XALQARO NORDIK UNIVERSITETI

Iqtisodiyot va pedagogika fakulteti,
Iqtisodiyot va biznesni boshqarish kafedrasi

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Mavzu: Amaliy ekonometrik (sinxron tenglamali) modellar

Reja:

1. **Talab va taklif modeli.**
2. **Qisqartirilgan shakldagi tenglamalarni baholash**
3. **2SLS orqali baliq mahsulotiga bo`lgan talablarni baholash**
4. **2SLS ning alternativlari**
5. **Monte Karlo simulatisiya natijalari**

11.1. TRUFFLE komponiyasining taklif va talab modeli

Truffles komponiyasi uchun talab va taklif modelini ko'rib chiqamiz:

Talab: $Q = \alpha_1 + \alpha_2 P + \alpha_3 PS + \alpha_4 DI + e_d$

Taklif: $Q = \beta_1 + \beta_2 P + \beta_3 PF + e_x$

Q talab tenglamasida ma'lum bir fransuz bozorida sotiladigan truffle miqdori, P - truffelning bozor narxi, PS - haqiqiy truffle o'rnini bosuvchi mahsulotning bozor narxi (boshqa mahsulot juda kam baholanadi), va DI - mahalliy aholining jon boshiga oylik ixtiyoridagi daromadidir. Taklif tenglamasi bozor narxini va taklif qilingan miqdorni o'z ichiga oladi. Shuningdek, u ishlab chiqarish omilining narxini o'z ichiga oladi, PF, bu holda qidiruv jarayonida ishlatiladigan truffle ning soatlik ijara narxi. Ushbu modelda biz P va Q endogen o'zgaruvchilar deb faraz qilamiz. Ekzogen o'zgaruvchilar PS, DI, PF va kesishuvchi o'zgaruvchilardir.

Ushbu misol uchun ***truffles.dta*** ma'lumotlari faylidan foydalanamiz. Odatiy boshlash buyruqlarini bajaring, jurnalni ishga tushiring va ma'lumotlar faylini oching.

use truffles, clear

describe

Dastlabki 5 ta kuzatuvni sanab o'tish va umumiy statistikani hisoblash orqali ma'lumotlarni tekshiring.

list in 1/5

Natijalar:

```
. list in 1/5
```

	p	q	ps	di	pf
1.	29.64	19.89	19.97	2.103	10.52
2.	40.23	13.04	18.04	2.043	19.67
3.	34.71	19.61	22.36	1.87	13.74
4.	41.43	17.13	20.87	1.525	17.95
5.	53.37	22.55	19.79	2.709	13.71

summarize

Variable	Obs	Mean	Std. Dev.	Min	Max
p	30	62.724	18.72346	29.64	105.45
q	30	18.45833	4.613088	6.37	26.27
ps	30	22.022	4.077237	15.21	28.98
di	30	3.526967	1.040803	1.525	5.125
pf	30	22.75333	5.329654	10.52	34.01

11.2. Qisqartirilgan shakldagi tenglamalarni baholash

Qisqartirilgan shakldagi tenglamalar har bir endogen o'zgaruvchini, P va Q ni ifodalaydi ekzogen o'zgaruvchilar PS, DI, PF va kesishuvchi o'zgaruvchi, ortiqcha xato atamasidir. Ular:

$$Q = \pi_{11} + \pi_{21}PS + \pi_{31}PS + \pi_{41}PF + v_1$$

$$P = \pi_{12} + \pi_{22}PS + \pi_{32}PF + v_2$$

Biz bu tenglamalarni eng kichik kvadratlar bilan baholashimiz mumkin, chunki o'ng tomondagi o'zgaruvchilar ekzogen va tasodifiy xatolar bilan bog'liq bo'lmagan. QUANTITY uchun qisqartirilgan shakl yordamida olinadi.

```
reg q ps di pf
```

Source	SS	df	MS		
Model	430.382604	3	143.460868	Number of obs	= 30
Residual	186.754213	26	7.18285434	F(3, 26)	= 19.97
				Prob > F	= 0.0000
Total	617.136817	29	21.2805799	R-squared	= 0.6974
				Adj R-squared	= 0.6625
				Root MSE	= 2.6801

q	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ps	.6564021	.1425376	4.61	0.000	.3634118	.9493923
di	2.167156	.7004738	3.09	0.005	.727311	3.607
pf	-.5069823	.1212617	-4.18	0.000	-.7562392	-.2577254
_cons	7.895099	3.243422	2.43	0.022	1.228151	14.56205

Narx uchun qisqartirilgan shakl esa:

```
reg p ps di pf
```

Source	SS	df	MS		
Model	9034.77551	3	3011.59184	Number of obs	= 30
Residual	1131.69721	26	43.5268157	F(3, 26)	= 69.19
				Prob > F	= 0.0000
Total	10166.4727	29	350.568025	R-squared	= 0.8887
				Adj R-squared	= 0.8758
				Root MSE	= 6.5975

p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ps	1.708147	.3508806	4.87	0.000	.9869017	2.429393
di	7.602491	1.724336	4.41	0.000	4.058068	11.14691
pf	1.353906	.2985062	4.54	0.000	.7403175	1.967494
_cons	-32.51242	7.984235	-4.07	0.000	-48.92425	-16.10059

Keyinchalik foydalanish uchun biz taxmindan keyingi taxmin buyrug'i yordamida narxning o'rnatilgan yoki **predict** qiymatlarini olamiz. $\hat{P}$ ni eslatish uchun **phat** o'zgaruvchisini nomlang.

predict phat

11.3. 2SLS truffle talabini baholash

Ikki bosqichli eng kichik kvadratlar (2SLS) hisoblarini strukturaviy tenglamalarning o'ng tomonidagi endogen o'zgaruvchini qisqartirilgan shakldagi o'rnatilgan qiymatga almashtirish va keyin eng kichik kvadratlarni qo'llash orqali olish mumkin. Ushbu yondashuv yordamida olingan talab tenglamasining ikki bosqichli eng kichik kvadrat natijalari:

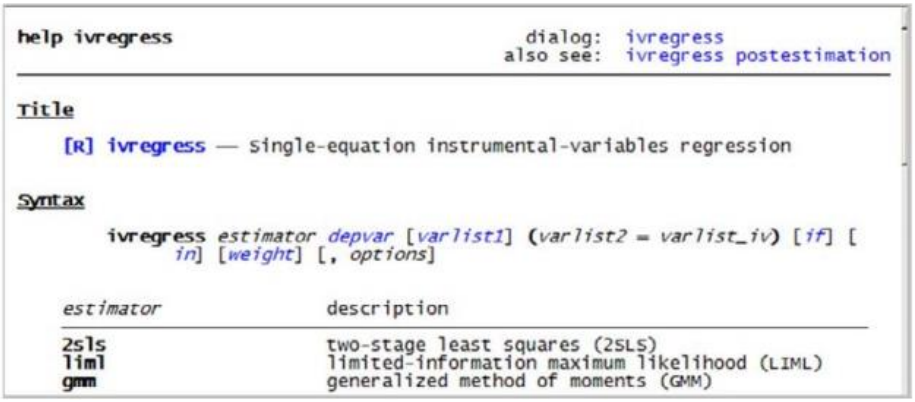
reg q phat ps di

Source	SS	df	MS		
Model	430.382596	3	143.460865	Number of obs	= 30
Residual	186.754221	26	7.18285466	F(3, 26)	= 19.97
				Prob > F	= 0.0000
Total	617.136817	29	21.2805799	R-squared	= 0.6974
				Adj R-squared	= 0.6625
				Root MSE	= 2.6801

q	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
phat	-.374459	.0895643	-4.18	0.000	-.5585611	-.1903569
ps	1.296033	.1930944	6.71	0.000	.8991219	1.692944
di	5.013976	1.241414	4.04	0.000	2.462213	7.56574
_cons	-4.27947	3.013834	-1.42	0.168	-10.47449	1.915554

Ushbu chiqishdagi standart xatolar, t-statistik ma'lumotlar va 95% ishonch oraliqlari noto'g'ri, chunki xato dispersiyasi eng kichik kvadratlar qoldiqlariga asoslangan. 2SLS uchun dasturiy ta'minot buyruqlaridan foydalanish har doim yaxshiroqdir.

Stata-da **ivregress** "Instrumental o'zgaruvchilar regressiyasi"deb nomlangan 2SLS baholash uchun o'rnatilgan buyruq mavjud. 2SLS nima uchun chaqirilganini to'liq tushuntirish uchun instrumental o'zgaruvchilar baholovchisini Principle of Econometrics 4-nashr adabiyotining 10-bobida to`liq ifodalanilgan. Stata yordami uchun **help ivregress** buyruqni kiriting.



help ivregress — dialog: ivregress; also see: ivregress postestimation

Title

[R] ivregress — single-equation instrumental-variables regression

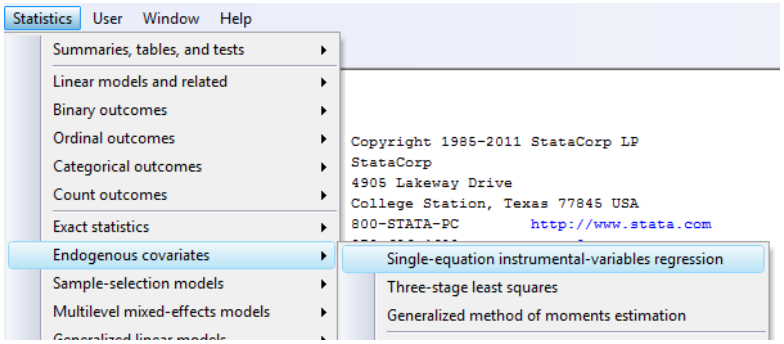
Syntax

ivregress estimator depvar [varlist1] (varlist2 = varlist_iv) [if] [in] [weight] [, options]

estimator	description
2sls	two-stage least squares (2SLS)
liml	limited-information maximum likelihood (LIML)
gmm	generalized method of moments (GMM)

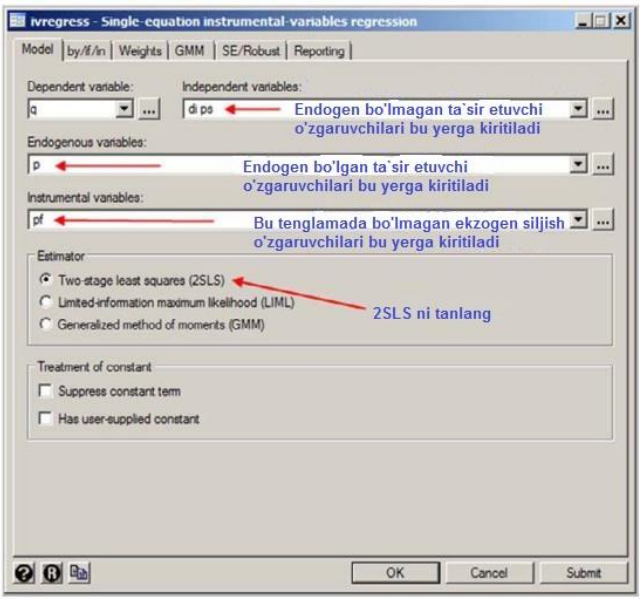
Uni ochiladigan menyular orqali ifodalash ham mumkin. Quyidagi ketma-ketlikni bajaring.

Statistics > Endogenous covariates > Single-equation instrumental-variables regression



Statadagi nomlash konventsiyalari statistik amaliyotchilarning keng segmentiga murojaat qiladi. "**Covariates**" - bu regressiyani tushuntiruvchi o'zgaruvchilar uchun ishlatiladigan yana bir atama. "**Endogenous covariates**" o'ng tomondagi tushuntirish o'zgaruvchilari endogen ekanligini va ular bilan bog'liqligini anglatadigan xato atama. Ushbu turkumda bir nechta tanlov mavjud, ammo biz bitta tenglama bilan ishlayapmiz va tanlov aniq bo'lishi uchun instrumental o'zgaruvchilarni baholashdan foydalanmoqchimiz.

Buyruqlar qatoriga **db ivregress** ni kiritish yoki yordam oynasi dialog oynasini bosish orqali muloqot oynasiga kirish mumkin: **ivregress.** Muloqot oynasidagi (keyingi sahifadagi) "instrumental o'zgaruvchilari" talab tenglamasida bo'lmagan ekzogen o'zgaruvchilardir. Bunday holda, bu o'zgaruvchi **pf** bo'lib, u talab tenglamasida emas, balki taklif tenglamasida ko'rinadigan ishlab chiqarish omilining narxidir. Muloqot oynasidagi "mustaqil o'zgaruvchilar" endogen bo'lmagan o'ng tomondagi o'zgaruvchilardir. Biz 2SLS variantini tanlaymiz va OK tugmasini bosing.



Natijalar oynasida ko'rsatilgan Stata buyrug'i quyidagicha:

ivregress 2sls q di ps (p = pf)

```
. ivregress 2sls q di ps (p = pf)

Instrumental variables (2SLS) regression          Number of obs =      30
                                                  Wald chi2(3)  =   20.43
                                                  Prob > chi2   =  0.0001
                                                  R-squared     =       .
                                                  Root MSE      =  4.5895

------------------------------------------------------------------------------
           q |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           p |  -.3744591   .1533755    -2.44   0.015    -.6750695   -.0738486
          di |   5.013977   2.125875     2.36   0.018     .847339    9.180615
          ps |   1.296033   .3306669     3.92   0.000     .6479381   1.944128
       _cons |  -4.279471   5.161076    -0.83   0.407    -14.39499    5.836052
------------------------------------------------------------------------------
Instrumented:  p
Instruments:   di ps pf
```

Ivregress buyrug'idan so'ng biz qaysi hisoblagichni xohlayotganimizni, bu holda qaysi ekanligini ko'rsatishimiz kerak **2sls.** Regressiya modeli spetsifikatsiyasi standart bo'lib, birinchi navbatda qaram o'zgaruvchi *q* keladi. Endogen bo'lgan har qanday tushuntirish o'zgaruvchisi uchun bizda qavs ichidagi bayonot mavjud, ya'ni

(varlist2 = varlist_iv)

bunda

varlist2 o'ng tomondagi barcha endogen o'zgaruvchilar ro'yxati

varlist_iv modelda mavjud bo'lmagan barcha ekzogen o'zgaruvchilar ro'yxati

Endogen bo'lmagan izohli o'zgaruvchilar qavs ichidagi ifodadan oldin yoki keyin sanab o'tiladi. Shuningdek, olingan natijalardagi mustaqil o'zgaruvchilarning tartibi ularning dialog oynasiga kiritilish tartibiga bog'liq.

IV regressiya chiqishi z-qiymatlari haqida xabar beradi, chunki IV regressiya katta qiymatlar xususiyatiga ega bo'lgan va biz bilamizki, katta qiymatlarda t-distribution standart normal N (0,1) taqsimotiga yaqinlashadi. Shunday qilib, t-statistika z-statistikaga aylanadi. Katta qiymatlarda testlar uchun kritik qiymatlar u yoki bu taqsimotdan kelib chiqishi muhim emas, lekin kichikroq namunalarda bu muhim bo'lishi mumkin. Xulosalarni har doim t-taqsimotiga asoslashni afzal ko'ramiz. Bunga Stata-da ***small*** opsiyasi yordamida erishiladi. Quyidagi buyruqda, shuningdek, endogen o'zgaruvchini ***(p=pf)*** bog'liq o'zgaruvchidan keyin qo'yganimizni, uning oxirida ko'rsatilishi shart emasligini ta'kidlashni unutmang.

ivregress 2sls q (p=pf) ps di, sma11

Natija:

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      30
-------------+------------------------------           F(  3,    26) =    5.90
       Model |  -14.780326     3 -4.92677534            Prob > F      =  0.0033
    Residual |  631.917143    26  24.3045055            R-squared     =       .
-------------+------------------------------           Adj R-squared =       .
       Total |  617.136817    29  21.2805799            Root MSE      =    4.93

------------------------------------------------------------------------------
           q |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           p |  -.3744591   .1647517    -2.27   0.032     -.713111   -.0358071
          ps |   1.296033   .3551932     3.65   0.001     .5659232    2.026143
          di |   5.013977   2.283556     2.20   0.037     .3200608    9.707893
       _cons |  -4.279471   5.543884    -0.77   0.447    -15.67509    7.116147
------------------------------------------------------------------------------
Instrumented:  p
Instruments:   ps di pf
```

Natija ikki jihatdan farq qiladi. Oldingi baholashda model ahamiyatining umumiy testi Wald chi-kvadrat testiga asoslangan edi. ***Small*** varianti bilan umumiy test F-testi sifatida xabar qilinadi. Ikkinchi farq shundaki, t-qiymatlari xabar qilinadi va p-qiymatlari va intervalli taxminlar t-taqsimotiga asoslanadi.

Stata shuningdek, ikki bosqichning birinchi bosqichini (qisqartirilgan shakl) ko'rsatadigan variantni o'z ichiga oladi eng kichik kvadratlar. Bu variantni nomlanishi ***first*** bilan.

ivregress 2sls q (p=pf) ps di, small first

```
First-stage regressions
```

```
                                      Number of obs   =         30
                                      F(  3,     26)  =      69.19
                                      Prob > F        =     0.0000
                                      R-squared       =     0.8887
                                      Adj R-squared   =     0.8758
                                      Root MSE        =     6.5975
```

p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ps	1.708147	.3508806	4.87	0.000	.9869017	2.429393
di	7.602491	1.724336	4.41	0.000	4.058068	11.14691
pf	1.353906	.2985062	4.54	0.000	.7403175	1.967494
_cons	-32.51242	7.984235	-4.07	0.000	-48.92425	-16.10059

Qo'shimcha natija birinchi bosqichdagi regressiya hisoblanadi. Bunday holda, bitta o'ng tomonda endogen o'zgaruvchi mavjud bo'lganligi sababli, ***PRICE(p)***, Stata uning qisqartirilgan shaklida ifodalaydi. Buning sababi shundaki, bu qisqartirilgan shaklda o`zgaruvchi, ***pf***, aslida muhim tushuntirish o'zgaruvchisi ekanligiga dalil bo'lishi kerak. Uning t-statistikasi 4,54 ekanligini ko'ramiz. Ushbu adabiyotda ikki bosqichli eng kichik kvadratlarni baholash ishonchli bo'lishi uchun t-statistika taxminan 3,3 dan katta bo'lishi yoki o`zgaruvchilarni sinash uchun F-qiymati 10 dan katta bo'lishi kerak bo'lgan umumiy qoida mavjud. Ushbu masala bo'yicha batafsilroq ma'lumot olish uchun Principle of Econometrics, 4-nashri darsligining 10-bobi, E-ilovasida va 10.6-bobda to`liqroq ifodalanilgan.

O`garuvchining haqiqiyligini tekshirishni amalga oshiradigan ***estat firststage*** deb nomlangan "post-baholash" buyrug'i mavjud. U ochiladigan Stata menyusida **Statistics > Postestimation > Reports and statistics** ketma-ketlikni ham bajarish mumkin. Olingan ro'yxatdan birinchi elementni tanlang.

Natija juda ko'p va siz ko'pchiligini tushunmaysiz, lekin asosiy element – qiymati F-statistikadir. Bu qiymat bitta tashqi vosita bo'lganligi sababli, 20,5717 qisqartirilgan shakldan t-statistikaning kvadratidir.

```
. estat firststage
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(1,26)	Prob > F
p	0.8887	0.8758	0.4417	20.5717	0.0001

Keyingi sahifada ko'rsatilgan chiqishning pastki qismida, birinchi bosqichdan boshlab, o`zgaruvchilar kuchli yoki kuchli emasligini tekshirish uchun ***Stock-Yogo*** kritik qiymatlari mavjud. Birinchi bosqich F-testi uchun umumiy qiymat qoidasi 10 ga teng, ammo bu aniqlangan. Ushbu muhim qiymatlardan qanday foydalanish haqida tushuntirish uchun ushbu qo'llanmaning 10.6-bobida ifodalanilgan.

Minimum eigenvalue statistic = 20.5717

Critical Values Ho: Instruments are weak	# of endogenous regressors: 1 # of excluded instruments: 1			
2SLS relative bias	5%	10%	20%	30%
	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Stata buyrug'i:

estat firststage

11.4. 2SLS orqali truffle komponiyasining taklif modelini baholash

Taklif tenglamasining ikki bosqichli eng kichik kvadratlari xuddi shunday tarzda olinadi. E'tibor bering, bu baho uchun ikkita ekzogen siljish o'zgaruvchilari mavjud, ular ***ps*** va ***di*** talab tenglamasida o'zgaruvchilar edi.

ivregress 2sls q (p=ps di) pf, small first

Birinchi bosqichni baholash natijalari quyida ko'rsatilgan. Ushbu baholashda tashqi o`zgaruvchilardan kamida bittasi, ***ps*** va ***di*** siljish o'zgaruvchilari muhim bo'lishi kerak.

First-stage regressions

Number of obs	= 30
F(3, 26)	= 69.19
Prob > F	= 0.0000
R-squared	= 0.8887
Adj R-squared	= 0.8758
Root MSE	= 6.5975

p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pf	1.353906	.2985062	4.54	0.000	.7403175	1.967494
ps	1.708147	.3508806	4.87	0.000	.9869017	2.429393
di	7.602491	1.724336	4.41	0.000	4.058068	11.14691
_cons	-32.51242	7.984235	-4.07	0.000	-48.92425	-16.10059

Taklif tenglamasining 2SLS natijalari:

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      30
-------------+------------------------------           F(  2,    27) =   95.26
       Model |  556.582251     2  278.291126            Prob > F      =  0.0000
    Residual |  60.5545652    27  2.24276167            R-squared     =  0.9019
-------------+------------------------------           Adj R-squared =  0.8946
       Total |  617.136817    29  21.2805799            Root MSE      =  1.4976

------------------------------------------------------------------------------
           q |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           p |   .3379816   .0249196    13.56   0.000     .2868509    .3891123
          pf |  -1.000909   .0825279   -12.13   0.000    -1.170243   -.831576
       _cons |    20.0328   1.223115    16.38   0.000     17.52318    22.54243
------------------------------------------------------------------------------
Instrumented:  p
Instruments:   pf ps di
```

Shift o'zgaruvchilarning umumiy ahamiyatini tekshirish uchun biz quyidagi buyruqdan foydalanamiz:

estat firststage

```
First-stage regression summary statistics

    Variable |    R-sq.  Adjusted R-sq.  Partial R-sq.    F(2,26)  Prob > F
-------------+------------------------------------------------------------
           p |   0.8887       0.8758         0.7614      41.4873    0.0000
```

Asosiy ko'rsatkich F-statistikadir. 41,4873 qiymati 10 ga teng bo'lgan chegara qoidasidan kattaroqdir, bu bizni ***ps*** va ***di*** o'zgaruvchan o'zgaruvchilardan kamida bittasining birinchi bosqich koeffitsienti noldan sezilarli darajada farq qilishiga ishontiradi.

11.5. Baliq mahsulotiga bo`lgan taklif va talab modellari

Ikkinchi misolimiz bir vaqtda tenglamalar Nyu-York shahridagi Fulton baliq bozoridan olingan ma`lumotlar bilan modellarni tuzamiz. Bu bozor uchun talab tenglamasini quyidagicha belgilaymiz.

$$\ln(QUAN_t) = \alpha_1 + \alpha_2 \ln(PRICE_t) + \alpha_3 MON_t + \alpha_4 TUE_t + \alpha_5 WED_t + \alpha_6 THH_t + e_t^x$$

bu yerda $QUAN_t$ – funtda sotilgan mahsulot miqdori va $PRICE_t$ – funt uchun o‘rtacha kunlik narx. E'tibor bering, biz ma'lumotlarning vaqtli qatorlar xususiyatiga ega bo'lganligi sababli, biz ushbu munosabat bo'yicha kuzatuvlarni indekslash uchun "t" pastki belgisidan foydalanmoqdamiz. Qolgan o'zgaruvchilar haftaning kunlari uchun ko'rsatkich o'zgaruvchilari bo'lib, juma o'tkazib yuborilgan. α_2 koeffitsienti talabning narx egiluvchanligi bo'lib, biz uni manfiy bo'lishini kutgandik. Kundalik ko'rsatkich o'zgaruvchilari talabning kundan-kunga o'zgarishini aks ettiradi. Taklif tenglamasi:

$$\ln(QUAN_t) = \beta_1 + \beta_2 \ln(PRICE_t) + \beta_3 STORMY_t + e_t^x$$

β_2 koeffitsienti taklifning narx egiluvchanligi. STORMY o'zgaruvchisi oldingi uch kun ichida bo'ronli ob-havoni ko'rsatadigan indikator o'zgaruvchisidir. Bu o'zgaruvchi ta'minot tenglamasida muhim ahamiyatga ega, chunki bo'ronli ob-havo baliq ovlashni qiyinlashtiradi, bozorga olib kelingan baliq ta'minotini kamaytiradi.

Yangi ishchi faylini oching va ***fultonfish.dta*** ma’lumotlar faylini oching hamda tekshiramiz.

use fultonfish, clear

describe

Tizimdagi o'zgaruvchilar uchun dastlabki 5 ta kuzatuvni ro'yxatga olish orqali ma'lumotlarni tekshiramiz.

list lquan lprice mon tue wed thu stormy in 1/5

	lquan	lprice	mon	tue	wed	thu	stormy
1.	8.994421	-.4307829	1	0	0	0	1
2.	7.707063	0	0	1	0	0	1
3.	8.350194	.0723207	0	0	1	0	0
4.	8.656955	.247139	0	0	0	1	1
5.	7.844241	.6643268	0	0	0	0	1

Endi ushbu o'zgaruvchilar uchun umumiy statistik ma'lumotlarni olamiz:

summarize lquan lprice mon tue wed thu stormy

Natijasi:

Variable	Obs	Mean	Std. Dev.	Min	Max
lquan	111	8.52343	.741672	6.194406	9.981374
lprice	111	-.1936811	.3819346	-1.107745	.6643268
mon	111	.1891892	.3934351	0	1
tue	111	.2072072	.4071434	0	1
wed	111	.1891892	.3934351	0	1
thu	111	.2072072	.4071434	0	1
stormy	111	.2882883	.4550202	0	1

11.6. Baliq narxi va miqdori uchun qisqartirilgan shakllar

Bir vaqtning o'zida tenglamalar tizimida har bir endogen o'zgaruvchi uchun qisqartirilgan shakldagi tenglamalarni baholash juda muhimdir. Qisqartirilgan shakldagi tenglamalarni eng kichik kvadratlar bilan baholash mumkin, chunki barcha o'ng tomondagi o'zgaruvchilar ekzogendir. ***ln (QUAN)*** uchun qisqartirilgan shakl yordamida tenglamani tuzib olamiz.

reg lquan mon tue wed thu stormy

ln(PRICE) o'ng tomondagi ta`sir etuvchi o'zgaruvchisi bo'lgani uchun, keling, uning qisqartirilgan shakli tenglamasini batafsilroq ko'rib chiqamiz.

reg lprice mon tue wed thu stormy

Source	SS	df	MS
Model	2.87047878	5	.574095757
Residual	13.1756621	105	.125482496
Total	16.0461409	110	.145874008

Number of obs	= 111
F(5, 105)	= 4.58
Prob > F	= 0.0008
R-squared	= 0.1789
Adj R-squared	= 0.1398
Root MSE	= .35424

lprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
mon	-.1129225	.1072918	-1.05	0.295	-.3256623	.0998174
tue	-.0411493	.1045087	-0.39	0.695	-.2483707	.1660721
wed	-.011825	.1069299	-0.11	0.912	-.2238473	.2001973
thu	.0496456	.1044582	0.48	0.636	-.1574758	.256767
stormy	.3464055	.0746776	4.64	0.000	.1983337	.4944774
_cons	-.2717054	.076389	-3.56	0.001	-.4231706	-.1202402

Identifikatsiya tushunchasi POE4 adabiyotida to`liqroq muhokama qilingan. 2SLS dan foydalanish uchun tenglamadan chiqarib tashlangan M-1 (M - tenglamalar soni) ekzogen o'zgaruvchilar bo'lishi kerak - bular instrumental o'zgaruvchilardir. Biroq, ular

nafaqat ko'rib chiqilayotgan tenglamadan chiqarib tashlanishi kerak, balki ular qisqartirilgan shaklda statistik ahamiyatga ega bo'lishi kerak.

Talab tenglamasida o'zgaruvchan **stormy** kiritilmagan, chunki bo'ronlar talabga emas, balki taklifga ta'sir qiladi. ***ln(PRICE)*** uchun qisqartirilgan shaklda o'zgaruvchan bo'ron 2SLS yaxshi ishlashi uchun juda muhim bo'lishi kerak. E'tibor bering, bo'ron uchun t-statistik 4,64 va p-qiymati juda kichik. Bu juda yaxshi. Shift o'zgaruvchisining t-statistik qiymati uchun asosiy "asosiy qoidasi" chegarasi 3.3 ni tashkil qiladi. Agar t-statistika ushbu qiymatdan past bo'lsa, 2SLS juda yaxshi ishlamasligi mumkin.

Taklif tenglamasida o'zgarmaydiganlar haftaning kunlari, dushanba, seshanba, chorshanba va payshanba kunlari hisoblanadi. Taklif tenglamasini baholash uchun 2SLS dan foydalanish uchun ushbu o'zgaruvchilardan kamida bittasi (juda) muhim bo'lishi kerak. t-qiymatlari kichik. Ushbu o'zgaruvchilarning barchasi hech qanday ta'sir ko'rsatmasligi haqidagi qo'shma nol gipotezaning F-statistikasi yordamida olinadi.

test mon tue wed thu

Ushbu maxsus sintaksis 6-bobdagi test bayonotini muhokama qilishda qo'llanganning yana bir soddalashtirilganidir. Har bir koeffitsient nol gipoteza bo'yicha nolga teng bo'lganligi sababli, testdan so'ng oddiygina o'zgaruvchilarni ro'yxatga olishingiz mumkin. Natija esa:

```
. test mon tue wed thu

 ( 1)  mon = 0
 ( 2)  tue = 0
 ( 3)  wed = 0
 ( 4)  thu = 0

       F(  4,   105) =    0.62
            Prob > F =    0.6501
```

Taklif tenglamasi uchun 2SLS dan foydalanish uchun biz F-qiymati 10 dan yuqori bo'lgan juda muhim sinov natijasini qidiramiz. Bu shunday emasligi aniq. Shunday qilib, amaliy jihatdan ta'minot tenglamasi aniqlanmagan va shuning uchun biz ushbu tenglama uchun 2SLS taxminlariga tayanmasligimiz kerak.

11.7. 2SLS orqali baliq mahsulotiga bo`lgan talablarni baholash

Talab tenglamasining 2SLS bahosini olish uchun biz yana Stata ning ***ivregress*** buyrug'idan foydalanamiz. Ekzogen siljish o'zgaruvchisi bu ***stormy*** dir. Qavslar ichida o'ng tomondagi endogen o'zgaruvchi ***lprice*** bilan birga ko'rinadi va boshqa ta`sir etuvchi o'zgaruvchilari oldin yoki keyin sanab o'tilgan. Biz z-statistik emas, balki t-statistik ma'lumotlar ko'rsatilishi uchun kichik variantdan foydalanamiz va biz birinchi bosqich regressiyasini olish uchun birinchi variantdan foydalanamiz, ya'ni narx uchun pasaytirilgan shakl.

ivregress 2sls lquan (lprice=stormy) mon tue wed thu, small first

First-stage regressions

Number of obs	111
F(5, 105)	4.58
Prob > F	0.0008
R-squared	0.1789
Adj R-squared	0.1398
Root MSE	0.3542

lprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
mon	-.1129225	.1072918	-1.05	0.295	-.3256623	.0998174
tue	-.0411493	.1045087	-0.39	0.695	-.2483707	.1660721
wed	-.011825	.1069299	-0.11	0.912	-.2238473	.2001973
thu	.0496456	.1044582	0.48	0.636	-.1574758	.256767
stormy	.3464055	.0746776	4.64	0.000	.1983337	.4944774
_cons	-.2717054	.076389	-3.56	0.001	-.4231706	-.1202402

Esda tutingki, stormy t-qiymati 4,64 bo'lganida ahamiyatli bo'lib, bu umumiy qiymat 3,3 qoidasidan kattaroqdir. Shuni ham ta'kidlash kerakki, kichik variant p-qiymatlari va ishonch oraliqlarini hisoblashni o'zgartiradi, ular ham t-distribution ga asoslangan. Ikki bosqichli eng kichik kvadratlar, instrumental o'zgaruvchilar, hisob-kitoblari:

Instrumental variables (2SLS) regression

Source	SS	df	MS
Model	8.41819623	5	1.68363925
Residual	52.0903208	105	.496098293
Total	60.508517	110	.550077427

Number of obs	111
F(5, 105)	4.72
Prob > F	0.0006
R-squared	0.1391
Adj R-squared	0.0981
Root MSE	.70434

lquan	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lprice	-1.119417	.428645	-2.61	0.010	-1.969341	-.269493
mon	-.0254022	.2147742	-0.12	0.906	-.4512596	.4004553
tue	-.5307694	.2080001	-2.55	0.012	-.9431951	-.1183437
wed	-.5663511	.2127549	-2.66	0.009	-.9882047	-.1444975
thu	.1092673	.2087866	0.52	0.602	-.3047179	.5232525
_cons	8.505911	.1661669	51.19	0.000	8.176433	8.83539

Instrumented: lprice
Instruments: mon tue wed thu stormy

Hisoblashdan keyingi ***estat firsttage*** bosqichi buyrug'ining haqiqiyligini tekshirish uchun ham instrumental o`zgaruvchi **stormy** dan foydalanish mumkin.

estat firststage

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(1,105)	Prob > F
lprice	0.1789	0.1398	0.1701	21.5174	0.0000

Minimum eigenvalue statistic = 21.5174

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

	5%	10%	20%	30%
2SLS relative bias		(not available)		
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Yana bir bor shuni ta'kidlaymizki, mahsulotning pastki qismida birinchi bosqich F-testi uchun Stok-Yogo kritik qiymatlari mavjud va bu muhim qiymatlardan foydalanish POE4 darsligida, 10-bob, E ilovasi va 10.6-bobda tushuntirilgan.

11.8. 2SLS ning alternativlari

Standart IV/2SLS hisoblagichiga muqobillarga har doim katta qiziqish bo'lgan. *Principles of Econometrics*, 4-nashr adabiyotida, E ilovasida to`liq ifodalanilgan. Cheklangan ma'lumotlarning maksimal ehtimolligi (LIML) asoschisi birinchi marta 1949[1] yilda Anderson va Rubin tomonidan yaratilgan. Kuchsiz instrumental o`zgaruvchilar mavjud bo'lganda LIMLga ehtiyoj tug`iladi. LIMLning bir qancha modifikatsiyalari Fuller (1977) va boshqalar tomonidan taklif qilingan. Bu baholovchilar k-sinf baholovchilar g`oyasidan foydalangan holda 2SLS bilan birgalikda umumiy tizimda birlashtirilgan. LIML 2SLS hisoblagichiga qaraganda test o'lchamidagi aberatsiyalardan kamroq aziyat chekadi, Fuller modifikatsiyasi esa tarafkashlikdan kamroq aziyat chekadi.

M bir vaqtda tenglamalar tizimida endogen o'zgaruvchilar bo'lsin $y_1, y_2, \ldots . y_M$. K ekzogen o‘zgaruvchilar bo‘lsin $x_1, x_2, \ldots . x_k$. Faraz qilaylik, ushbu tizimdagi birinchi struktura tenglamasi:

$$y_1 = \alpha_2 y_2 + \beta_1 x_1 + \beta_2 x_2 + e_1$$

Endogen o'zgaruvchi $y_2$qisqartirilgan shaklga ega:

$$y_2 = \pi_{12} x_1 + \pi_{22} x_2 + \cdots + \pi_{K2} x_K + v_2 = E(y_2) + v_2.$$

Qisqartirilgan shakl tenglamasining parametrlari doimiy ravishda eng kichik kvadratlar bilan baholanadi, shuning uchun uni quyidagicha ifodalaymiz.

$$\widehat{E(y_2)} = \hat{\pi}_{12} x_1 + \hat{\pi}_{22} x_2 + \cdots + \hat{\pi}_{k2} x_k$$

Qisqartirilgan shakl qoldiqlari esa:

$$\hat{v}_2 = y_2 - \widehat{E(y_2)}$$

Ikki bosqichli eng kichik kvadratlar hisoblagichi IV baholovchidan foydalanadi $\widehat{E(y_2)}$ instrumental o`zgaruvchi sifatida. K-sinf baholovchisi instrumental o'zgaruvchidan foydalangan holda IV baholovchi hisoblanadi $y_2 - kv_2$. LIML hisoblagichi foydalanadi $k = \hat{e}$ qayerdaki $\hat{e}$ ikki regressiyadan olingan kvadrat qoldiqlar yig‘indisining minimal nisbati. To`liq tushunish uchun POE4 qo’llanmaning 468-469-betlarida ma`lumotlar keltirilgan. Ueyn Fuller (1977)[2] tomonidan taklif qilingan modifikatsiya k-sinf qiymatidan foydalanadi.

$$k = \hat{e} - \frac{a}{N - K}$$

Bu yerda K - instrumental o'zgaruvchilarning umumiy soni (qo'shilgan va chiqarib tashlangan ekzogen o'zgaruvchilar) va N - tanlov hajmi. a qiymati doimiy - odatda 1 yoki 4 ga teng.

Mroz ma'lumotlari bilan biz HOURS taklif tenglamasini taxmin qilamiz:

$$HOURS = \beta_1 + \beta_2 MTR + \beta_3 EDUC + \beta_4 KIDSL6 + \beta_5 NWIFEINC + e$$

---

[1] Anderson, T.W. and H. Rubin (1949) “Estimation of the Parameters of a Single Equation in a Complete System of Stochastic Equations,” Annals of Mathematical Statistics, 21, pp. 46-63

[2] 2 “Some Properties of a Modification of the Limited Information Estimator,” Econometrica, 45, pp.939-953.

Ushbu misol ushbu qo'llanmaning 10.6-bobida ishlatilgan. Biz ko'rib chiqayotgan misolda ***educ*** va ***mtr*** hamda IV ***mothereduc*** va ***fathereduc*** hamda experience, ***exper*** endogen o'zgaruvchilari mavjud.

Yangi ishchi faylni oching va Mroz ma'lumotlarini qayta oching, xotirani tozalang. Misolda ishlatiladigan o'zgaruvchilarni yarating.

use mroz, clear

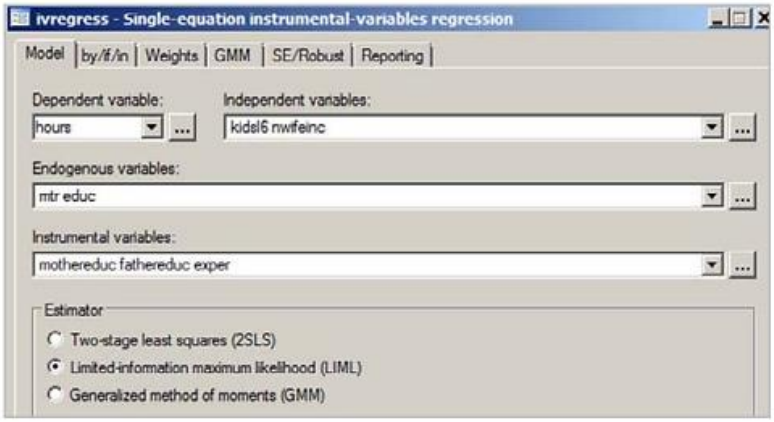
drop if lfp==0

gen lwage=ln(wage)

gen nwifeinc = (faminc-wage*hours)/1000

gen exper2 = exper^2

LIML baholari ***ivregress*** yordamida olinadi. ***db ivregress*** dialog oynasidan foydalanib, cheklangan ma'lumotlarning maksimal ehtimoli (LIML) tugmasini bosing.



Stata buyrug'i esa:

ivregress liml hours kidsl6 nwifeinc (mtr educ = mothereduc fathereduc exper)

```
. ivregress liml hours kidsl6 nwifeinc (mtr educ = mothereduc fathereduc exper)

Instrumental variables (LIML) regression          Number of obs =     428
                                                  Wald chi2(4)  =   36.52
                                                  Prob > chi2   =  0.0000
                                                  R-squared     =       .
                                                  Root MSE      =  852.35

------------------------------------------------------------------------------
       hours |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mtr |  -19196.52   3980.227    -4.82   0.000    -26997.62   -11395.42
        educ |  -197.2591   64.24267    -3.07   0.002    -323.1724   -71.34579
     kidsl6  |   207.5531   162.2957     1.28   0.201    -110.5406    525.6469
    nwifeinc |  -104.9415   20.56548    -5.10   0.000    -145.2491   -64.63395
       _cons |   18587.91   3662.026     5.08   0.000     11410.47    25765.35
------------------------------------------------------------------------------
Instrumented:  mtr educ
Instruments:   kidsl6 nwifeinc mothereduc fathereduc exper
```

Kuchsiz instrumental o`zgaruvchilar uchun test yordamida tekshiriladi.

estat firststage

```
. estat firststage

Shea's partial R-squared
```

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
mtr	0.0618	0.0529
educ	0.1042	0.0957

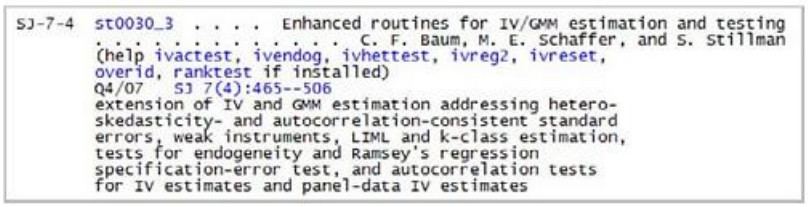
```
Minimum eigenvalue statistic = 8.60138

Critical Values                          # of endogenous regressors:    2
Ho: Instruments are weak                 # of excluded instruments:     3
```

2SLS relative bias	5%	10%	20%	30%
	(not available)			

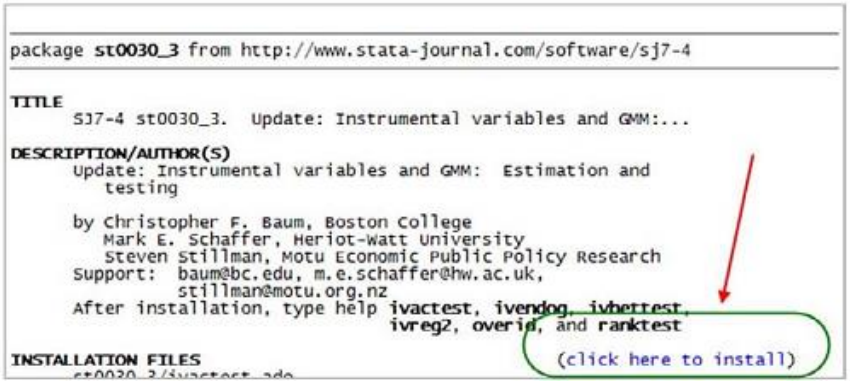
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	13.43	8.18	6.40	5.45
LIML Size of nominal 5% Wald test	5.44	3.81	3.32	3.09

10% maksimal hajmidan foydalanib, endogen o'zgaruvchining koeffitsientiga oid gipotezaning nominal 5% sinovi uchun Stata chiqishida kritik qiymat 5,44 sifatida berilgan. Biz Cragg-Donald F-test statistikasi (Stata tomonidan Minimal xos qiymat statistikasi deb ataladi) 8,60 dan foydalangan holda instrumental o`zgaruvchilar kuchsizligi haqidagi nol gipotezani rad qilamiz. Agar biz 2SLS/IV hisoblagichidan foydalansak, instrumental o`zgaruvchilar kuchsiz degan gipotezani rad etmagan bo'lardik, chunki kritik qiymat 13,43. Ushbu test haqida ko'proq ma'lumot olish uchun siz ushbu qo'llanmaning 10.6-bobiga va *Principles of Econometrics*, 4-nashr adabiyotning 11-bobi, B ilovasida ham ifodalanilgan.

Stata ***ivregress*** buyrug'ida Fullerning o'zgartirilgan k-sinfi uchun imkoniyat yo'q baholovchi. Biroq, foydalanish uchun foydalanuvchi tomonidan yozilgan tartib mavjud. Stata buyrug'i oynasida ***findit ivreg2*** ni kiriting. Ma`lumotni yordam oynasidan topishingiz mumkin.



st0030_3 tugmasini bosing. Olingan natijada siz ushbu paketni kompyuterda ma'muriy imtiyozlarga ega bo'lsangiz o'rnatishingiz mumkin.



Buyruqning sintaksisi **ivregress** ga o'xshaydi.

ivreg2 hours (mtr educ = mothereduc fathereduc exper) kidsl6 nwifeinc, fuller(1) small

Fullerr(1) variantida 1 a = 1 konstantasini o'rnatishni bildiradi. Natijaning yuqori qismida biz parametr baholarini va baholashda ishlatiladigan k-qiymatini, shuningdek qiymatini topamiz.

```
LIML estimation
---------------

k                =1.00051
lambda           =1.00288
Fuller parameter=1

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                 Number of obs =       428
                                                 F(  4,   423) =      9.22
                                                 Prob > F      =    0.0000
Total (centered) SS     =  257311019.9           Centered R2   =   -0.1746
Total (uncentered) SS   =   983895094            Uncentered R2 =    0.6928
Residual SS             =  302240888.2           Root MSE      =     845.3

------------------------------------------------------------------------------
       hours |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mtr |  -18730.16   3870.958    -4.84   0.000    -26338.87   -11121.45
        educ |  -191.1248   62.73944    -3.05   0.002    -314.4446   -67.80487
      kidsl6 |   193.2295   159.1413     1.21   0.225    -119.5767    506.0358
    nwifeinc |  -102.629    20.03279    -5.12   0.000    -142.0052   -63.25276
       _cons |   18156.78   3560.13      5.10   0.000     11159.04    25154.53
------------------------------------------------------------------------------
```

Hisob-kitoblarga qo'shimcha ravishda bizga avtomatik ravishda ko'plab diagnostika natijalari beriladi. Joriy maqsadlar uchun biz faqat kuchsiz instrumental o`zgaruvchilar testi natijalarini xabar qilamiz. Cragg-Donald F-statistik ma'lumotlar nisbiy tarafkashlikka asoslangan mezonlar uchun kritik qiymatlar bilan birga xabar qilinadi.

```
Weak identification test (Cragg-Donald Wald F statistic):                8.601
Stock-Yogo weak ID test critical values:  5% maximal Fuller rel. bias    10.83
                                         10% maximal Fuller rel. bias     8.96
                                         20% maximal Fuller rel. bias     7.18
                                         30% maximal Fuller rel. bias     6.15
                                          5% Fuller maximum bias         10.00
                                         10% Fuller maximum bias          8.39
                                         20% Fuller maximum bias          6.79
                                         30% Fuller maximum bias          5.88
NB: Critical values based on Fuller parameter=1
Source: Stock-Yogo (2005).  Reproduced by permission.
```

11.9. Monte Karlo simulatisiya natijalari

Bu rejada biz LIML va k-sinf baholovchilarining aspektlarini qo'shib, xuddi shu tajribadan foydalanamiz. Buyruq ushbu bobning oxiridagi 11-bobda to'liq berilgan. Tuzilma ushbu qo'llanmaning 10.8-bobida tushuntirilgan misol bilan davom ettiramiz. Birinchi qism, global boshqaruv parametrlari va ma'lumotlarni yaratish jarayoni o'zgarmagan.

```
clear all
set more off
global numobs 100
global pi 0.5                // reduced form parameter controls IV strength
global rho 0.8               // rho controls endogeneity
```

set seed 1234567 // random number seed
set obs $numobs
matrix sig = (1, $rho \ $rho, 1) // corr(e1,v2)
drawnorm e v, n($numobs) corr(sig) // e1 & v2 values
generate z1 = rnormal()
generate z2 = rnormal()
generate z3 = rnormal()
generate x = $pi*z1 + $pi*z2 + $pi*z3 + v // reduced form
generate y = x + e
correlate x e
regress x z1 z2 z3
regress y x
ivregress 2sls y (x=z1 z2 z3), small

Birinchi yangi element simulyatsiya qilingan ma'lumotlarga LIML hisoblagichini qo'llashdir. Buyruq va chiqish quyida keltirilgan. E'tibor bering, LIML baholari haqiqiy qiymatlarga yaqin, chunki biz instrumental o`zgaruvchilar kuchli bo'lishi uchun global o'zgaruvchisini ***$pi = 0,5*** o'rnatdik.

ivregress liml y (x=z1 z2 z3), small

```
. ivregress liml y (x=z1 z2 z3), small

Instrumental variables (LIML) regression

      Source |       SS       df       MS              Number of obs =     100
-------------+------------------------------           F(  1,    98) =   51.15
       Model |  356.810445     1  356.810445            Prob > F      =  0.0000
    Residual |  112.041511    98  1.14328073            R-squared     =  0.7610
-------------+------------------------------           Adj R-squared =  0.7586
       Total |  468.851956    99  4.73587834            Root MSE      =  1.0692

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   .9951923   .1391497     7.15   0.000     .7190542     1.27133
       _cons |   .1290802   .1074206     1.20   0.232    -.0840924    .3422528
------------------------------------------------------------------------------
Instrumented:  x
Instruments:   z1 z2 z3
```

Keyinchalik, a = 1 va a = 4 bo'lgan Fuller tomonidan o'zgartirilgan k-sinf baholovchisini kiritamiz.

ivreg2 y (x=z1 z2 z3), small fuller(1)

```
. ivreg2 y (x=z1 z2 z3), small fuller(1)

LIML estimation
---------------
k                =0.99954
lambda           =1.00996
Fuller parameter=1

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =       100
                                                      F(  1,    98) =     55.25
                                                      Prob > F      =    0.0000
Total (centered) SS     =  468.8519559                Centered R2   =    0.7671
Total (uncentered) SS   =  469.1579693                Uncentered R2 =    0.7672
Residual SS             =  109.2043273                Root MSE      =     1.056

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.010894   .1359953     7.43   0.000     .7410159    1.280772
       _cons |    .130244    .106042     1.23   0.222    -.0801929    .3406808
------------------------------------------------------------------------------
```

ivreg2 y (x=z1 z2 z3), small fuller(4)

```
. ivreg2 y (x=z1 z2 z3), small fuller(4)

LIML estimation
---------------
k                =0.96829
lambda           =1.00996
Fuller parameter=4

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =       100
                                                      F(  1,    98) =     68.37
                                                      Prob > F      =    0.0000
Total (centered) SS     =  468.8519559                Centered R2   =    0.7829
Total (uncentered) SS   =  469.1579693                Uncentered R2 =    0.7830
Residual SS             =  101.7893518                Root MSE      =     1.019

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |   1.054443   .1275256     8.27   0.000      .801373    1.307514
       _cons |   .1334717   .1023524     1.30   0.195    -.0696432    .3365867
------------------------------------------------------------------------------
```

Simulyatsiya uchun foydalaniladigan dastur tuzilishi jihatidan ushbu qo'llanmaning 10.8-rejasida qo'llangan dasturga o'xshaydi.

```
program ch11sim, rclass
version 11.1
drop _all
set obs $numobs

matrix sig = (1, $rho \ $rho, 1)          // cov(e1,v2)
drawnorm e v, n($numobs) corr(sig)  // e1 & v2 values
generate z1 = rnormal()
generate z2 = rnormal()
generate z3 = rnormal()
generate x = $pi*z1 + $pi*z2 + $pi*z3 + v
generate y = x + e

ivregress 2sls y (x=z1 z2 z3), small
```

return scalar b2sls =_b[x]
return scalar se2sls = _se[x]
return scalar t2sls = (_b[x]-1)/_se[x] return scalar r2sls = abs(return(t2sls))>invttail($numobs-2,.025)

Biz LIML va Fuller tomonidan o'zgartirilgan k-sinfni 2SLS bilan bir xil daromad bilan tanishtirdik.

ivregress liml y (x=z1 z2 z3), small
return scalar bliml =_b[x]
return scalar seliml = _se[x]
return scalar tliml = (_b[x]-1)/_se[x]
return scalar rliml = abs(return(tliml))>invttail($numobs-2,.025)

ivreg2 y (x=z1 z2 z3), small fuller(1)
return scalar bfull =_b[x]
return scalar sefull = _se[x]
return scalar tfull = (_b[x]-1)/_se[x]
return scalar rfull = abs(return(tfull))>invttail($numobs-2,.025)

ivreg2 y (x=z1 z2 z3), small fuller(4)
return scalar bfull4 =_b[x]
return scalar sefull4 = _se[x]
return scalar tfull4 = (_b[x]-1)/_se[x]
return scalar rfull4 = abs(return(tfull4))>invttail($numobs-2,.025)
end

Simulyatsiya buyrug'i ko'proq elementlarga ega, ammo ushbu qo'llanmaning 10.8-rejasidagi kabi tuzilishga ega.

simulate b2slsr=r(b2sls) se2slsr=r(se2sls) t2slsr=r(t2sls) ///
r2slsr=r(r2sls) blimlr=r(bliml) selimlr=r(seliml) ///
tlimlr=r(tliml) rlimlr=r(rliml) bfullr=r(bfull) ///
sefullr=r(sefull) tfullr=r(tfull) rfullr=r(rfull) ///
bfull4r=r(bfull4) sefull4r=r(sefull4) tfull4r=r(tfull4)///
rfull4r=r(rfull4), reps(10000) nodots nolegend seed(1234567):
ch11sim

2SLS uchun birinchi displey va natijalar ham ushbu qo'llanmaning 10.8-bobidagi bilan bir xil.

di " Simulation parameters"
di " rho = " $rho
di " N = " $numobs
di " pi = " $pi

```
. di " Simulation parameters"
 Simulation parameters

. di " rho = " $rho
 rho = .8

. di " N = " $numobs
 N = 100

. di " pi = "  $pi
 pi = .5
```

di " 2sls"

gen mse2sls = (b2slsr-1)^2

tabstat b2slsr se2slsr r2slsr mse2sls, stat(mean sd)

```
. tabstat b2slsr se2slsr r2slsr mse2sls, stat(mean sd)
```

stats	b2slsr	se2slsr	r2slsr	mse2sls
mean	1.011116	.11695	.0636	.0139068
sd	.1174081	.0274133	.2440512	.0227001

Yuqorida aytib o'tilganlarga e'tibor bering, o'rtacha 10 000 dan ortiq simulyatsiya qilingan ikki bosqichli eng kichik kvadratlarni baholash 1-haqiqiy koeffitsient parametr qiymatiga juda yaqin va haqiqiy nol gipotezaning t-testi kerak bo'lganidek, vaqtning taxminan 5% ni rad etadi.

di " liml"

gen mseliml = (blimlr-1)^2

tabstat blimlr selimlr rlimlr mseliml, stat(mean sd)

```
. tabstat blimlr selimlr rlimlr mseliml, stat(mean sd)
```

stats	blimlr	selimlr	rlimlr	mseliml
mean	.9881047	.1210493	.0509	.0153914
sd	.1234965	.029831	.2198045	.0276647

Yuqoridagi LIML natijalari ushbu kuchli IV misolda o'xshash.

di " fuller(1)"

gen msefull = (bfullr-1)^2

tabstat bfullr sefullr rfullr msefull, stat(mean sd)

```
. tabstat bfullr sefullr rfullr msefull, stat(mean sd)
```

stats	bfullr	sefullr	rfullr	msefull
mean	.999965	.1189061	.0553	.0141615
sd	.1190081	.0283846	.2285763	.0239569

Fuller tomonidan o'zgartirilgan a = 1 bo'lgan k-sinf baholovchisi deyarli xolis bo'lgan baholovchini ishlab chiqarish uchun mo'ljallangan va yuqoridagi natijalar ushbu maqsadga mos keladi.

di " fuller(4)"

gen msefull4 = (bfull4r-1)^2

tabstat bfull4r sefull4r rfull4r msefull4, stat(mean sd)

```
. tabstat bfull4r sefull4r rfull4r msefull4, stat(mean sd)

   stats |   bfull4r   sefull4r    rfull4r   msefull4
---------+--------------------------------------------
    mean |  1.033343   .1130738       .0812   .0126647
      sd |  .1074901   .0247115   .2731557   .0177391
```

Fuller tomonidan o'zgartirilgan a=4 bo'lgan k-sinf baholovchisi kichik o'rtacha kvadrat xatoga ega bo'lishi uchun mo'ljallangan va yuqoridagi natijalar uning boshqa baholovchilarga qaraganda past MSEga ega ekanligini ko'rsatadi. Eslatib o'tamiz, har bir baholovchi uchun o'rtacha kvadrat xatosi hisoblanadi.

$$mse(\beta_2) = \frac{\sum_{m=1}^{10000}(\beta_{2m} - \beta_2)^2}{10000}$$

XI bob mavzularini mustahkamlash uchun savollar

1. Truffles komponiyasi uchun talab va taklif modelini ifodalang.
2. Ikki bosqichli eng kichik kvadratlar (2SLS) hisoblaridan nima uchun foydalaniladi?
3. **Covariates** nima?
4. Qaysi buyruq o`garuvchining haqiqiyligini tekshirishni amalga oshiradi?
5. ***ln (QUAN)*** uchun qisqartirilgan shakl yordamida tenglama qanday tuziladi?
6. 2SLS orqali talabni baholash qanday amalga oshiriladi?
7. 2SLS ning alternativlari haqida nimalarni bilasiz?
8. Stata tomonidan Minimal xos qiymat statistikasi deb nimaga aytiladi?
9. Monte Karlo simulatisiya natijalari nima uchun qo’llaniladi?
10. Nima sababdan baholovchi uchun o'rtacha kvadrat xatosi hisoblanadi?