250321   .0166068     1.51   0.132    -.0075591    .0576234
       exper |     .01442   .0033208     4.34   0.000     .0079029    .0209371
      tenure |   .0104562   .0026012     4.02   0.000     .0053512    .0155612
     married |   .2006904   .0406775     4.93   0.000     .1208596    .2805212
       south |  -.0515532   .0311279    -1.66   0.098    -.1126426    .0095362
       urban |   .1767058   .0282117     6.26   0.000     .1213394    .2320722
       black |  -.0225611   .0739597    -0.31   0.760    -.1677092     .122587
       _cons |   4.592453   .3257807    14.10   0.000     3.953099    5.231807
------------------------------------------------------------------------------
Instrumented:  IQ
Instruments:   educ exper tenure married south urban black KWW
------------------------------------------------------------------------------
```

Example 15.7: Return to Education for Working Women

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/MROZ

reg educ exper expersq motheduc fatheduc if lwage<.
```

小于号后面的点表示0？

```
      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  4,   423) =   28.36
       Model |  471.620998     4   117.90525           Prob > F      =  0.0000
    Residual |  1758.57526   423  4.15738833           R-squared     =  0.2115
-------------+------------------------------           Adj R-squared =  0.2040
       Total |  2230.19626   427  5.22294206           Root MSE      =   2.039

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       exper |   .0452254   .0402507     1.12   0.262    -.0338909    .1243417
     expersq |  -.0010091   .0012033    -0.84   0.402    -.0033744    .0013562
    motheduc |    .157597   .0358941     4.39   0.000      .087044    .2281501
    fatheduc |   .1895484   .0337565     5.62   0.000     .1231971    .2558997
       _cons |    9.10264   .4265614    21.34   0.000     8.264196    9.941084
------------------------------------------------------------------------------

predict double uhat1, res

reg lwage educ exper expersq uhat1

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  4,   423) =   20.50
       Model |  36.2573159     4  9.06432898           Prob > F      =  0.0000
    Residual |  187.070135   423  .442246183           R-squared     =  0.1624
-------------+------------------------------           Adj R-squared =  0.1544
       Total |  223.327451   427  .523015108           Root MSE      =  .66502

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0613966   .0309849     1.98   0.048      .000493    .1223003
       exper |   .0441704   .0132394     3.34   0.001     .0181471    .0701937
     expersq |   -.000899   .0003959    -2.27   0.024    -.0016772   -.0001208
       uhat1 |   .0581666   .0348073     1.67   0.095    -.0102501    .1265834
       _cons |   .0481003   .3945753     0.12   0.903    -.7274721    .8236727
------------------------------------------------------------------------------

reg lwage educ exper expersq

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  3,   424) =   26.29
       Model |  35.0223023     3  11.6741008           Prob > F      =  0.0000
    Residual |  188.305149   424  .444115917           R-squared     =  0.1568
```

```
-------------+------------------------------           Adj R-squared =  0.1509
       Total |  223.327451   427  .523015108           Root MSE      =  .66642

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1074896   .0141465     7.60   0.000     .0796837    .1352956
       exper |   .0415665   .0131752     3.15   0.002     .0156697    .0674633
     expersq |  -.0008112   .0003932    -2.06   0.040    -.0015841   -.0000382
       _cons |  -.5220407   .1986321    -2.63   0.009    -.9124668   -.1316145
------------------------------------------------------------------------------
```

ivreg lwage (educ = motheduc fatheduc) exper expersq

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  3,   424) =    8.14
       Model |  30.3074295     3  10.1024765           Prob > F      =  0.0000
    Residual |  193.020022   424    .4552359           R-squared     =  0.1357
-------------+------------------------------           Adj R-squared =  0.1296
       Total |  223.327451   427  .523015108           Root MSE      =  .67471

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0613966   .0314367     1.95   0.051    -.0003945    .1231878
       exper |   .0441704   .0134325     3.29   0.001     .0177679    .0705729
     expersq |   -.000899   .0004017    -2.24   0.026    -.0016885   -.0001094
       _cons |   .0481003   .4003281     0.12   0.904    -.7387744     .834975
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq motheduc fatheduc
------------------------------------------------------------------------------
```

Example 15.8: Return to Education for Working Women

use http://fmwww.bc.edu/ec-p/data/wooldridge/MROZ

ivreg lwage (educ = motheduc fatheduc) exper expersq

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  3,   424) =    8.14
       Model |  30.3074295     3  10.1024765           Prob > F      =  0.0000
    Residual |  193.020022   424    .4552359           R-squared     =  0.1357
-------------+------------------------------           Adj R-squared =  0.1296
```

```
       Total |  223.327451   427  .523015108           Root MSE      =  .67471

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0613966   .0314367     1.95   0.051    -.0003945    .1231878
       exper |   .0441704   .0134325     3.29   0.001     .0177679    .0705729
     expersq |   -.000899   .0004017    -2.24   0.026    -.0016885   -.0001094
       _cons |   .0481003   .4003281     0.12   0.904    -.7387744     .834975
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq motheduc fatheduc
------------------------------------------------------------------------------
```

ssc install overid, replace

overid

```
Test of overidentifying restrictions:   .378071  Chi-sq( 1)  P-value =  .5386
```

ivreg lwage (educ = motheduc fatheduc huseduc) exper expersq

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =     428
-------------+------------------------------           F(  3,   424) =   11.52
       Model |  33.3927427     3  11.1309142           Prob > F      =  0.0000
    Residual |  189.934709   424  .447959218           R-squared     =  0.1495
-------------+------------------------------           Adj R-squared =  0.1435
       Total |  223.327451   427  .523015108           Root MSE      =   .6693

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0803918    .021774     3.69   0.000     .0375934    .1231901
       exper |   .0430973   .0132649     3.25   0.001     .0170242    .0691704
     expersq |  -.0008628   .0003962    -2.18   0.030    -.0016415   -.0000841
       _cons |  -.1868574   .2853959    -0.65   0.513    -.7478243    .3741096
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq motheduc fatheduc huseduc
------------------------------------------------------------------------------
```

overid

```
Test of overidentifying restrictions:  1.115043  Chi-sq( 2)  P-value =  .5726
```

Example 15.9: Return of Education to Fertility

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/FERTIL1

ivreg kids (educ = meduc feduc) age agesq black east northcen west farm othrural
town smcity y74 y76 y78 y80 y82 y84

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =    1129
-------------+------------------------------           F( 17,  1111) =    7.72
       Model |   395.36632    17  23.2568424           Prob > F      =  0.0000
    Residual |  2690.14298  1111  2.42137082           R-squared     =  0.1281
-------------+------------------------------           Adj R-squared =  0.1148
       Total |   3085.5093  1128  2.73538059           Root MSE      =  1.5561

------------------------------------------------------------------------------
        kids |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |  -.1527395   .0392232    -3.89   0.000    -.2296993   -.0757796
         age |   .5235536   .1390348     3.77   0.000     .2507532     .796354
       agesq |   -.005716   .0015705    -3.64   0.000    -.0087976   -.0026345
       black |   1.072952   .1737155     6.18   0.000      .732105      1.4138
        east |   .2285554   .1338537     1.71   0.088    -.0340792      .49119
    northcen |   .3744188    .122061     3.07   0.002     .1349228    .6139148
        west |   .2076398   .1676568     1.24   0.216    -.1213199    .5365995
        farm |  -.0770015   .1513718    -0.51   0.611    -.3740083    .2200052
    othrural |  -.1952451    .181551    -1.08   0.282    -.5514666    .1609764
        town |     .08181   .1246821     0.66   0.512     -.162829    .3264489
      smcity |   .2124996    .160425     1.32   0.186    -.1022706    .5272698
         y74 |   .2721292    .172944     1.57   0.116    -.0672045    .6114629
         y76 |  -.0945483   .1792324    -0.53   0.598    -.4462205    .2571239
         y78 |  -.0572543   .1825536    -0.31   0.754     -.415443    .3009343
         y80 |   -.053248   .1847175    -0.29   0.773    -.4156825    .3091865
         y82 |  -.4962149   .1765888    -2.81   0.005       -.8427   -.1497298
         y84 |  -.5213604   .1779205    -2.93   0.003    -.8704586   -.1722623
       _cons |  -7.241244   3.136642    -2.31   0.021    -13.39565   -1.086834
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   age agesq black east northcen west farm othrural town smcity y74
               y76 y78 y80 y82 y84 meduc feduc
------------------------------------------------------------------------------

reg kids educ age agesq black east northcen west farm othrural town smcity y74 y76
y78 y80 y82 y84

      Source |       SS       df       MS              Number of obs =    1129
-------------+------------------------------           F( 17,  1111) =    9.72
       Model |  399.610888    17  23.5065228           Prob > F      =  0.0000
    Residual |  2685.89841  1111  2.41755033           R-squared     =  0.1295
-------------+------------------------------           Adj R-squared =  0.1162
       Total |   3085.5093  1128  2.73538059           Root MSE      =  1.5548
```

```
------------------------------------------------------------------------------
        kids |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |  -.1284268   .0183486    -7.00   0.000    -.1644286    -.092425
         age |   .5321346   .1383863     3.85   0.000     .2606065    .8036626
       agesq |   -.005804   .0015643    -3.71   0.000    -.0088733   -.0027347
       black |   1.075658   .1735356     6.20   0.000     .7351631    1.416152
        east |    .217324   .1327878     1.64   0.102    -.0432192    .4778672
    northcen |    .363114   .1208969     3.00   0.003      .125902    .6003261
        west |   .1976032   .1669134     1.18   0.237    -.1298978    .5251041
        farm |  -.0525575     .14719    -0.36   0.721    -.3413592    .2362443
    othrural |  -.1628537    .175442    -0.93   0.353    -.5070887    .1813814
        town |   .0843532    .124531     0.68   0.498    -.1599893    .3286957
      smcity |   .2118791    .160296     1.32   0.187    -.1026379    .5263961
         y74 |   .2681825    .172716     1.55   0.121    -.0707039    .6070689
         y76 |  -.0973795   .1790456    -0.54   0.587     -.448685    .2539261
         y78 |  -.0686665   .1816837    -0.38   0.706    -.4251483    .2878154
         y80 |  -.0713053   .1827707    -0.39   0.697      -.42992    .2873093
         y82 |  -.5224842   .1724361    -3.03   0.003    -.8608214    -.184147
         y84 |  -.5451661   .1745162    -3.12   0.002    -.8875846   -.2027477
       _cons |  -7.742457   3.051767    -2.54   0.011    -13.73033   -1.754579
------------------------------------------------------------------------------
```

reg educ meduc feduc age agesq black east northcen west farm othrural town smcity y74 y76 y78 y80 y82 y84

```
      Source |       SS       df       MS              Number of obs =    1129
-------------+------------------------------           F( 18,  1110) =   24.82
       Model |  2256.26171    18  125.347873           Prob > F      =  0.0000
    Residual |  5606.85432  1110  5.05122011           R-squared     =  0.2869
-------------+------------------------------           Adj R-squared =  0.2754
       Total |  7863.11603  1128  6.97084755           Root MSE      =  2.2475

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       meduc |   .1723015   .0221964     7.76   0.000     .1287499    .2158531
       feduc |   .2074188   .0254604     8.15   0.000     .1574629    .2573747
         age |  -.2243687   .2000013    -1.12   0.262     -.616792    .1680546
       agesq |   .0025664   .0022605     1.14   0.256     -.001869    .0070018
       black |   .3667819   .2522869     1.45   0.146    -.1282311     .861795
        east |   .2488042   .1920135     1.30   0.195    -.1279462    .6255546
    northcen |   .0913945   .1757744     0.52   0.603    -.2534931    .4362821
        west |   .1010676   .2422408     0.42   0.677    -.3742339    .5763691
        farm |  -.3792615   .2143864    -1.77   0.077    -.7999099    .0413869
    othrural |   -.560814   .2551196    -2.20   0.028    -1.061385    -.060243
        town |   .0616337   .1807832     0.34   0.733    -.2930816     .416349
      smcity |   .0806634   .2317387     0.35   0.728    -.3740319    .5353587
         y74 |   .0060993    .249827     0.02   0.981    -.4840872    .4962858
         y76 |   .1239104   .2587922     0.48   0.632    -.3838667    .6316874
```

```
        y78 |   .2077861   .2627738     0.79   0.429    -.3078033    .7233755
        y80 |   .3828911   .2642433     1.45   0.148    -.1355816    .9013638
        y82 |   .5820401   .2492372     2.34   0.020     .0930108    1.071069
        y84 |   .4250429   .2529006     1.68   0.093    -.0711741      .92126
      _cons |   13.63334   4.396773     3.10   0.002     5.006421    22.26027
------------------------------------------------------------------------------
```

predict v, res

reg kids educ age agesq black east northcen west farm othrural town smcity y74 y76 y78 y80 y82 y84 v

```
      Source |       SS       df       MS              Number of obs =    1129
-------------+------------------------------           F( 18,  1110) =    9.21
       Model |  400.802376    18  22.2667987           Prob > F      =  0.0000
    Residual |  2684.70692  1110  2.41865489           R-squared     =  0.1299
-------------+------------------------------           Adj R-squared =  0.1158
       Total |   3085.5093  1128  2.73538059           Root MSE      =  1.5552

------------------------------------------------------------------------------
        kids |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |  -.1527395   .0392012    -3.90   0.000    -.2296562   -.0758227
         age |   .5235536   .1389568     3.77   0.000      .250906    .7962012
       agesq |   -.005716   .0015697    -3.64   0.000    -.0087959   -.0026362
       black |   1.072952    .173618     6.18   0.000     .7322958    1.413609
        east |   .2285554   .1337787     1.71   0.088    -.0339321     .491043
    northcen |   .3744188   .1219925     3.07   0.002     .1350569    .6137807
        west |   .2076398   .1675628     1.24   0.216    -.1211357    .5364153
        farm |  -.0770015   .1512869    -0.51   0.611     -.373842    .2198389
    othrural |  -.1952451   .1814491    -1.08   0.282    -.5512671    .1607769
        town |     .08181   .1246122     0.66   0.512     -.162692    .3263119
      smcity |   .2124996    .160335     1.33   0.185    -.1020943    .5270935
         y74 |   .2721292    .172847     1.57   0.116    -.0670144    .6112729
         y76 |  -.0945483   .1791319    -0.53   0.598    -.4460236    .2569269
         y78 |  -.0572543   .1824512    -0.31   0.754    -.4152424    .3007337
         y80 |   -.053248   .1846139    -0.29   0.773    -.4154795    .3089836
         y82 |  -.4962149   .1764897    -2.81   0.005     -.842506   -.1499238
         y84 |  -.5213604   .1778207    -2.93   0.003    -.8702631   -.1724578
           v |   .0311374   .0443634     0.70   0.483    -.0559081    .1181829
       _cons |  -7.241244   3.134883    -2.31   0.021    -13.39221    -1.09028
------------------------------------------------------------------------------
```

Example 15.10: Job Training and Worker Productivity

use http://fmwww.bc.edu/ec-p/data/wooldridge/JTRAIN

tsset fcode year

```
sort fcode year

drop if year==1989

ivreg D.lscrap (D.hrsemp = D.grant)

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      45
-------------+------------------------------           F(  1,    43) =    3.20
       Model |  .274952567     1  .274952567           Prob > F      =  0.0808
    Residual |  17.0148863    43   .39569503           R-squared     =  0.0159
-------------+------------------------------           Adj R-squared = -0.0070
       Total |  17.2898389    44  .392950883           Root MSE      =  .62904

------------------------------------------------------------------------------
D.lscrap     |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
hrsemp       |
          D1 |  -.0141532   .0079147    -1.79   0.081    -.0301148    .0018084
_cons        |  -.0326684   .1269512    -0.26   0.798    -.2886898     .223353
------------------------------------------------------------------------------
Instrumented:  D.hrsemp
Instruments:   D.grant
------------------------------------------------------------------------------

reg D.lscrap D.hrsemp


      Source |       SS       df       MS              Number of obs =      45
-------------+------------------------------           F(  1,    43) =    2.84
       Model |  1.07071319     1  1.07071319           Prob > F      =  0.0993
    Residual |  16.2191257    43  .377188969           R-squared     =  0.0619
-------------+------------------------------           Adj R-squared =  0.0401
       Total |  17.2898389    44  .392950883           Root MSE      =  .61416

------------------------------------------------------------------------------
D.lscrap     |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
hrsemp       |
          D1 |  -.0076007   .0045112    -1.68   0.099    -.0166984    .0014971
_cons        |  -.1035161    .103736    -1.00   0.324    -.3127197    .1056875
------------------------------------------------------------------------------
```

This page prepared by Oleksandr Talavera (revised 8 Dec 2002)

Send your questions/comments/suggestions to Kit Baum at **baum@bc.edu**
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