Multiple linear regression 2

Morten Frydenberg ©
Institut for Biostatistik

Categorical variables in regression models.

The changing **reference** level

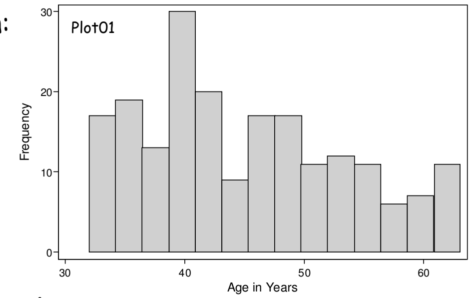
Interaction/effect modification

Interaction between a **categorical** and **continuous** variable

Interaction between two **categorical** variables

Categorical variable in regression models

The age distribution:



Let us divide *age* into **three** agegroups ,

0: *age*≤40, 1: 40<*age*≤50, 2: 50<*age*

and consider the new model

$$\ln(sbp) = \alpha_0 + \boxed{\alpha_1 \cdot age1 + \alpha_2 \cdot age2} + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

Categorical variable : age group 0 reference

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

age1 is one if a person is in age group **1** and zero otherwise
age2 is one if a person is in age group **2** and zero otherwise

The expected $\ln(sbp)$ in the three age groups will be:

$age < 40:\quad \ln(sbp) = \alpha_0 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

$40 \le age < 50:\quad \ln(sbp) = \alpha_0 + \alpha_1 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

$50 \le age:\quad \ln(sbp) = \alpha_0 + \alpha_2 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

We see that α_1 is the adjusted difference in $\ln(sbp)$ when comparing a person in the **second group** with one in the **first group**.

And α_2 is the adjusted difference in $\ln(sbp)$ when comparing a person in the **third group** with one in the **first group**.

Categorical variable : age group 0 reference

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

Finally we see that α_0 is the expected $\ln(sbp)$ for a man in the **first** (reference) age group, with $bmi=25$.

In most programs the model is fitted by first generating the grouping variable and then making the regression telling the program which variables are categorical.

In STATA this done like this:

```
egen agegrp3=cut(age), at(0,40,50,120) label
xi: regress lnSBP woman i.agegrp3 lnBMI25
```

Categorical variables included (→ xi:)

This is categorical (→ i.)

Categorical variable : age group 0 reference

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

agegrp3 is treated as categorical

The value 0 is chosen as reference

OUTPUT:

```
i.agegrp3         _Iagegrp3_0-2         (naturally coded; _Iagegrp3_0 omitted)

      Source |       SS       df       MS              Number of obs =     200
-------------+------------------------------           F(  4,   195) =   11.20
       Model |  .980169926     4  .245042482           Prob > F      =  0.0000
    Residual |  4.26524771   195  .021873065           R-squared     =  0.1869
-------------+------------------------------           Adj R-squared =  0.1702
       Total |  5.24541764   199  .026358883           Root MSE      =   .1479

------------------------------------------------------------------------------
       lnSBP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       woman |   .0035403   .0212026     0.17   0.868    -.0382757    .0453562
 _Iagegrp3_1 |   .0715136   .0253373     2.82   0.005     .0215432     .121484
 _Iagegrp3_2 |    .130465   .0280521     4.65   0.000     .0751404    .1857895
     lnBMI25 |   .2898622   .0772432     3.75   0.000     .1375229    .4422015
       _cons |   4.789641   .0224814   213.05   0.000     4.745303    4.833979
------------------------------------------------------------------------------
```


Categorical variable : age group 0 reference

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

Adjusted difference between for a person in **age group 1** compared to **age group 0**

```
------------------------------------------------------------------------------
       lnSBP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       woman |   .0035403   .0212026     0.17   0.868    -.0382757    .0453562
 _Iagegrp3_1 |   .0715136   .0253373     2.82   0.005     .0215432     .121484
 _Iagegrp3_2 |    .130465   .0280521     4.65   0.000     .0751404    .1857895
     lnBMI25 |   .2898622   .0772432     3.75   0.000     .1375229    .4422015
       _cons |   4.789641   .0224814   213.05   0.000     4.745303    4.833979
------------------------------------------------------------------------------
```

Adjusted difference between for a person in **age group 2** compared to **age group 0**

Expected value for a man in **age group 0** with bmi=25.

The expected values:

$age < 40$: $\ln(sbp) = \alpha_0 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

$40 \le age < 50$: $\ln(sbp) = \alpha_0 + \alpha_1 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

$50 \le age$: $\ln(sbp) = \alpha_0 + \alpha_2 \quad + \alpha_3 \cdot woman + \alpha_4 \cdot \ln(bmi/25)$

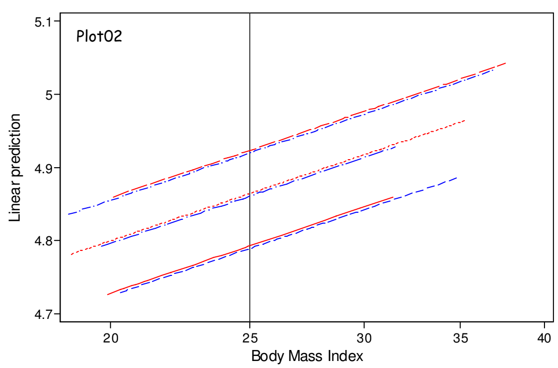
The estimates

```
       lnSBP |     Coef.
-------------+-----------
       woman |   .003540      3
 _Iagegrp3_1 |   .071514      1
 _Iagegrp3_2 |   .130465      2
     lnBMI25 |   .289862      4
       _cons |  4.789641      0
```

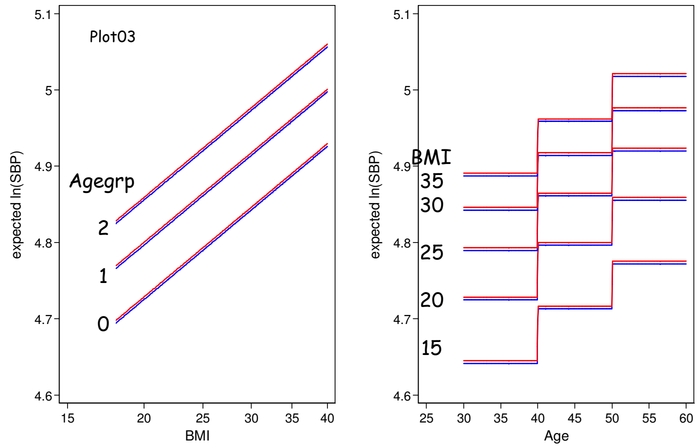
$age < 40$: $\ln(sbp) = 4.789 + \quad 0.004 \cdot woman + 0.290 \cdot \ln(bmi/25)$

$40 \le age < 50$: $\ln(sbp) = 4.789 + 0.072 + 0.004 \cdot woman + 0.290 \cdot \ln(bmi/25)$

$50 \le age$: $\ln(sbp) = 4.789 + 0.130 + 0.004 \cdot woman + 0.290 \cdot \ln(bmi/25)$



Agegroup	Women	Men
0:	$4.793 + 0.290 \cdot \ln(bmi/25)$	$4.790 + 0.290 \cdot \ln(bmi/25)$
1:	$4.865 + 0.290 \cdot \ln(bmi/25)$	$4.861 + 0.290 \cdot \ln(bmi/25)$
2:	$4.924 + 0.290 \cdot \ln(bmi/25)$	$4.920 + 0.290 \cdot \ln(bmi/25)$



Categorical variable : age group 1 reference

$$\ln(sbp) = \gamma_0 + \gamma_1 \cdot age0 + \gamma_2 \cdot age2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

$age0$ is one if a person is in age group **0** and zero otherwise
$age2$ is one if a person is in age group **2** and zero otherwise

The expected $\ln(sbp)$ in the three age groups will be:

$age < 40$: $\ln(sbp) = \gamma_0 + \gamma_1 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln(bmi/25)$

$40 \le age < 50$: $\ln(sbp) = \gamma_0 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln(bmi/25)$

$50 \le age$: $\ln(sbp) = \gamma_0 + \gamma_2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln(bmi/25)$

We see that γ_1 is the adjusted difference in $\ln(sbp)$ when comparing a person in the **first group** with one in the **second group**.

And γ_2 is the adjusted difference in $\ln(sbp)$ when comparing a person in the **third group** with one in the **second group**.

Categorical variable : age group 1 reference

$$\ln(sbp) = \gamma_0 + \gamma_1 \cdot age0 + \gamma_2 \cdot age2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

Finally we see that γ_0 is the expected $\ln(sbp)$ for a man in the **second** (reference) age group, with bmi=25.

Many programs (but regression in SPSS) let you chose the reference group

In STATA this done like this:

char agegrp3[*omit*]1 ← The group label 1 is reference

xi: *regress* lnSBP woman **i.**agegrp3 lnBMI25

Categorical variables included

This is categorical

Categorical variable : age group 1 reference

$$\ln(sbp) = \gamma_0 + \gamma_1 \cdot age0 + \gamma_2 \cdot age2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

agegrp3 is treated as categorical

The value 1 is chosen as reference

```
i.agegrp3         _Iagegrp3_0-2    (naturally coded; _Iagegrp3_1 omitted)

  Source |       SS       df       MS              Number of obs =     200
---------+------------------------------           F(  4,   195) =   11.20
   Model |  .980169926     4  .245042482           Prob > F      =  0.0000
Residual |  4.26524771   195  .021873065           R-squared     =  0.1869
---------+------------------------------           Adj R-squared =  0.1702
   Total |  5.24541764   199  .026358883           Root MSE      =   .1479

------------------------------------------------------------------------------
   lnSBP |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
   woman |   .0035403   .0212026     0.17   0.868     -.0382757    .0453562
_Iagegrp3_0 |  -.0715136   .0253373    -2.82   0.005     -.121484    -.0215432
_Iagegrp3_2 |   .0589513   .0263496     2.24   0.026     .0069846    .1109181
 lnBMI25 |   .2898622   .0772432     3.75   0.000     .1375229    .4422015
   _cons |   4.861154   .0207406    234.4   0.000     4.82025     4.902059
------------------------------------------------------------------------------
```

Categorical variable : age group 1 reference

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

Adjusted difference between for a person in **age group 0** compared to **age group 1**

lnSBP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
woman	.0035403	.0212026	0.17	0.868	-.0382757	.0453562
_Iagegrp3_0	-.0715136	.0253373	-2.82	0.005	-.121484	-.0215432
_Iagegrp3_2	.0589513	.0263496	2.24	0.026	.0069846	.1109181
lnBMI25	.2898622	.0772432	3.75	0.000	.1375229	.4422015
_cons	4.861154	.0207406	234.4	0.000	4.82025	4.902059

Adjusted difference between for a person in **age group 2** compared to **age group 1**

Expected value for a man in **age group 1** with bmi=25.

Categorical variable: Comparing to parameterizations

$$\ln(sbp) = \alpha_0 + \alpha_1 \cdot age1 + \alpha_2 \cdot age2 + \alpha_3 \cdot woman + \alpha_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

$$\ln(sbp) = \gamma_0 + \gamma_1 \cdot age0 + \gamma_2 \cdot age2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

age group 0: $\alpha_0 = \gamma_0 + \gamma_1$

age group 1: $\alpha_0 + \alpha_1 = \gamma_0$

age group 2: $\alpha_0 + \alpha_2 = \gamma_0 + \gamma_2$

$\alpha_0 = \gamma_0 + \gamma_1$ $\quad$ $\gamma_0 = \alpha_0 + \alpha_1$

$\alpha_1 = -\gamma_1$ $\quad$ $\gamma_1 = -\alpha_1$

$\alpha_2 = \gamma_2 - \gamma_1$ $\quad$ $\gamma_2 = \alpha_2 - \alpha_1$

$\alpha_3 = \gamma_3$ $\quad$ $\gamma_3 = \alpha_3$

$\alpha_4 = \gamma_4$ $\quad$ $\gamma_4 = \alpha_4$

Categorical variable: Comparing two parameterizations

The estimates:

age group 0 reference

Root MSE = .1479

lnSBP	Coef.	[95%	CI]
woman	.0035	-.0382	.0453
_Iagegrp3_1	.0715	.0215	.1214
_Iagegrp3_2	.1304	.0751	.1857
lnBMI25	.2898	.1375	.4422
_cons	4.7896	4.745	4.833

age group 1 reference

Root MSE = .1479

lnSBP	Coef.	[95%	CI]
woman	.0035	-.0382	.0453
_Iagegrp3_0	-.0715	-.1214	-.0215
_Iagegrp3_2	.0589	.0069	.1109
lnBMI25	.2898	.1375	.4422
_cons	4.8611	4.820	4.902

Note, the estimates fulfil the same equations.

The interpretation of the " **_Iagegrp3_2** line" and " **_cons** line" are altered!!!!!!!!!

Always remember: what is the reference group!

Categorical variable : age group 1 reference

lnSBP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
woman	.0035403	.0212026	0.17	0.868	-.0382757	.0453562
_Iagegrp3_0	-.0715136	.0253373	-2.82	0.005	-.121484	-.0215432
_Iagegrp3_2	.0589513	.0263496	2.24	0.026	.0069846	.1109181
lnBMI25	.2898622	.0772432	3.75	0.000	.1375229	.4422015
_cons	4.861154	.0207406	234.4	0.000	4.82025	4.902059

Two test:

One testing no difference between age group **0** and **1**.
One testing no difference between age group **2** and **1**.

Can we get **one test** testing no difference between age groups?

A F-test in STATA: *testparm* _Iagegrp3*

```
 ( 1)  _Iagegrp3_0 = 0
 ( 2)  _Iagegrp3_2 = 0
       F(  2,   195) =   10.93
            Prob > F =    0.0000
```

Highly significant

Interactions/effectmodification

$$\ln(sbp) = \gamma_0 + \gamma_1 \cdot age0 + \gamma_2 \cdot age2 + \gamma_3 \cdot woman + \gamma_4 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

One of the **central** assumptions was "no effect modification".

E.g. in model above the "effect" of **age**, **sex** and **bmi** did not depend on the value of each other.

One can **introduce** effect modification between a categorical variable and another variable.

Here we first will look at **agegr3** and **lnBMI25**.

The effect modification will be that the coefficient to lnBMI25 depend on **age group**.

That is, we will allow **different effect** of bmi in the **different age** groups.

Interactions/effectmodification

$$\ln(sbp) = \omega_0 + \omega_1 \cdot age0 + \omega_2 \cdot age2 + \omega_3 \cdot woman$$
$$+\omega_4 \cdot \ln\left(\frac{bmi}{25}\right) + \omega_5 \cdot age0 \cdot \ln\left(\frac{bmi}{25}\right) + \omega_6 \cdot age2 \cdot \ln\left(\frac{bmi}{25}\right) + E$$

$$age \le 40: \quad \ln(sbp) = (\omega_0 + \omega_1) + (\omega_4 + \omega_5) \cdot \ln\left(\frac{bmi}{25}\right) + \omega_3 \cdot woman$$

$$40 < age \le 50: \quad \ln(sbp) = \omega_0 + \omega_4 \cdot \ln\left(\frac{bmi}{25}\right) + \omega_3 \cdot woman$$

$$50 < age: \quad \ln(sbp) = (\omega_0 + \omega_2) + (\omega_4 + \omega_6) \cdot \ln\left(\frac{bmi}{25}\right) + \omega_3 \cdot woman$$

ω_1 is the **difference** between the constant for age **group 0** and **reference** group.
ω_5 is the **difference** between the coefficient to lnBMI25 for age **group 0** and **reference** group.

Interactions/effectmodification

```
 xi: regress lnSBP woman i.agegrp3*lnBMI25

i.agegrp3         _Iagegrp3_0-2     (naturally coded; _Iagegrp3_1 omitted)
i.ageg~3*lnB~25   _IageXlnBMI_#     (coded as above)

  Source |       SS       df       MS              Number of obs =     200
---------+------------------------------           F(  6,   193) =    7.53
   Model |  .994860827     6  .165810138           Prob > F      =  0.0000
Residual |  4.25055681   193   .02202361           R-squared     =  0.1897
---------+------------------------------           Adj R-squared =  0.1645
   Total |  5.24541764   199  .026358883           Root MSE      =   .1484

------------------------------------------------------------------
      lnSBP |    Coef.   Std. E.     t    P>|t|    [95% Conf. Interval]
------------+-----------------------------------------------------
      woman |  .0076438   .02191    0.35  0.728  -.03558      .0508772
 _Iagegrp3_0 | -.0708045   .02611   -2.71  0.007  -.1223213   -.0192877
 _Iagegrp3_2 |  .0631082   .02703    2.33  0.021   .009787     .1164287
     lnBMI25 |  .3155479   .12229    2.58  0.011   .074350     .5567453
_IageXlnBM~0 |  .0429736   .19123    0.22  0.822  -.334209      .420157
_IageXlnBM~2 | -.1165375   .18554   -0.63  0.531  -.482499     .2494241
       _cons |  4.859743   .02141   226.9  0.000   4.81751      4.901975
------------------------------------------------------------------
```


Interactions/effect modification

Ref: constant and 'slope' in reference group

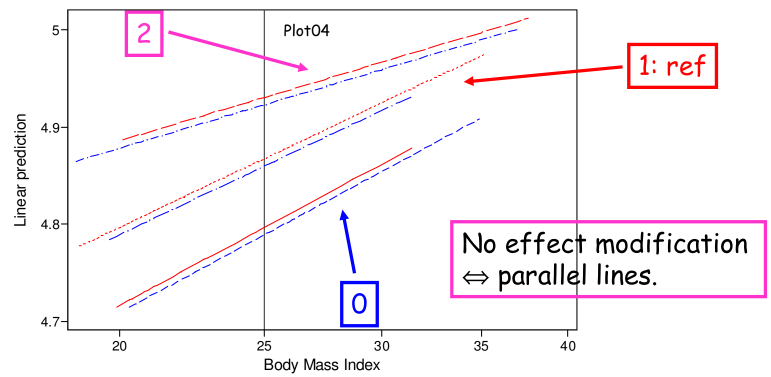
0: difference in constant and slope compared to reference

2: difference in constant and slope compared to reference

```
       lnSBP |    Coef.   Std. E.     t    P>|t|    [95% Conf. Interval]
-------------+-------------------------------------------------------
       woman |  .0076438   .02191    0.35  0.728  -.03558      .050877
0_Iagegrp3_0 | -.0708045   .02611   -2.71 0.007  -.1223213   -.019287
 _Iagegrp3_2 |  .0631082   .02703    2.33  0.021   .009787     .116428   2
     lnBMI25 |  .3155479   .12229    2.58  0.011   .074350     .556745   Ref
0IageXlnBM~0 |  .0429736   .19123    0.22  0.822  -.334209     .420157
_IageXlnBM~2 | -.1165375   .18554   -0.63  0.531  -.482499     .249424   2
       _cons |  4.859743   .02141   226.9  0.000   4.81751     4.901975  Ref
---------------------------------------------------------------------
```

Note the larger standard errors

Based on the estimates one can find the six "dose-response" curves:



Agegroup	Women	Men
0:	$4.797 + 0.359 \cdot \ln(bmi/25)$	$4.789 + 0.359 \cdot \ln(bmi/25)$
1:	$4.867 + 0.316 \cdot \ln(bmi/25)$	$4.860 + 0.316 \cdot \ln(bmi/25)$
2:	$4.930 + 0.199 \cdot \ln(bmi/25)$	$4.923 + 0.199 \cdot \ln(bmi/25)$

Interactions/effect modification

```
------------------------------------------------------------------------------
       lnSBP |     Coef.   Std. E.      t    P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
       woman |  .0076438   .02191     0.35  0.728  -.03558      .0508772
 _Iagegrp3_0 | -.0708045   .02611    -2.71  0.007  -.12232     -.0192877
 _Iagegrp3_2 |  .0631082   .02703     2.33  0.021   .009787     .1164287
     lnBMI25 |  .3155479   .12229     2.58  0.011   .074350     .5567453
_IageXlnBM~0 |  .0429736   .19123     0.22  0.822  -.334209     .420157
_IageXlnBM~2 | -.1165375   .18554    -0.63  0.531  -.482499     .2494241
       _cons |  4.859743   .02141    226.9  0.000  4.81751     4.901975
------------------------------------------------------------------------------
```

Two test:

One testing differences between "slope" in age group **0** and **1**.

One testing differences between "slope" in age group **2** and **1**.

Can we get **one test** testing no difference between age groups?

A F-test in STATA: *testparm* _IageX*

```
 ( 1)  _IageXlnBMI_0 = 0
 ( 2)  _IageXlnBMI_2 = 0
       F(  2,   193) =    0.33
            Prob > F =    0.7168
```

Non-significant

Interactions/effect modification

The test of no interaction was non-significant.

But look at the **confidence interval** for the difference in slope for between age group **2** and group **1** !

```
------------------------------------------------------------------------------
       lnSBP |     Coef.   Std. E.      t    P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
       woman |  .0076438   .02191     0.35  0.728  -.03558      .0508772
 _Iagegrp3_0 | -.0708045   .02611    -2.71 0.007  -.1223213   -.0192877
 _Iagegrp3_2 |  .0631082   .02703     2.33  0.021   .009787     .1164287
     lnBMI25 |  .3155479   .12229     2.58  0.011   .074350     .5567453
_IageXlnBM~0 |  .0429736   .19123     0.22  0.822  -.334209     .420157
_IageXlnBM~2 | -.1165375   .18554    -0.63  0.531  -.482499     .2494241
       _cons |  4.859743   .02141    226.9  0.000   4.81751     4.901975
------------------------------------------------------------------------------
```

It is very wide!!! We know very little about this difference!

The test for no interaction has **very low power**!!!

The data have very **little information** on whether there is effect modification.

Interaction between age group and sex

xi: regress lnSBP lnBMI25 **i.agegrp3*i.sex**

```
i.agegrp3         _Iagegrp3_0-2       (naturally coded; _Iagegrp3_1 omitted)
i.sex             _Isex_1-2           (naturally coded; _Isex_1 omitted)
i.age~3*i.sex     _IageXsex_#_#       (coded as above)

      Source |       SS       df       MS              Number of obs =     200
-------------+------------------------------           F(  6,   193) =    9.96
       Model |  1.24006476     6  .20667746            Prob > F      =  0.0000
    Residual |  4.00535288   193  .020753124           R-squared     =  0.2364
-------------+------------------------------           Adj R-squared =  0.2127
       Total |  5.24541764   199  .026358883           Root MSE      =  .14406
------------------------------------------------------------------------------
       lnSBP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnBMI25 |   .2265018   .0774898     2.92   0.004     .0736662    .3793374
 _Iagegrp3_0 |  -.0426734   .0377096    -1.13   0.259    -.1170493    .0317025
 _Iagegrp3_2 |  -.0025412   .0365457    -0.07   0.945    -.0746215    .0695391
     _Isex_2 |  -.0210869   .0322283    -0.65   0.514    -.0846518     .042478
_IageXse~0_2 |  -.0548967   .0501668    -1.09   0.275    -.1538422    .0440488
_IageXse~2_2 |    .133379   .0501308     2.66   0.008     .0345043    .2322536
       _cons |   4.873442   .0251767   193.57   0.000     4.823786    4.923099
------------------------------------------------------------------------------
. testparm _IageX*
 ( 1)  _IageXsex_0_2 = 0
 ( 2)  _IageXsex_2_2 = 0
       F(  2,   193) =    6.26
            Prob > F =    0.0023
```

Highly significant

Interaction between age group and sex

Differences between age groups among men are small

lnSBP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnBMI25	.2265018	.0774898	2.92	0.004	.0736662	.3793374
_Iagegrp3_0	-.0426734	.0377096	-1.13	0.259	-.1170493	.0317025
_Iagegrp3_2	-.0025412	.0365457	-0.07	0.945	-.0746215	.0695391
_Isex_2	-.0210869	.0322283	-0.65	0.514	-.0846518	.042478
_IageXse~0_2	-.0548967	.0501668	-1.09	0.275	-.1538422	.0440488
_IageXse~2_2	.133379	.0501308	2.66	0.008	.0345043	.2322536
_cons	4.873442	.0251767	193.57	0.000	4.823786	4.923099

Women age group 1: $4.873-0.021=4.852$

Women age group 0: $4.873-0.021-0.042-0.055=4.755$ (-0.097)

Women age group 2: $4.873-0.021-0.003+0.133=4.982$ (0.130)

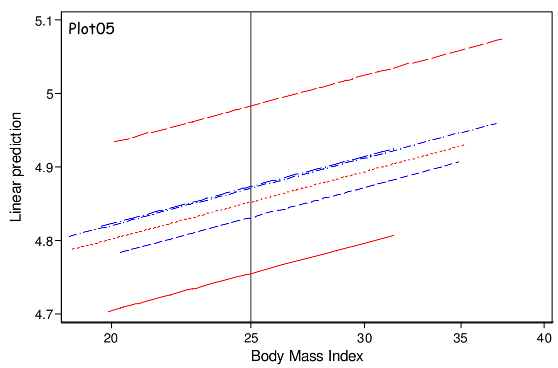
Large differences in the age groups among women.

Interaction between age group and sex

Using women as reference: *char* sex[*omit*]2

Large differences between age groups among women

lnSBP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnBMI25	.2265018	.0774898	2.92	0.004	.0736662	.3793374
_Iagegrp3_0	-.0975701	.0328469	-2.97	0.003	-.162355	-.0327852
_Iagegrp3_2	.1308378	.0354804	3.69	0.000	.0608587	.2008168
_Isex_1	.0210869	.0322283	0.65	0.514	-.042478	.0846518
_IageXse~0_1	.0548967	.0501668	1.09	0.275	-.0440488	.1538422
_IageXse~2_1	-.133379	.0501308	-2.66	0.008	-.2322536	-.0345043
_cons	4.852355	.0205502	236.12	0.000	4.811824	4.892887



Agegroup	Women	Men
0:	$4.755+0.227\cdot\ln(bmi/25)$	$4.831+0.227\cdot\ln(bmi/25)$
1:	$4.852+0.227\cdot\ln(bmi/25)$	$4.873+0.227\cdot\ln(bmi/25)$
2:	$4.982+0.227\cdot\ln(bmi/25)$	$4.871+0.227\cdot\ln(bmi/25)$