interaction term

gen x3=x1*x2

reg y x1 x2 x3

multiple items

g x1=x^3

reg y x x1

heteroskedasticity

```
. clear all

. global root "C:\Users\Sabrina\Desktop\econometrics"

. cd "$root"
C:\Users\Sabrina\Desktop\econometrics

. use nerlove.dta
(Nerlove 1963 paper)
```

test

1.residual plot

```
. reg lntc lnq lnpl lnpk lnpf
```

Source	SS	df	MS		
				Number of obs	= 145
				F(4, 140)	= 437.90
Model	269.524728	4	67.3811819	Prob > F	= 0.0000
Residual	21.5420958	140	.153872113	R-squared	= 0.9260
				Adj R-squared	= 0.9239
Total	291.066823	144	2.02129738	Root MSE	= .39227

lntc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnq	.7209135	.0174337	41.35	0.000	.6864462	.7553808
lnpl	.4559645	.299802	1.52	0.131	-.1367602	1.048689
lnpk	-.2151476	.3398295	-0.63	0.528	-.8870089	.4567136
lnpf	.4258137	.1003218	4.24	0.000	.2274721	.6241554
_cons	-3.566513	1.779383	-2.00	0.047	-7.084448	-.0485779

```
. rvfplot
```

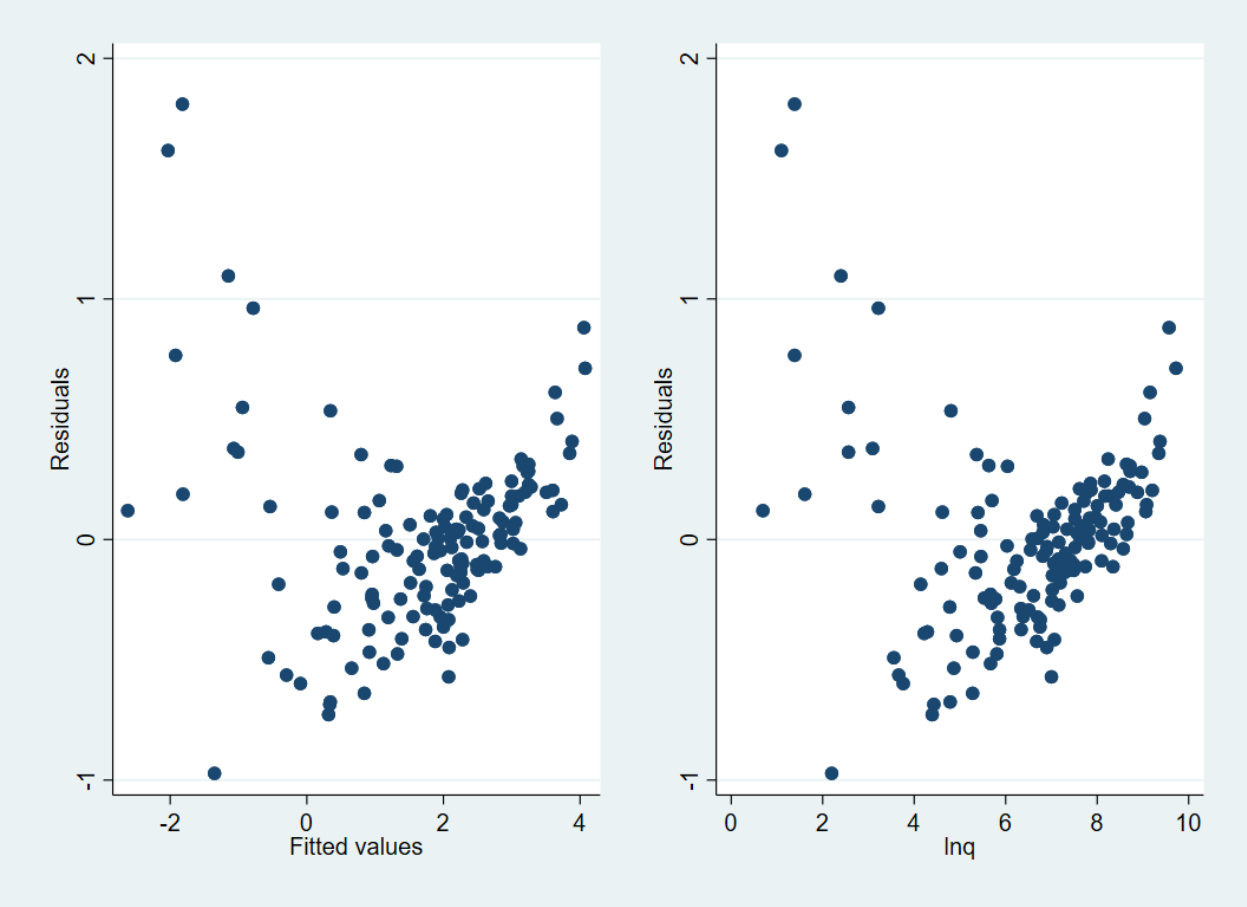
```
. graph save sca1,replace
(file sca1.gph saved)

. rvpplot lnq

. graph save sca2,replace
(file sca2.gph saved)

. graph combine sca1.gph sca2.gph

. graph export sca3.png,replace
(file sca3.png written in PNG format)
```



scatter

2.White Test

```
. estat imtest,white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(14)     =     73.88
```

```
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	73.88	14	0.0000
Skewness	22.79	4	0.0001
Kurtosis	2.62	1	0.1055
Total	99.29	19	0.0000

```
. ssc install whitetst
checking whitetst consistency and verifying not already installed...
all files already exist and are up to date.

. whitetst

White's general test statistic :   73.8771  Chi-sq(14)  P-value =  3.8e-10
```

3.BP Test

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lntc

         chi2(1)      =    96.53
         Prob > chi2  =   0.0000

. estat hettest,rhs

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: lnq lnpl lnpk lnpf

         chi2(4)      =   119.83
         Prob > chi2  =   0.0000

. estat hettest lnq

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: lnq

         chi2(1)      =   106.35
         Prob > chi2  =   0.0000
```

```
. estat hettest, iid

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lntc

         chi2(1)      =    29.13
         Prob > chi2  =   0.0000

. estat hettest,rhs iid

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: lnq lnpl lnpk lnpf

         chi2(4)      =    36.16
         Prob > chi2  =   0.0000

. estat hettest lnq, iid

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: lnq

         chi2(1)      =    32.10
         Prob > chi2  =   0.0000
```

correction

OLS + robust

```
. reg lntc lnq lnpl lnpk lnpf,r

Linear regression                               Number of obs     =        145
                                                F(4, 140)         =     177.19
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9260
                                                Root MSE          =     .39227
```

lntc	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnq	.7209135	.0325376	22.16	0.000	.656585	.785242
lnpl	.4559645	.260326	1.75	0.082	-.0587139	.9706429
lnpk	-.2151476	.3233711	-0.67	0.507	-.8544698	.4241745
lnpf	.4258137	.0740741	5.75	0.000	.2793653	.5722622
_cons	-3.566513	1.718304	-2.08	0.040	-6.963693	-.1693331

WLS

```
. quietly reg lntc lnq lnpl lnpk lnpf

. predict e11,res

. g e22=e11^2

. g lne22=log(e22)

. reg lne22 lnq,noc
```

Source	SS	df	MS	Number of obs	=	145
				F(1, 144)	=	419.95
Model	2065.53636	1	2065.53636	Prob > F	=	0.0000
Residual	708.275258	144	4.91857818	R-squared	=	0.7447
				Adj R-squared	=	0.7429
Total	2773.81162	145	19.1297353	Root MSE	=	2.2178

lne22	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnq	-.5527533	.0269733	-20.49	0.000	-.6060681	-.4994384

```
. predict lne22f
(option xb assumed; fitted values)

. g e22f = exp(lne22f)

. reg lntc lnq lnpl lnpk lnpf [aw=1/e22f]
(sum of wgt is 8,181.07969295173)
```

Source	SS	df	MS	Number of obs	=	145
				F(4, 140)	=	895.03
Model	173.069988	4	43.2674971	Prob > F	=	0.0000
Residual	6.76790874	140	.048342205	R-squared	=	0.9624
				Adj R-squared	=	0.9613
Total	179.837897	144	1.24887428	Root MSE	=	.21987

lntc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnq	.8759035	.0153841	56.94	0.000	.8454883	.9063187
lnpl	.5603879	.1734141	3.23	0.002	.2175389	.9032369
lnpk	-.0929807	.1960402	-0.47	0.636	-.4805627	.2946014
lnpf	.4672438	.0616476	7.58	0.000	.3453632	.5891243
_cons	-5.522088	.9928472	-5.56	0.000	-7.485	-3.559176

Logit & Probit Model

command:

probit: probit y x1 x2 x3,r

logit: logit y x1 x2 x3 , or vce(cluster clustvar)

examples:

```
. use "$root\11.6\womenwk.dta",clear

. reg work age married children education,r

Linear regression                               Number of obs     =      2,000
                                                F(4, 1995)        =     192.58
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2026
                                                Root MSE          =     .41992

------------------------------------------------------------------------------
             |               Robust
        work |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0102552   .0012236     8.38   0.000     .0078556    .0126548
     married |   .1111116   .0226719     4.90   0.000     .0666485    .1555748
    children |   .1153084   .0056978    20.24   0.000     .1041342    .1264827
   education |   .0186011   .0033006     5.64   0.000     .0121282     .025074
       _cons |  -.2073227   .0534581    -3.88   0.000    -.3121622   -.1024832
------------------------------------------------------------------------------

. logit work age married children education,nolog

Logistic regression                             Number of obs     =      2,000
                                                LR chi2(4)        =     476.62
                                                Prob > chi2       =     0.0000
Log likelihood = -1027.9144                     Pseudo R2         =     0.1882

------------------------------------------------------------------------------
        work |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0579303    .007221     8.02   0.000     .0437773    .0720833
     married |   .7417775   .1264705     5.87   0.000     .4938998    .9896552
    children |   .7644882   .0515289    14.84   0.000     .6634935     .865483
   education |   .0982513   .0186522     5.27   0.000     .0616936     .134809
       _cons |  -4.159247   .3320401   -12.53   0.000    -4.810034   -3.508461
------------------------------------------------------------------------------

. logit work age married children education, r nolog

Logistic regression                             Number of obs     =      2,000
```

```
                                                Wald chi2(4)      =     344.54
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -1027.9144               Pseudo R2         =     0.1882
```

work	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0579303	.0072054	8.04	0.000	.0438079	.0720527
married	.7417775	.1272191	5.83	0.000	.4924326	.9911224
children	.7644882	.0497584	15.36	0.000	.6669635	.8620129
education	.0982513	.019011	5.17	0.000	.0609904	.1355121
_cons	-4.159247	.327398	-12.70	0.000	-4.800936	-3.517559

```
. logit work age married children education, or nolog

Logistic regression                             Number of obs     =      2,000
                                                LR chi2(4)        =     476.62
                                                Prob > chi2       =     0.0000
Log likelihood = -1027.9144                     Pseudo R2         =     0.1882
```

work	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	1.059641	.0076517	8.02	0.000	1.04475	1.074745
married	2.099664	.2655457	5.87	0.000	1.638694	2.690307
children	2.147895	.1106786	14.84	0.000	1.941563	2.376153
education	1.10324	.0205779	5.27	0.000	1.063636	1.144318
_cons	.0156193	.0051862	-12.53	0.000	.0081476	.029943

```
Note: _cons estimates baseline odds.

. margins,dydx(*)

Average marginal effects                        Number of obs     =      2,000
Model VCE    : OIM

Expression   : Pr(work), predict()
dy/dx w.r.t. : age married children education
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0099674	.0011682	8.53	0.000	.0076778	.0122569
married	.127629	.021152	6.03	0.000	.0861717	.1690862
children	.1315365	.007073	18.60	0.000	.1176736	.1453994
education	.0169049	.0031243	5.41	0.000	.0107814	.0230285

```
. margins,dydx(*) atmeans

Conditional marginal effects                    Number of obs     =      2,000
Model VCE    : OIM

Expression   : Pr(work), predict()
dy/dx w.r.t. : age married children education
at           : age             =      36.208 (mean)
               married         =       .6705 (mean)
               children        =      1.6445 (mean)
               education       =      13.084 (mean)
```

	Delta-method				
	dy/dx	Std. Err.	z	P>|z|	[95% Conf. Interval]
age	.0115031	.0014236	8.08	0.000	.0087129 .0142934
married	.1472934	.0248209	5.93	0.000	.0986453 .1959415
children	.151803	.0093768	16.19	0.000	.1334249 .1701812
education	.0195096	.0036991	5.27	0.000	.0122596 .0267596

```
. margins,dydx(*) at(age==30)

Average marginal effects                        Number of obs     =      2,000
Model VCE    : OIM

Expression   : Pr(work), predict()
dy/dx w.r.t. : age married children education
at           : age             =          30
```

	Delta-method				
	dy/dx	Std. Err.	z	P>|z|	[95% Conf. Interval]
age	.011179	.0014719	7.59	0.000	.008294 .0140639
married	.1431427	.0232525	6.16	0.000	.0975687 .1887167
children	.1475253	.0074033	19.93	0.000	.1330151 .1620355
education	.0189598	.0034727	5.46	0.000	.0121534 .0257662

```
. logit work age married children education , nolog vce(cluster age)

Logistic regression                             Number of obs     =      2,000
                                                Wald chi2(4)      =     576.81
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -1027.9144               Pseudo R2         =     0.1882

                                (Std. Err. adjusted for 40 clusters in age)
```

	Robust

work	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0579303	.0055907	10.36	0.000	.0469728	.0688879
married	.7417775	.1084937	6.84	0.000	.5291337	.9544213
children	.7644882	.0540759	14.14	0.000	.6585014	.870475
education	.0982513	.0148423	6.62	0.000	.0691609	.1273416
_cons	-4.159247	.2494119	-16.68	0.000	-4.648086	-3.670409

```
. probit work age married children education ,nolog

Probit regression                                 Number of obs     =      2,000
                                                  LR chi2(4)        =     478.32
                                                  Prob > chi2       =     0.0000
Log likelihood = -1027.0616                       Pseudo R2         =     0.1889
```

work	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0347211	.0042293	8.21	0.000	.0264318	.0430105
married	.4308575	.074208	5.81	0.000	.2854125	.5763025
children	.4473249	.0287417	15.56	0.000	.3909922	.5036576
education	.0583645	.0109742	5.32	0.000	.0368555	.0798735
_cons	-2.467365	.1925635	-12.81	0.000	-2.844782	-2.089948

```
. margins,dydx(*)

Average marginal effects                          Number of obs     =      2,000
Model VCE    : OIM

Expression   : Pr(work), predict()
dy/dx w.r.t. : age married children education
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0100768	.0011647	8.65	0.000	.0077941	.0123595
married	.1250441	.0210541	5.94	0.000	.0837788	.1663094
children	.1298233	.0068418	18.98	0.000	.1164137	.1432329
education	.0169386	.0031183	5.43	0.000	.0108269	.0230504