```
 1 . do "/Users/imisiaiyetan/Documents/Final .do"

 2 . clear all

 3 . use "/Users/imisiaiyetan/Downloads/Table19_4_data.dta"
   (Earnings function, USA, 2000 data set)

 4 .
 5 . * Question 1
 6 .
 7 . * To generate the treatment variable
 8 . gen treatment = 0

 9 . replace treatment = 1 if s >=15
   (175 real changes made)

10 . * To generate the instrumental variables
11 . gen ssf = 0

12 . replace ssf = 1 if sf>=15
   (107 real changes made)

13 . gen ssm = 0

14 . replace ssm = 1 if sm>=15
   (63 real changes made)

15 . gen sib = 1

16 . replace sib = 0 if siblings > 3
   (189 real changes made)

17 . * Question 2
18 . * Before jumping into iv-regression, I estimate the effect of treatment
19 . *and other covariates on earnings
20 . reg earnings treatment wexp female  ethblack ethhisp married
```

Source	SS	df	MS		
Model	30490.8343	6	5081.80572	Number of obs	540
Residual	90027.5936	533	168.907305	F(6, 533)	30.09
				Prob > F	0.0000
				R-squared	0.2530
				Adj R-squared	0.2446
Total	120518.428	539	223.596341	Root MSE	12.996

earnings	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	13.23761	1.26289	10.48	0.000	10.75676	15.71846
wexp	.4819368	.1269443	3.80	0.000	.2325642	.7313094
female	-6.968988	1.149743	-6.06	0.000	-9.227572	-4.710404
ethblack	-3.88289	1.841426	-2.11	0.035	-7.500233	-.2655468
ethhisp	-4.003112	2.553102	-1.57	0.117	-9.018489	1.012265
married	.6896808	1.238592	0.56	0.578	-1.74344	3.122801

_cons	11.19942	2.67259	4.19	0.000	5.949315	16.44952

```
21 .
22 . *Robust ols
23 . reg earnings treatment wexp female ethblack ethhisp married, robust
```

Linear regression

Number of obs	540
F(6, 533)	17.60
Prob > F	0.0000
R-squared	0.2530
Root MSE	12.996

earnings	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	13.23761	1.493037	8.87	0.000	10.30465	16.17057
wexp	.4819368	.1163086	4.14	0.000	.2534573	.7104162
female	-6.968988	1.107371	-6.29	0.000	-9.144335	-4.793641
ethblack	-3.88289	1.374433	-2.83	0.005	-6.582861	-1.182919
ethhisp	-4.003112	1.375958	-2.91	0.004	-6.706078	-1.300145
married	.6896808	1.213343	0.57	0.570	-1.69384	3.073202
_cons	11.19942	2.231041	5.02	0.000	6.816705	15.58213

```
24 .
25 . *Question 3
26 . *****************IV-regression*******************************
27 . ****2sls*****************
28 . ivregress 2sls earnings (treatment= ssf ssm sib) wexp female  ethblack ethhisp ///
> married
```

Instrumental variables (2SLS) regression

Number of obs	540
Wald chi2(6)	109.32
Prob > chi2	0.0000
R-squared	0.1512
Root MSE	13.763

earnings	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
treatment	23.99881	3.525716	6.81	0.000	17.08853	30.90908
wexp	.7779901	.1616396	4.81	0.000	.4611824	1.094798
female	-7.041232	1.217784	-5.78	0.000	-9.428045	-4.654419
ethblack	-1.630569	2.066161	-0.79	0.430	-5.680171	2.419032
ethhisp	-2.533138	2.740232	-0.92	0.355	-7.903893	2.837617
married	-.309908	1.346226	-0.23	0.818	-2.948462	2.328646
_cons	3.147162	3.737522	0.84	0.400	-4.178246	10.47257

Instrumented: treatment
Instruments: wexp female ethblack ethhisp married ssf ssm sib

```
29 . ***** 2SLS Bias****
```

```
30 . estat firststage
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(3,531)	Prob > F
treatment	**0.2335**	**0.2220**	**0.1439**	**29.7495**	**0.0000**

Minimum eigenvalue statistic = **29.7495**

Critical Values	# of endogenous regressors:	**1**
Ho: Instruments are weak	# of excluded instruments:	**3**

	5%	10%	20%	30%
2SLS relative bias	**13.91**	**9.08**	**6.46**	**5.39**
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	**22.30**	**12.83**	**9.54**	**7.80**
LIML Size of nominal 5% Wald test	**6.46**	**4.36**	**3.69**	**3.32**

```
31 . ******Equivalently, Gmm IV-regression***************
32 . ivregress gmm earnings (treatment= ssf ssm sib) wexp female  ethblack ethhisp ///
> married
```

Instrumental variables (GMM) regression

Number of obs	=	**540**
Wald chi2(**6**)	=	**77.19**
Prob > chi2	=	**0.0000**
R-squared	=	**0.1541**
Root MSE	=	**13.74**

GMM weight matrix: Robust

earnings	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
treatment	**23.83851**	**4.730701**	**5.04**	**0.000**	**14.5665**	**33.11051**
wexp	**.745146**	**.171683**	**4.34**	**0.000**	**.4086536**	**1.081638**
female	**-7.004812**	**1.137456**	**-6.16**	**0.000**	**-9.234184**	**-4.77544**
ethblack	**-1.401401**	**1.688912**	**-0.83**	**0.407**	**-4.711607**	**1.908806**
ethhisp	**-2.50877**	**1.886951**	**-1.33**	**0.184**	**-6.207126**	**1.189586**
married	**-.0138035**	**1.341536**	**-0.01**	**0.992**	**-2.643166**	**2.615559**
_cons	**3.439198**	**3.749987**	**0.92**	**0.359**	**-3.910641**	**10.78904**

Instrumented: treatment
Instruments: wexp female ethblack ethhisp married ssf ssm sib

```
33 . *****Standard Errors*************
34 . * To estimate the correct standard error, we use bootstrap
35 . ivregress 2sls earnings (treatment= ssf ssm sib) wexp female ethblack ethhisp ///
> married, vce(bootstrap, reps(1000) seed(423))
```

```
(running ivregress on estimation sample)

Bootstrap replications (1000)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................................................    50
..................................................   100
..................................................   150
..................................................   200
..................................................   250
..................................................   300
..................................................   350
..................................................   400
..................................................   450
..................................................   500
..................................................   550
..................................................   600
..................................................   650
..................................................   700
..................................................   750
..................................................   800
..................................................   850
..................................................   900
..................................................   950
..................................................  1000

Instrumental variables (2SLS) regression              Number of obs =     540
                                                      Wald chi2(6)  =   70.60
                                                      Prob > chi2   =  0.0000
                                                      R-squared     =  0.1512
                                                      Root MSE      =  13.763

------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
    earnings |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   treatment |   23.99881   4.864031     4.93   0.000     14.46548    33.53213
        wexp |   .7779901   .1792944     4.34   0.000     .4265796    1.129401
      female |  -7.041232   1.236768    -5.69   0.000    -9.465252   -4.617212
   ethblack  |  -1.630569   1.771078    -0.92   0.357    -5.101819     1.84068
     ethhisp |  -2.533138   2.086988    -1.21   0.225     -6.62356    1.557284
     married |   -.309908    1.46668    -0.21   0.833    -3.184547    2.564731
       _cons |   3.147162   3.885418     0.81   0.418    -4.468119    10.76244
------------------------------------------------------------------------------
Instrumented:  treatment
Instruments:   wexp female ethblack ethhisp married ssf ssm sib

36 . *Alternatively,
37 . bootstrap, reps(1000) seed(423):ivregress 2sls  earnings ///
> (treatment= ssf ssm sib) wexp female  ethblack ethhisp married, robust
(running ivregress on estimation sample)

Bootstrap replications (1000)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................................................    50
```

```
..................................................   100
..................................................   150
..................................................   200
..................................................   250
..................................................   300
..................................................   350
..................................................   400
..................................................   450
..................................................   500
..................................................   550
..................................................   600
..................................................   650
..................................................   700
..................................................   750
..................................................   800
..................................................   850
..................................................   900
..................................................   950
..................................................  1000

Instrumental variables (2SLS) regression              Number of obs =     540
                                                      Wald chi2(6)  =   70.60
                                                      Prob > chi2   =  0.0000
                                                      R-squared     =  0.1512
                                                      Root MSE      =  13.763
```

earnings	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal-based [95% Conf.	Interval]
treatment	23.99881	4.864031	4.93	0.000	14.46548	33.53213
wexp	.7779901	.1792944	4.34	0.000	.4265796	1.129401
female	-7.041232	1.236768	-5.69	0.000	-9.465252	-4.617212
ethblack	-1.630569	1.771078	-0.92	0.357	-5.101819	1.84068
ethhisp	-2.533138	2.086988	-1.21	0.225	-6.62356	1.557284
married	-.309908	1.46668	-0.21	0.833	-3.184547	2.564731
_cons	3.147162	3.885418	0.81	0.418	-4.468119	10.76244

```
Instrumented:  treatment
Instruments:   wexp female ethblack ethhisp married ssf ssm sib

38 .
39 . *
40 .
41 . bootstrap _b[treatment] _se[treatment], reps(1000) seed(423) ///
> saving(bootstrap_data, replace): ivregress 2sls earnings ///
> (treatment= ssf ssm sib) wexp female  ethblack ethhisp married, robust
(running ivregress on estimation sample)

Bootstrap replications (1000)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................................................    50
..................................................   100
..................................................   150
```

```
..................................................   200
..................................................   250
..................................................   300
..................................................   350
..................................................   400
..................................................   450
..................................................   500
..................................................   550
..................................................   600
..................................................   650
..................................................   700
..................................................   750
..................................................   800
..................................................   850
..................................................   900
..................................................   950
..................................................  1000

Bootstrap results                               Number of obs      =       540
                                                Replications       =      1000

      command:  ivregress 2sls earnings (treatment= ssf ssm sib) wexp female ethblac
                    ethhisp married, robust
        _bs_1:  _b[treatment]
        _bs_2:  _se[treatment]

------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _bs_1 |   23.99881   4.864031     4.93   0.000     14.46548    33.53213
       _bs_2 |   4.761793   .8396382     5.67   0.000     3.116132    6.407453
------------------------------------------------------------------------------

42 .
43 . use "/Users/imisiaiyetan/Downloads/bootstrap_data.dta", clear
(bootstrap: ivregress)

44 .
45 . gen temp=(_bs_1+ 23.99881 )^2

46 . egen temp2=mean(temp)

47 . gen se=sqrt(temp2)

48 . sum se

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          se |       1000    48.06244           0   48.06244   48.06244

49 . /* From asymptotic approx, Normal 95% CI is roughly  14.5665  33.11051*/
50 . /* From boot-c, Normal 95% CI is roughly 14.46548    33.53213. */
51 .
```

```
52 . _pctile _bs_1, p(14.5 33.5)

53 .
54 . dis r(r2)
   21.408965

55 . dis r(r1)
   18.772781

56 .
57 . /* From boot-c, 95% CI is roughly 14.46548   33.53213. */
58 .
59 . /* Boot-t */
60 . gen t=(_bs_1+23.99881)/(_bs_2)

61 . sum t,d

                            t
-------------------------------------------------------------
      Percentiles      Smallest
 1%     7.771082       6.71648
 5%     8.428115       6.790602
10%      8.76158       6.89824      Obs                1000
25%     9.500162       7.063953     Sum of Wgt.        1000

50%     10.28139                    Mean           10.36817
                       Largest      Std. Dev.      1.282455
75%     11.19782       14.53651
90%     12.04036       14.93969     Variance       1.644691
95%     12.53066       15.00796     Skewness       .3429689
99%     13.64298       15.05114     Kurtosis       3.288581

62 . _pctile t, p(14.5 33.5)

63 .
64 . dis r(r2)
   9.8139997

65 . dis r(r1)
   9.0587931

66 .
67 . /* This is based on coeff and std. error from regular robust SE estimation */
68 . dis 23.99881+( 4.864031 )*(r(r1))
   68.06106

69 . dis 23.99881+( 4.864031 )*(r(r2))
   71.734409

70 .
71 .
72 .
73 .
74 .
```

```
75 .
76 .
   end of do-file

77 .
```