```
------------------------------------------------------------------------------------------------------------------------------------------------------------------------
      name:  <unnamed>
       log:  D:\Jason\workshop\interpreting, constructing, and  presenting interaction\2023\interpreting_2023.log
  log type:  text
 opened on:  23 Oct 2023, 11:23:08

.
. set more 1

.
.
. use http://www.stata-press.com/data/r14/margex, clear
(Artificial data for margins)

.
. *********************************
. * 1. Analyzing a two-ways interaction in the OLS regression
. *********************************
.
. reg y i.sex##c.age

      Source |       SS           df       MS      Number of obs   =     3,000
-------------+----------------------------------   F(3, 2996)      =    139.91
       Model |  170983.675         3  56994.5583   Prob > F        =    0.0000
    Residual |  1220449.33     2,996   407.35959   R-squared       =    0.1229
-------------+----------------------------------   Adj R-squared   =    0.1220
       Total |  1391433.01     2,999  463.965657   Root MSE        =    20.183

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
     female  |   14.92308   2.789012     5.35   0.000     9.454508    20.39165
         age |  -.4929608   .0480944   -10.25   0.000    -.5872622   -.3986595
             |
   sex#c.age |
     female  |  -.0224116   .0674167    -0.33   0.740    -.1545994    .1097762
             |
       _cons |   82.36936   1.812958    45.43   0.000      78.8146    85.92413
------------------------------------------------------------------------------

.
.         ************************************************************
.         * 1.1 Average Adjusted Prediction and Average Marginal Effect
.         ************************************************************
.         margins  i.sex,

Predictive margins                                  Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
       male  |   62.75002   .5509414   113.90   0.000     61.66975    63.83028
     female  |   76.78114   .5491282   139.82   0.000     75.70443    77.85784
------------------------------------------------------------------------------

.         margins, dydx(i.sex)
```

```
Average marginal effects                                    Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()
dy/dx wrt:  1.sex

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
     female  |   14.03112   .7778678    18.04   0.000     12.50591    15.55633
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 1.2 Adjusted Predictions and Marginal Effects at the Means
.         ************************************************************************
.         margins  i.sex,      atmeans

Adjusted predictions                                        Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()
At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
       male  |   62.75002   .5509414   113.90   0.000     61.66975    63.83028
     female  |   76.78114   .5491282   139.82   0.000     75.70443    77.85784
------------------------------------------------------------------------------

.         margins, dydx(i.sex) atmeans

Conditional marginal effects                                Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()
dy/dx wrt:  1.sex
At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
     female  |   14.03112   .7778678    18.04   0.000     12.50591    15.55633
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 1.3 Adjusted Predictions and Marginal Effects at Representative values and
.         ************************************************************************
.         margins  i.sex,      at(age=(20(10)80))
```

```
Adjusted predictions                                    Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()
1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60
6._at: age = 70
7._at: age = 80

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     _at#sex |
     1#male  |   72.51015   .9336568    77.66   0.000     70.67947    74.34082
   1#female  |     86.985    1.22567    70.97   0.000     84.58175    89.38824
     2#male  |   67.58054   .5984013   112.94   0.000     66.40722    68.75386
   2#female  |   81.83127   .8228617    99.45   0.000     80.21784     83.4447
     3#male  |   62.65093   .5541361   113.06   0.000     61.56441    63.73746
   3#female  |   76.67755   .5461908   140.39   0.000      75.6066    77.74849
     4#male  |   57.72132   .8477402    68.09   0.000     56.05911    59.38353
   4#female  |   71.52382    .604927   118.24   0.000     70.33771    72.70994
     5#male  |   52.79171   1.262091    41.83   0.000     50.31706    55.26637
   5#female  |    66.3701   .9380502    70.75   0.000     64.53081    68.20939
     6#male  |   47.86211   1.711636    27.96   0.000     44.50601    51.21821
   6#female  |   61.21637   1.356587    45.13   0.000     58.55644    63.87631
     7#male  |    42.9325   2.174658    19.74   0.000     38.66852    47.19647
   7#female  |   56.06265   1.801974    31.11   0.000     52.52942    59.59588
------------------------------------------------------------------------------

.         margins, dydx(i.sex) at(age=(20(10)80))

Conditional marginal effects                            Number of obs = 3,000
Model VCE: OLS

Expression: Linear prediction, predict()
dy/dx wrt:  1.sex
1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60
6._at: age = 70
7._at: age = 80

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
         _at |
          1  |   14.47485   1.540773     9.39   0.000     11.45377    17.49593
          2  |   14.25073   1.017441    14.01   0.000     12.25578    16.24568
          3  |   14.02662   .7780689    18.03   0.000     12.50101    15.55222
          4  |    13.8025   1.041441    13.25   0.000     11.76049    15.84451
          5  |   13.57838   1.572518     8.63   0.000     10.49506    16.66171
          6  |   13.35427   2.184039     6.11   0.000     9.071899    17.63664
```

```
          7  |   13.13015   2.824225     4.65   0.000     7.592536    18.66777
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.
. ****************************************************************
. * 2. Analyzing a two-ways interaction in the Logistic regression
. ****************************************************************
.
. logit outcome i.sex##c.age

Iteration 0:  Log likelihood = -1366.0718
Iteration 1:  Log likelihood = -1130.6519
Iteration 2:  Log likelihood = -1086.7145
Iteration 3:  Log likelihood =   -1084.73
Iteration 4:  Log likelihood = -1084.7241
Iteration 5:  Log likelihood = -1084.7241

Logistic regression                                     Number of obs =  3,000
                                                        LR chi2(3)    = 562.70
                                                        Prob > chi2   = 0.0000
Log likelihood = -1084.7241                             Pseudo R2     = 0.2060

------------------------------------------------------------------------------
     outcome | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
      female |     1.3517    .622081     2.17   0.030     .1324438    2.570957
         age |    .110599    .010689    10.35   0.000      .089649     .131549
             |
   sex#c.age |
      female |  -.0104589   .0130144    -0.80   0.422    -.0359667    .0150489
             |
       _cons |  -7.030922   .5024759   -13.99   0.000    -8.015757   -6.046088
------------------------------------------------------------------------------

.
.         ***********************************************************
.         * 2.1 Average Adjusted Prediction and Average Marginal Effect
.         ***********************************************************
.         margins  i.sex,

Predictive margins                                      Number of obs = 3,000
Model VCE: OIM

Expression: Pr(outcome), predict()

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
        male |   .1126685   .0093343    12.07   0.000     .0943737    .1309633
      female |    .208375   .0090897    22.92   0.000     .1905596    .2261905
------------------------------------------------------------------------------

.         margins, dydx(i.sex)

Average marginal effects                                Number of obs = 3,000
Model VCE: OIM

Expression: Pr(outcome), predict()
```

```
dy/dx wrt:  1.sex

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
     female  |   .0957065   .0130288     7.35   0.000     .0701705    .1212426
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 2.2 Adjusted Predictions and Marginal Effects at the Means
.         ************************************************************************
.         margins  i.sex,      atmeans

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM

Expression: Pr(outcome), predict()
At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
       male  |   .0672832   .0076099     8.84   0.000     .0523679    .0821984
     female  |   .1552839   .0120209    12.92   0.000     .1317234    .1788445
------------------------------------------------------------------------------

.         margins, dydx(i.sex) atmeans

Conditional marginal effects                          Number of obs = 3,000
Model VCE: OIM

Expression: Pr(outcome), predict()
dy/dx wrt:  1.sex
At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
         sex |
     female  |   .0880008   .0142272     6.19   0.000      .060116    .1158856
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 2.3 Adjusted Predictions and Marginal Effects at Representative values and
.         ************************************************************************
.         margins  i.sex,      at(age=(20(10)60))

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM
```

```
Expression: Pr(outcome), predict()
1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
     _at#sex |
     1#male  |   .0080106    .002354     3.40   0.001      .003397    .0126243
   1#female  |   .0246885   .0053467     4.62   0.000     .0142092    .0351678
     2#male  |    .023824   .0046315     5.14   0.000     .0147463    .0329016
   2#female  |   .0644637   .0091944     7.01   0.000     .0464431    .0824843
     3#male  |   .0686917   .0076827     8.94   0.000     .0536339    .0837496
   3#female  |   .1579425   .0120468    13.11   0.000     .1343312    .1815539
     4#male  |   .1822807   .0163514    11.15   0.000     .1502325     .214329
   4#female  |   .3380009   .0144851    23.33   0.000     .3096107    .3663911
     5#male  |   .4025188   .0433544     9.28   0.000     .3175457     .487492
   5#female  |   .5815612   .0257546    22.58   0.000     .5310831    .6320392
------------------------------------------------------------------------------

.         margins, dydx(i.sex) at(age=(20(10)60))

Conditional marginal effects                              Number of obs = 3,000
Model VCE: OIM

Expression: Pr(outcome), predict()
dy/dx wrt:  1.sex
1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
         _at |
          1  |   .0166779   .0058419     2.85   0.004     .0052279    .0281278
          2  |   .0406397    .010295     3.95   0.000     .0204619    .0608176
          3  |   .0892508   .0142881     6.25   0.000     .0612466     .117255
          4  |   .1557201   .0218446     7.13   0.000     .1129055    .1985348
          5  |   .1790423   .0504272     3.55   0.000     .0802068    .2778779
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.
.
. ****************************
. * 3. multinomial logistic regression
. ****************************
.
. mlogit group i.sex##c.age

Iteration 0:  Log likelihood = -3213.9305
```

```
Iteration 1:  Log likelihood = -2441.2113
Iteration 2:  Log likelihood = -2339.4727
Iteration 3:  Log likelihood = -2324.0574
Iteration 4:  Log likelihood = -2323.1654
Iteration 5:  Log likelihood = -2323.1628
Iteration 6:  Log likelihood = -2323.1628

Multinomial logistic regression                       Number of obs =   3,000
                                                      LR chi2(6)    = 1781.54
                                                      Prob > chi2   =  0.0000
Log likelihood = -2323.1628                           Pseudo R2     =  0.2772

------------------------------------------------------------------------------
       group | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
1            |  (base outcome)
-------------+----------------------------------------------------------------
2            |
         sex |
      female |  -2.361453   .4732721    -4.99   0.000     -3.28905   -1.433857
         age |  -.0884692   .0088024   -10.05   0.000    -.1057215   -.0712169
             |
   sex#c.age |
      female |   .0116919   .0105998     1.10   0.270    -.0090833    .0324671
             |
       _cons |   4.863548   .4000653    12.16   0.000     4.079434    5.647661
-------------+----------------------------------------------------------------
3            |
         sex |
      female |   -3.10343   .7024166    -4.42   0.000    -4.480142   -1.726719
         age |  -.1600698   .0099236   -16.13   0.000    -.1795197   -.1406199
             |
   sex#c.age |
      female |   -.023138   .0203289    -1.14   0.255    -.0629819    .0167058
             |
       _cons |   7.224298   .4232181    17.07   0.000     6.394806     8.05379
------------------------------------------------------------------------------

.
.         ************************************************************
.         * 3.1 Average Adjusted Prediction and Average Marginal Effect
.         ************************************************************
.         margins  i.sex,

Predictive margins                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
_predict#sex |
     1#male  |   .1963344   .0109191    17.98   0.000     .1749333    .2177355
   1#female  |   .5876871   .0122378    48.02   0.000     .5637015    .6116728
     2#male  |   .4564214   .0134995    33.81   0.000     .4299629    .4828799
   2#female  |   .3454528   .0127735    27.04   0.000     .3204172    .3704885
     3#male  |   .3472442   .0109808    31.62   0.000     .3257222    .3687663
   3#female  |     .06686   .0076335     8.76   0.000     .0518987    .0818213
------------------------------------------------------------------------------
```

```
.         margins, dydx(i.sex)

Average marginal effects                                  Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
    _predict |
          1  |   .3913528    .016401    23.86   0.000     .3592075     .423498
          2  |  -.1109686   .0185849    -5.97   0.000    -.1473943   -.0745428
          3  |  -.2803842   .0133734   -20.97   0.000    -.3065956   -.2541728
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 3.2 Adjusted Predictions and Marginal Effects at the Means
.         ************************************************************************
.         margins  i.sex,      atmeans

Adjusted predictions                                      Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
_predict#sex |
     1#male  |   .1393318   .0108882    12.80   0.000     .1179914    .1606723
   1#female  |   .6184776   .0144219    42.88   0.000     .5902113    .6467439
     2#male  |   .5334788   .0156358    34.12   0.000     .5028332    .5641243
   2#female  |   .3555603   .0141027    25.21   0.000     .3279194    .3832011
     3#male  |   .3271894   .0151745    21.56   0.000     .2974479     .356931
   3#female  |   .0259622   .0054847     4.73   0.000     .0152123     .036712
------------------------------------------------------------------------------

.         margins, dydx(i.sex) atmeans

Conditional marginal effects                              Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex
```

```
1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

At: 0.sex = .4993333 (mean)
    1.sex = .5006667 (mean)
    age   =   39.799 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
    _predict |
           1 |   .4791458   .0180705    26.52   0.000     .4437283    .5145633
           2 |  -.1779185   .0210562    -8.45   0.000    -.2191879   -.1366491
           3 |  -.3012272   .0161353   -18.67   0.000    -.3328519   -.2696026
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ********************************************************************
.         * 3.3 Adjusted Predictions and Marginal Effects at Representative values and
.         ********************************************************************
.         margins  i.sex,      at(age=(20(10)60))

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60

------------------------------------------------------------------------------
                 |            Delta-method
                 |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-----------------+------------------------------------------------------------
_predict#_at#sex |
       1#1#male  |   .0126692   .0028692     4.42   0.000     .0070457    .0182927
     1#1#female  |   .1920224   .0228275     8.41   0.000     .1472813    .2367635
       1#2#male  |   .0467692   .0066373     7.05   0.000     .0337604     .059778
     1#2#female  |   .4044238    .021257    19.03   0.000     .3627608    .4460867
       1#3#male  |   .1421408   .0109796    12.95   0.000     .1206213    .1636604
     1#3#female  |   .6224511   .0143228    43.46   0.000      .594379    .6505232
       1#4#male  |   .3320474   .0208241    15.95   0.000     .2912329    .3728619
     1#4#female  |    .787917   .0130506    60.37   0.000     .7623382    .8134958
       1#5#male  |   .5768218   .0383867    15.03   0.000     .5015853    .6520583
     1#5#female  |   .8905212   .0121263    73.44   0.000     .8667539    .9142884
       2#1#male  |   .2795929   .0208103    13.44   0.000     .2388054    .3203804
     2#1#female  |   .5047988   .0395215    12.77   0.000      .427338    .5822596
       2#2#male  |   .4261096    .015173    28.08   0.000     .3963711    .4558481
     2#2#female  |   .4933594   .0211976    23.27   0.000      .451813    .5349059
       2#3#male  |   .5346418   .0157039    34.05   0.000     .5038627    .5654208
     2#3#female  |   .3523646   .0140078    25.15   0.000     .3249099    .3798194
       2#4#male  |   .5156169   .0212172    24.30   0.000      .474032    .5572017
```

```
     2#4#female  |   .2069798   .0129141    16.03   0.000     .1816685     .232291
       2#5#male  |   .3697871   .0352686    10.48   0.000     .3006619    .4389123
     2#5#female  |   .1085555    .012078     8.99   0.000      .084883    .1322281
       3#1#male  |   .7077379   .0212994    33.23   0.000     .6659919    .7494839
     3#1#female  |   .3031788   .0460007     6.59   0.000     .2130191    .3933386
       3#2#male  |   .5271211   .0154281    34.17   0.000     .4968825    .5573597
     3#2#female  |   .1022168   .0122213     8.36   0.000     .0782635     .12617
       3#3#male  |   .3232174   .0152249    21.23   0.000     .2933772    .3530576
     3#3#female  |   .0251843   .0053923     4.67   0.000     .0146155     .035753
       3#4#male  |   .1523357   .0149037    10.22   0.000      .123125    .1815464
     3#4#female  |   .0051032   .0018942     2.69   0.007     .0013906    .0088158
       3#5#male  |   .0533911    .009203     5.80   0.000     .0353536    .0714286
     3#5#female  |   .0009233   .0004988     1.85   0.064    -.0000544     .001901
------------------------------------------------------------------------------

.         margins, dydx(i.sex) at(age=(20(10)60))

Conditional marginal effects                              Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
_predict#_at |
        1 1  |   .1793532   .0230071     7.80   0.000     .1342601    .2244463
        1 2  |   .3576545   .0222691    16.06   0.000     .3140079    .4013012
        1 3  |   .4803103    .018047    26.61   0.000     .4449389    .5156816
        1 4  |   .4558696   .0245757    18.55   0.000     .4077022     .504037
        1 5  |   .3136994   .0402565     7.79   0.000     .2347981    .3926006
        2 1  |   .2252059   .0446657     5.04   0.000     .1376628     .312749
        2 2  |   .0672498   .0260683     2.58   0.010     .0161569    .1183427
        2 3  |  -.1822771   .0210435    -8.66   0.000    -.2235217   -.1410325
        2 4  |  -.3086371   .0248383   -12.43   0.000    -.3573193   -.2599549
        2 5  |  -.2612315   .0372794    -7.01   0.000    -.3342978   -.1881652
        3 1  |  -.4045591   .0506925    -7.98   0.000    -.5039146   -.3052036
        3 2  |  -.4249043   .0196821   -21.59   0.000    -.4634806    -.386328
        3 3  |  -.2980331   .0161516   -18.45   0.000    -.3296896   -.2663766
        3 4  |  -.1472325   .0150236    -9.80   0.000    -.1766782   -.1177868
        3 5  |  -.0524678   .0092165    -5.69   0.000    -.0705318   -.0344038
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.
.
. ******************************************************
. * 4. Plotting the results from the -margins- command
```

```
. ****************************************************
. use http://www.stata-press.com/data/r14/margex, clear
(Artificial data for margins)

. mlogit group i.sex##c.age

Iteration 0:  Log likelihood = -3213.9305
Iteration 1:  Log likelihood = -2441.2113
Iteration 2:  Log likelihood = -2339.4727
Iteration 3:  Log likelihood = -2324.0574
Iteration 4:  Log likelihood = -2323.1654
Iteration 5:  Log likelihood = -2323.1628
Iteration 6:  Log likelihood = -2323.1628

Multinomial logistic regression                       Number of obs =   3,000
                                                      LR chi2(6)    = 1781.54
                                                      Prob > chi2   =  0.0000
Log likelihood = -2323.1628                           Pseudo R2     =  0.2772

------------------------------------------------------------------------------
       group | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
1            |  (base outcome)
-------------+----------------------------------------------------------------
2            |
         sex |
     female  |  -2.361453   .4732721    -4.99   0.000     -3.28905   -1.433857
         age |  -.0884692   .0088024   -10.05   0.000    -.1057215   -.0712169
             |
   sex#c.age |
     female  |   .0116919   .0105998     1.10   0.270    -.0090833    .0324671
             |
       _cons |   4.863548   .4000653    12.16   0.000     4.079434    5.647661
-------------+----------------------------------------------------------------
3            |
         sex |
     female  |   -3.10343   .7024166    -4.42   0.000    -4.480142   -1.726719
         age |  -.1600698   .0099236   -16.13   0.000    -.1795197   -.1406199
             |
   sex#c.age |
     female  |   -.023138   .0203289    -1.14   0.255    -.0629819    .0167058
             |
       _cons |   7.224298   .4232181    17.07   0.000     6.394806     8.05379
------------------------------------------------------------------------------

.
.
.         ************************************
.         * 4.1. Plotting the Adjusted Predictions
.         ************************************
.         margins  i.sex,      at(age=(20(10)60))

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

1._at: age = 20
2._at: age = 30
3._at: age = 40
4._at: age = 50
```

5._at: age = 60

	Delta-method				
	Margin	std. err.	z	P>|z|	[95% conf. interval]
_predict#_at#sex					
1#1#male	.0126692	.0028692	4.42	0.000	.0070457 .0182927
1#1#female	.1920224	.0228275	8.41	0.000	.1472813 .2367635
1#2#male	.0467692	.0066373	7.05	0.000	.0337604 .059778
1#2#female	.4044238	.021257	19.03	0.000	.3627608 .4460867
1#3#male	.1421408	.0109796	12.95	0.000	.1206213 .1636604
1#3#female	.6224511	.0143228	43.46	0.000	.594379 .6505232
1#4#male	.3320474	.0208241	15.95	0.000	.2912329 .3728619
1#4#female	.787917	.0130506	60.37	0.000	.7623382 .8134958
1#5#male	.5768218	.0383867	15.03	0.000	.5015853 .6520583
1#5#female	.8905212	.0121263	73.44	0.000	.8667539 .9142884
2#1#male	.2795929	.0208103	13.44	0.000	.2388054 .3203804
2#1#female	.5047988	.0395215	12.77	0.000	.427338 .5822596
2#2#male	.4261096	.015173	28.08	0.000	.3963711 .4558481
2#2#female	.4933594	.0211976	23.27	0.000	.451813 .5349059
2#3#male	.5346418	.0157039	34.05	0.000	.5038627 .5654208
2#3#female	.3523646	.0140078	25.15	0.000	.3249099 .3798194
2#4#male	.5156169	.0212172	24.30	0.000	.474032 .5572017
2#4#female	.2069798	.0129141	16.03	0.000	.1816685 .232291
2#5#male	.3697871	.0352686	10.48	0.000	.3006619 .4389123
2#5#female	.1085555	.012078	8.99	0.000	.084883 .1322281
3#1#male	.7077379	.0212994	33.23	0.000	.6659919 .7494839
3#1#female	.3031788	.0460007	6.59	0.000	.2130191 .3933386
3#2#male	.5271211	.0154281	34.17	0.000	.4968825 .5573597
3#2#female	.1022168	.0122213	8.36	0.000	.0782635 .12617
3#3#male	.3232174	.0152249	21.23	0.000	.2933772 .3530576
3#3#female	.0251843	.0053923	4.67	0.000	.0146155 .035753
3#4#male	.1523357	.0149037	10.22	0.000	.123125 .1815464
3#4#female	.0051032	.0018942	2.69	0.007	.0013906 .0088158
3#5#male	.0533911	.009203	5.80	0.000	.0353536 .0714286
3#5#female	.0009233	.0004988	1.85	0.064	-.0000544 .001901

```
.         marginsplot, yline(0)

Variables that uniquely identify margins: age sex

.         marginsplot, by(sex) yline(0)

Variables that uniquely identify margins: age sex

.
.         ************************************
.         * 4.2 Plotting the marginal effect
.         ************************************
.         margins, dydx(i.sex) at(age=(20(10)60))

Conditional marginal effects                              Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(group==1), predict(pr outcome(1))
2._predict: Pr(group==2), predict(pr outcome(2))
3._predict: Pr(group==3), predict(pr outcome(3))

1._at: age = 20
```

```
2._at: age = 30
3._at: age = 40
4._at: age = 50
5._at: age = 60

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
_predict#_at |
        1 1  |   .1793532   .0230071     7.80   0.000     .1342601    .2244463
        1 2  |   .3576545   .0222691    16.06   0.000     .3140079    .4013012
        1 3  |   .4803103    .018047    26.61   0.000     .4449389    .5156816
        1 4  |   .4558696   .0245757    18.55   0.000     .4077022     .504037
        1 5  |   .3136994   .0402565     7.79   0.000     .2347981    .3926006
        2 1  |   .2252059   .0446657     5.04   0.000     .1376628     .312749
        2 2  |   .0672498   .0260683     2.58   0.010     .0161569    .1183427
        2 3  |  -.1822771   .0210435    -8.66   0.000    -.2235217   -.1410325
        2 4  |  -.3086371   .0248383   -12.43   0.000    -.3573193   -.2599549
        2 5  |  -.2612315   .0372794    -7.01   0.000    -.3342978   -.1881652
        3 1  |  -.4045591   .0506925    -7.98   0.000    -.5039146   -.3052036
        3 2  |  -.4249043   .0196821   -21.59   0.000    -.4634806    -.386328
        3 3  |  -.2980331   .0161516   -18.45   0.000    -.3296896   -.2663766
        3 4  |  -.1472325   .0150236    -9.80   0.000    -.1766782   -.1177868
        3 5  |  -.0524678   .0092165    -5.69   0.000    -.0705318   -.0344038
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.         marginsplot, yline(0)

Variables that uniquely identify margins: age

.
.
.
. ********************************************************************
. * 5. A three-way interactions in multi-nomial logistic regression
. ********************************************************************
.
. use http://www.stata-press.com/data/r14/margex, clear
(Artificial data for margins)

.
. mlogit outcome i.sex##c.age##c.c.distance

Iteration 0:  Log likelihood = -1366.0718
Iteration 1:  Log likelihood = -1102.3021
Iteration 2:  Log likelihood = -1047.5329
Iteration 3:  Log likelihood = -1042.4399
Iteration 4:  Log likelihood = -1041.1972
Iteration 5:  Log likelihood = -1040.8305
Iteration 6:  Log likelihood = -1040.6898
Iteration 7:  Log likelihood =  -1040.572
Iteration 8:  Log likelihood = -1040.5711
Iteration 9:  Log likelihood = -1040.5711

Multinomial logistic regression                       Number of obs =  3,000
                                                      LR chi2(7)    = 651.00
                                                      Prob > chi2   = 0.0000
Log likelihood = -1040.5711                           Pseudo R2     = 0.2383
```

```
------------------------------------------------------------------------------
             outcome | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
---------------------+--------------------------------------------------------------
0                    |  (base outcome)
---------------------+--------------------------------------------------------------
1                    |
                 sex |
              female |   1.177999   .9253177     1.27   0.203    -.6355902    2.991588
                 age |   .1134498   .0155369     7.30   0.000     .0829979    .1439016
                     |
           sex#c.age |
              female |  -.0063463    .019768    -0.32   0.748    -.0450909    .0323984
                     |
            distance |  -.0580359   .1127179    -0.51   0.607    -.2789589     .162887
                     |
      sex#c.distance |
              female |   .0339922   .1238225     0.27   0.784    -.2086955    .2766799
                     |
    c.age#c.distance |   .0007253   .0021538     0.34   0.736     -.003496    .0049467
                     |
sex#c.age#c.distance |
              female |  -.0005472    .002361    -0.23   0.817    -.0051746    .0040802
                     |
               _cons |   -6.90129   .7110662    -9.71   0.000    -8.294954   -5.507626
------------------------------------------------------------------------------
Note: 100 observations completely determined. Standard errors questionable.

.
.
.         * 5.1 Average Adjusted Prediction and Average Marginal Effect
.         ************************************************************
.         margins  i.sex,

Predictive margins                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
_predict#sex |
     1#male  |   .8914869   .0102949    86.59   0.000     .8713092    .9116646
   1#female  |   .7897127   .0093267    84.67   0.000     .7714328    .8079926
     2#male  |   .1085131   .0102949    10.54   0.000     .0883354    .1286908
   2#female  |   .2102873   .0093267    22.55   0.000     .1920074    .2285672
------------------------------------------------------------------------------

.         margins, dydx(i.sex)

Average marginal effects                            Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

------------------------------------------------------------------------------
             |            Delta-method
```

```
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+------------------------------------------------------------------
0.sex        |  (base outcome)
-------------+------------------------------------------------------------------
1.sex        |
    _predict |
           1 |  -.1017742   .0138914    -7.33   0.000    -.1290009   -.0745474
           2 |   .1017742   .0138914     7.33   0.000     .0745474    .1290009
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.         ************************************************************************
.         * 5.2 Adjusted Predictions and Marginal Effects at the Means
.         ************************************************************************
.
.         margins  i.sex,      atmeans

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

At: 0.sex    = .4993333 (mean)
    1.sex    = .5006667 (mean)
    age      =   39.799 (mean)
    distance = 58.58566 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
_predict#sex |
     1#male  |   .9836159   .0277532    35.44   0.000     .9292206    1.038011
   1#female  |   .9208433   .0531661    17.32   0.000     .8166396    1.025047
     2#male  |   .0163841   .0277532     0.59   0.555    -.0380112    .0707794
   2#female  |   .0791567   .0531661     1.49   0.137     -.025047    .1833604
------------------------------------------------------------------------------

.         margins, dydx(i.sex) atmeans

Conditional marginal effects                          Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

At: 0.sex    = .4993333 (mean)
    1.sex    = .5006667 (mean)
    age      =   39.799 (mean)
    distance = 58.58566 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
0.sex        |  (base outcome)
-------------+----------------------------------------------------------------
1.sex        |
    _predict |
           1 |  -.0627726    .059974    -1.05   0.295    -.1803195    .0547742
```

```
          2  |   .0627726    .059974     1.05   0.295    -.0547742    .1803195
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.
.         ************************************************************************
.         * 5.3 Adjusted Predictions and Marginal Effects at Representative values and
.         ************************************************************************
.         margins  i.sex,      at(age=(20(10)60) distance = (0(100)800))

Adjusted predictions                                  Number of obs = 3,000
Model VCE: OIM

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

1._at:  age      =  20
        distance =   0
2._at:  age      =  20
        distance = 100
3._at:  age      =  20
        distance = 200
4._at:  age      =  20
        distance = 300
5._at:  age      =  20
        distance = 400
6._at:  age      =  20
        distance = 500
7._at:  age      =  20
        distance = 600
8._at:  age      =  20
        distance = 700
9._at:  age      =  20
        distance = 800
10._at: age      =  30
        distance =   0
11._at: age      =  30
        distance = 100
12._at: age      =  30
        distance = 200
13._at: age      =  30
        distance = 300
14._at: age      =  30
        distance = 400
15._at: age      =  30
        distance = 500
16._at: age      =  30
        distance = 600
17._at: age      =  30
        distance = 700
18._at: age      =  30
        distance = 800
19._at: age      =  40
        distance =   0
20._at: age      =  40
        distance = 100
21._at: age      =  40
        distance = 200
22._at: age      =  40
        distance = 300
23._at: age      =  40
        distance = 400
```

```
24._at: age      =  40
        distance = 500
25._at: age      =  40
        distance = 600
26._at: age      =  40
        distance = 700
27._at: age      =  40
        distance = 800
28._at: age      =  50
        distance =   0
29._at: age      =  50
        distance = 100
30._at: age      =  50
        distance = 200
31._at: age      =  50
        distance = 300
32._at: age      =  50
        distance = 400
33._at: age      =  50
        distance = 500
34._at: age      =  50
        distance = 600
35._at: age      =  50
        distance = 700
36._at: age      =  50
        distance = 800
37._at: age      =  60
        distance =   0
38._at: age      =  60
        distance = 100
39._at: age      =  60
        distance = 200
40._at: age      =  60
        distance = 300
41._at: age      =  60
        distance = 400
42._at: age      =  60
        distance = 500
43._at: age      =  60
        distance = 600
44._at: age      =  60
        distance = 700
45._at: age      =  60
        distance = 800

------------------------------------------------------------------------------
                 |            Delta-method
                 |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-----------------+------------------------------------------------------------------
_predict#_at#sex |
      1# 1#male  |   .9903614   .0039662   249.70   0.000     .9825878     .998135
    1# 1#female  |   .9729125    .009381   103.71   0.000     .9545261    .9912989
      1# 2#male  |   .9998748     .00085  1176.28   0.000     .9982087    1.001541
    1# 2#female  |   .9964216   .0105769    94.21   0.000     .9756912    1.017152
      1# 3#male  |   .9999984   .0000223  4.5e+04   0.000     .9999546    1.000042
    1# 3#female  |    .999537   .0028632   349.10   0.000     .9939252    1.005149
      1# 4#male  |          1   4.34e-07  2.3e+06   0.000     .9999991    1.000001
    1# 4#female  |   .9999403   .0005622  1778.57   0.000     .9988383    1.001042
      1# 5#male  |          1   7.47e-09  1.3e+08   0.000            1           1
    1# 5#female  |   .9999923   .0000974  1.0e+04   0.000     .9998014    1.000183
      1# 6#male  |          1   1.20e-10  8.3e+09   0.000            1           1
    1# 6#female  |    .999999   .0000158  6.3e+04   0.000     .9999681     1.00003
      1# 7#male  |          1   1.86e-12  5.4e+11   0.000            1           1
```

1# 7#female	.9999999	2.45e-06	4.1e+05	0.000	.9999951	1.000005
1# 8#male	1	2.80e-14	3.6e+13	0.000	1	1
1# 8#female	1	3.69e-07	2.7e+06	0.000	.9999993	1.000001
1# 9#male	1	4.12e-16	2.4e+15	0.000	1	1
1# 9#female	1	5.45e-08	1.8e+07	0.000	.9999999	1
1#10#male	.970625	.0079919	121.45	0.000	.9549612	.9862889
1#10#female	.9248529	.0169642	54.52	0.000	.8916037	.958102
1#11#male	.9991962	.0038762	257.78	0.000	.991599	1.006793
1#11#female	.9876301	.0258494	38.21	0.000	.9369663	1.038294
1#12#male	.9999786	.0002104	4752.18	0.000	.9995662	1.000391
1#12#female	.9980731	.0084805	117.69	0.000	.9814517	1.014694
1#13#male	.9999994	8.44e-06	1.2e+05	0.000	.9999829	1.000016
1#13#female	.9997025	.0019943	501.28	0.000	.9957937	1.003611
1#14#male	1	3.00e-07	3.3e+06	0.000	.9999994	1.000001
1#14#female	.9999541	.0004129	2421.80	0.000	.9991449	1.000763
1#15#male	1	1.00e-08	1.0e+08	0.000	1	1
1#15#female	.9999929	.0000799	1.3e+04	0.000	.9998363	1.00015
1#16#male	1	3.19e-10	3.1e+09	0.000	1	1
1#16#female	.9999989	.0000148	6.7e+04	0.000	.9999699	1.000028
1#17#male	1	9.91e-12	1.0e+11	0.000	1	1
1#17#female	.9999998	2.67e-06	3.7e+05	0.000	.9999946	1.000005
1#18#male	1	3.01e-13	3.3e+12	0.000	1	1
1#18#female	1	4.71e-07	2.1e+06	0.000	.9999991	1.000001
1#19#male	.9139856	.0142329	64.22	0.000	.8860896	.9418816
1#19#female	.8083233	.0231498	34.92	0.000	.7629504	.8536961
1#20#male	.9948598	.0153149	64.96	0.000	.9648431	1.024876
1#20#female	.9581468	.0523962	18.29	0.000	.8554521	1.060842
1#21#male	.9997164	.0017346	576.33	0.000	.9963166	1.003116
1#21#female	.9920177	.0215841	45.96	0.000	.9497136	1.034322
1#22#male	.9999844	.0001439	6947.00	0.000	.9997023	1.000267
1#22#female	.9985199	.0061273	162.96	0.000	.9865106	1.010529
1#23#male	.9999991	.0000106	9.5e+04	0.000	.9999784	1.00002
1#23#female	.999727	.0015191	658.10	0.000	.9967496	1.002704
1#24#male	1	7.27e-07	1.4e+06	0.000	.9999985	1.000001
1#24#female	.9999497	.0003514	2845.52	0.000	.999261	1.000638
1#25#male	1	4.80e-08	2.1e+07	0.000	.9999999	1
1#25#female	.9999907	.0000779	1.3e+04	0.000	.999838	1.000143
1#26#male	1	3.08e-09	3.3e+08	0.000	1	1
1#26#female	.9999983	.0000168	6.0e+04	0.000	.9999654	1.000031
1#27#male	1	1.93e-10	5.2e+09	0.000	1	1
1#27#female	.9999997	3.54e-06	2.8e+05	0.000	.9999928	1.000007
1#28#male	.773609	.0328893	23.52	0.000	.7091472	.8380708
1#28#female	.5910039	.029551	20.00	0.000	.5330849	.6489229
1#29#male	.9678813	.0548437	17.65	0.000	.8603896	1.075373
1#29#female	.8677976	.0803169	10.80	0.000	.7103794	1.025216
1#30#male	.9962511	.0137048	72.69	0.000	.9693902	1.023112
1#30#female	.967552	.0469102	20.63	0.000	.8756097	1.059494
1#31#male	.9995735	.0023773	420.46	0.000	.994914	1.004233
1#31#female	.9926716	.0166564	59.60	0.000	.9600256	1.025318
1#32#male	.9999516	.000362	2761.92	0.000	.999242	1.000661
1#32#female	.9983775	.004998	199.76	0.000	.9885816	1.008173
1#33#male	.9999945	.0000515	1.9e+04	0.000	.9998935	1.000095
1#33#female	.9996424	.0013875	720.44	0.000	.9969228	1.002362
1#34#male	.9999994	7.03e-06	1.4e+05	0.000	.9999856	1.000013
1#34#female	.9999213	.0003683	2715.01	0.000	.9991994	1.000643
1#35#male	.9999999	9.32e-07	1.1e+06	0.000	.9999981	1.000002
1#35#female	.9999827	.0000949	1.1e+04	0.000	.9997967	1.000169
1#36#male	1	1.21e-07	8.3e+06	0.000	.9999998	1
1#36#female	.9999962	.0000239	4.2e+04	0.000	.9999493	1.000043
1#37#male	.5235589	.0731656	7.16	0.000	.3801568	.6669609
1#37#female	.3311656	.0428598	7.73	0.000	.247162	.4151692
1#38#male	.8243103	.3464305	2.38	0.017	.1453191	1.503302
1#38#female	.653037	.2058916	3.17	0.002	.249497	1.056577

1#39#male	.9524543	.226118	4.21	0.000	.5092711	1.395637
1#39#female	.8773692	.2111786	4.15	0.000	.4634667	1.291272
1#40#male	.9884434	.0867822	11.39	0.000	.8183533	1.158533
1#40#female	.9645344	.1032915	9.34	0.000	.7620867	1.166982
1#41#male	.9972691	.0277835	35.89	0.000	.9428145	1.051724
1#41#female	.9904197	.0386839	25.60	0.000	.9146006	1.066239
1#42#male	.999359	.008203	121.83	0.000	.9832814	1.015437
1#42#female	.9974618	.0129994	76.73	0.000	.9719833	1.02294
1#43#male	.9998498	.0023143	432.02	0.000	.9953138	1.004386
1#43#female	.999331	.0041397	241.40	0.000	.9912173	1.007445
1#44#male	.9999648	.0006338	1577.69	0.000	.9987226	1.001207
1#44#female	.9998239	.0012763	783.36	0.000	.9973224	1.002325
1#45#male	.9999918	.0001699	5885.00	0.000	.9996587	1.000325
1#45#female	.9999537	.0003849	2598.27	0.000	.9991994	1.000708
2# 1#male	.0096386	.0039662	2.43	0.015	.001865	.0174122
2# 1#female	.0270875	.009381	2.89	0.004	.0087011	.0454739
2# 2#male	.0001252	.00085	0.15	0.883	-.0015408	.0017913
2# 2#female	.0035784	.0105769	0.34	0.735	-.0171519	.0243088
2# 3#male	1.61e-06	.0000223	0.07	0.942	-.0000421	.0000454
2# 3#female	.000463	.0028632	0.16	0.872	-.0051488	.0060748
2# 4#male	2.07e-08	4.34e-07	0.05	0.962	-8.29e-07	8.71e-07
2# 4#female	.0000597	.0005622	0.11	0.915	-.0010422	.0011617
2# 5#male	2.67e-10	7.47e-09	0.04	0.971	-1.44e-08	1.49e-08
2# 5#female	7.71e-06	.0000974	0.08	0.937	-.0001832	.0001986
2# 6#male	3.44e-12	1.20e-10	0.03	0.977	-2.32e-10	2.39e-10
2# 6#female	9.94e-07	.0000158	0.06	0.950	-.0000299	.0000319
2# 7#male	4.42e-14	1.86e-12	0.02	0.981	-3.60e-12	3.69e-12
2# 7#female	1.28e-07	2.45e-06	0.05	0.958	-4.67e-06	4.92e-06
2# 8#male	5.69e-16	2.80e-14	0.02	0.984	-5.42e-14	5.54e-14
2# 8#female	1.65e-08	3.69e-07	0.04	0.964	-7.07e-07	7.40e-07
2# 9#male	7.32e-18	4.12e-16	0.02	0.986	-7.99e-16	8.14e-16
2# 9#female	2.13e-09	5.45e-08	0.04	0.969	-1.05e-07	1.09e-07
2#10#male	.029375	.0079919	3.68	0.000	.0137111	.0450388
2#10#female	.0751471	.0169642	4.43	0.000	.041898	.1083963
2#11#male	.0008038	.0038762	0.21	0.836	-.0067934	.008401
2#11#female	.0123699	.0258494	0.48	0.632	-.0382939	.0630337
2#12#male	.0000214	.0002104	0.10	0.919	-.000391	.0004338
2#12#female	.0019269	.0084805	0.23	0.820	-.0146945	.0185483
2#13#male	5.68e-07	8.44e-06	0.07	0.946	-.000016	.0000171
2#13#female	.0002975	.0019943	0.15	0.881	-.0036113	.0042063
2#14#male	1.51e-08	3.00e-07	0.05	0.960	-5.73e-07	6.04e-07
2#14#female	.0000459	.0004129	0.11	0.912	-.0007634	.0008551
2#15#male	4.02e-10	1.00e-08	0.04	0.968	-1.92e-08	2.00e-08
2#15#female	7.07e-06	.0000799	0.09	0.929	-.0001495	.0001637
2#16#male	1.07e-11	3.19e-10	0.03	0.973	-6.15e-10	6.36e-10
2#16#female	1.09e-06	.0000148	0.07	0.941	-.000028	.0000301
2#17#male	2.84e-13	9.91e-12	0.03	0.977	-1.91e-11	1.97e-11
2#17#female	1.68e-07	2.67e-06	0.06	0.950	-5.07e-06	5.40e-06
2#18#male	7.54e-15	3.01e-13	0.03	0.980	-5.83e-13	5.98e-13
2#18#female	2.59e-08	4.71e-07	0.05	0.956	-8.97e-07	9.49e-07
2#19#male	.0860144	.0142329	6.04	0.000	.0581184	.1139104
2#19#female	.1916767	.0231498	8.28	0.000	.1463039	.2370496
2#20#male	.0051402	.0153149	0.34	0.737	-.0248765	.0351569
2#20#female	.0418532	.0523962	0.80	0.424	-.0608415	.1445479
2#21#male	.0002836	.0017346	0.16	0.870	-.0031162	.0036834
2#21#female	.0079823	.0215841	0.37	0.712	-.0343217	.0502864
2#22#male	.0000156	.0001439	0.11	0.914	-.0002666	.0002977
2#22#female	.0014801	.0061273	0.24	0.809	-.0105293	.0134894
2#23#male	8.55e-07	.0000106	0.08	0.936	-.0000199	.0000216
2#23#female	.000273	.0015191	0.18	0.857	-.0027045	.0032504
2#24#male	4.69e-08	7.27e-07	0.06	0.949	-1.38e-06	1.47e-06
2#24#female	.0000503	.0003514	0.14	0.886	-.0006385	.000739
2#25#male	2.58e-09	4.80e-08	0.05	0.957	-9.15e-08	9.66e-08

```
    2#25#female  |   9.27e-06   .0000779     0.12   0.905    -.0001434     .000162
      2#26#male  |   1.41e-10   3.08e-09     0.05   0.963    -5.89e-09    6.17e-09
    2#26#female  |   1.71e-06   .0000168     0.10   0.919    -.0000312    .0000346
      2#27#male  |   7.77e-12   1.93e-10     0.04   0.968    -3.71e-10    3.86e-10
    2#27#female  |   3.14e-07   3.54e-06     0.09   0.929    -6.62e-06    7.25e-06
      2#28#male  |    .226391   .0328893     6.88   0.000     .1619292    .2908528
    2#28#female  |   .4089961    .029551    13.84   0.000     .3510771    .4669151
      2#29#male  |   .0321187   .0548437     0.59   0.558     -.075373    .1396104
    2#29#female  |   .1322024   .0803169     1.65   0.100    -.0252158    .2896206
      2#30#male  |   .0037489   .0137048     0.27   0.784     -.023112    .0306098
    2#30#female  |    .032448   .0469102     0.69   0.489    -.0594943    .1243903
      2#31#male  |   .0004265   .0023773     0.18   0.858     -.004233     .005086
    2#31#female  |   .0073284   .0166564     0.44   0.660    -.0253175    .0399744
      2#32#male  |   .0000484    .000362     0.13   0.894    -.0006612     .000758
    2#32#female  |   .0016225    .004998     0.32   0.745    -.0081733    .0114184
      2#33#male  |   5.49e-06   .0000515     0.11   0.915    -.0000955    .0001065
    2#33#female  |   .0003576   .0013875     0.26   0.797    -.0023619    .0030772
      2#34#male  |   6.22e-07   7.03e-06     0.09   0.929    -.0000132    .0000144
    2#34#female  |   .0000787   .0003683     0.21   0.831    -.0006431    .0008006
      2#35#male  |   7.06e-08   9.32e-07     0.08   0.940    -1.76e-06    1.90e-06
    2#35#female  |   .0000173   .0000949     0.18   0.855    -.0001686    .0002033
      2#36#male  |   8.00e-09   1.21e-07     0.07   0.947    -2.29e-07    2.45e-07
    2#36#female  |   3.82e-06   .0000239     0.16   0.873    -.0000431    .0000507
      2#37#male  |   .4764411   .0731656     6.51   0.000     .3330391    .6198432
    2#37#female  |   .6688344   .0428598    15.61   0.000     .5848308     .752838
      2#38#male  |   .1756897   .3464305     0.51   0.612    -.5033015    .8546809
    2#38#female  |    .346963   .2058916     1.69   0.092    -.0565771     .750503
      2#39#male  |   .0475457    .226118     0.21   0.833    -.3956374    .4907289
    2#39#female  |   .1226308   .2111786     0.58   0.561    -.2912717    .5365333
      2#40#male  |   .0115566   .0867822     0.13   0.894    -.1585334    .1816467
    2#40#female  |   .0354656   .1032915     0.34   0.731    -.1669821    .2379133
      2#41#male  |   .0027309   .0277835     0.10   0.922    -.0517237    .0571855
    2#41#female  |   .0095803   .0386839     0.25   0.804    -.0662388    .0853994
      2#42#male  |    .000641    .008203     0.08   0.938    -.0154367    .0167186
    2#42#female  |   .0025382   .0129994     0.20   0.845    -.0229402    .0280167
      2#43#male  |   .0001502   .0023143     0.06   0.948    -.0043858    .0046862
    2#43#female  |    .000669   .0041397     0.16   0.872    -.0074447    .0087827
      2#44#male  |   .0000352   .0006338     0.06   0.956    -.0012071    .0012774
    2#44#female  |   .0001761   .0012763     0.14   0.890    -.0023255    .0026776
      2#45#male  |   8.24e-06   .0001699     0.05   0.961    -.0003248    .0003413
    2#45#female  |   .0000463   .0003849     0.12   0.904     -.000708    .0008006
------------------------------------------------------------------------------

.         margins, dydx(i.sex) at(age=(20(10)60) distance = (0(100)800))

Conditional marginal effects                            Number of obs = 3,000
Model VCE: OIM

dy/dx wrt: 1.sex

1._predict: Pr(outcome==0), predict(pr outcome(0))
2._predict: Pr(outcome==1), predict(pr outcome(1))

1._at:  age      =  20
        distance =   0
2._at:  age      =  20
        distance = 100
3._at:  age      =  20
        distance = 200
4._at:  age      =  20
        distance = 300
5._at:  age      =  20
        distance = 400
```

```
6._at:  age      =  20
        distance = 500
7._at:  age      =  20
        distance = 600
8._at:  age      =  20
        distance = 700
9._at:  age      =  20
        distance = 800
10._at: age      =  30
        distance =   0
11._at: age      =  30
        distance = 100
12._at: age      =  30
        distance = 200
13._at: age      =  30
        distance = 300
14._at: age      =  30
        distance = 400
15._at: age      =  30
        distance = 500
16._at: age      =  30
        distance = 600
17._at: age      =  30
        distance = 700
18._at: age      =  30
        distance = 800
19._at: age      =  40
        distance =   0
20._at: age      =  40
        distance = 100
21._at: age      =  40
        distance = 200
22._at: age      =  40
        distance = 300
23._at: age      =  40
        distance = 400
24._at: age      =  40
        distance = 500
25._at: age      =  40
        distance = 600
26._at: age      =  40
        distance = 700
27._at: age      =  40
        distance = 800
28._at: age      =  50
        distance =   0
29._at: age      =  50
        distance = 100
30._at: age      =  50
        distance = 200
31._at: age      =  50
        distance = 300
32._at: age      =  50
        distance = 400
33._at: age      =  50
        distance = 500
34._at: age      =  50
        distance = 600
35._at: age      =  50
        distance = 700
36._at: age      =  50
        distance = 800
37._at: age      =  60
```

```
        distance =   0
38._at: age      =  60
        distance = 100
39._at: age      =  60
        distance = 200
40._at: age      =  60
        distance = 300
41._at: age      =  60
        distance = 400
42._at: age      =  60
        distance = 500
43._at: age      =  60
        distance = 600
44._at: age      =  60
        distance = 700
45._at: age      =  60
        distance = 800
```

	Delta-method					
	dy/dx	std. err.	z	P>|z|	[95% conf. interval]	
0.sex	(base outcome)					
1.sex						
_predict#_at						
1 1	-.0174489	.010185	-1.71	0.087	-.0374111	.0025132
1 2	-.0034532	.010611	-0.33	0.745	-.0242504	.017344
1 3	-.0004614	.0028633	-0.16	0.872	-.0060734	.0051506
1 4	-.0000597	.0005622	-0.11	0.915	-.0011617	.0010422
1 5	-7.71e-06	.0000974	-0.08	0.937	-.0001986	.0001832
1 6	-9.94e-07	.0000158	-0.06	0.950	-.0000319	.0000299
1 7	-1.28e-07	2.45e-06	-0.05	0.958	-4.92e-06	4.67e-06
1 8	-1.65e-08	3.69e-07	-0.04	0.964	-7.40e-07	7.07e-07
1 9	-2.13e-09	5.45e-08	-0.04	0.969	-1.09e-07	1.05e-07
1 10	-.0457722	.0187524	-2.44	0.015	-.0825263	-.0090181
1 11	-.0115661	.0261384	-0.44	0.658	-.0627964	.0396642
1 12	-.0019056	.0084831	-0.22	0.822	-.0185321	.014721
1 13	-.0002969	.0019943	-0.15	0.882	-.0042058	.0036119
1 14	-.0000459	.0004129	-0.11	0.912	-.0008551	.0007634
1 15	-7.07e-06	.0000799	-0.09	0.929	-.0001637	.0001495
1 16	-1.09e-06	.0000148	-0.07	0.941	-.0000301	.000028
1 17	-1.68e-07	2.67e-06	-0.06	0.950	-5.40e-06	5.07e-06
1 18	-2.59e-08	4.71e-07	-0.05	0.956	-9.49e-07	8.97e-07
1 19	-.1056623	.0271752	-3.89	0.000	-.1589248	-.0523999
1 20	-.036713	.0545886	-0.67	0.501	-.1437046	.0702786
1 21	-.0076987	.0216537	-0.36	0.722	-.0501392	.0347417
1 22	-.0014645	.006129	-0.24	0.811	-.0134772	.0105482
1 23	-.0002721	.0015192	-0.18	0.858	-.0032496	.0027054
1 24	-.0000502	.0003514	-0.14	0.886	-.000739	.0006385
1 25	-9.26e-06	.0000779	-0.12	0.905	-.0001619	.0001434
1 26	-1.71e-06	.0000168	-0.10	0.919	-.0000346	.0000312
1 27	-3.14e-07	3.54e-06	-0.09	0.929	-7.25e-06	6.62e-06
1 28	-.1826051	.044215	-4.13	0.000	-.2692649	-.0959452
1 29	-.1000837	.0972555	-1.03	0.303	-.290701	.0905336
1 30	-.0286991	.0488711	-0.59	0.557	-.1244847	.0670866
1 31	-.0069019	.0168252	-0.41	0.682	-.0398787	.0260749
1 32	-.0015741	.0050111	-0.31	0.753	-.0113957	.0082474
1 33	-.0003521	.0013885	-0.25	0.800	-.0030736	.0023693
1 34	-.0000781	.0003684	-0.21	0.832	-.0008001	.0006438
1 35	-.0000173	.0000949	-0.18	0.856	-.0002032	.0001687
1 36	-3.81e-06	.0000239	-0.16	0.874	-.0000507	.0000431
1 37	-.1923933	.0847949	-2.27	0.023	-.3585882	-.0261984

```
       1 38  |  -.1712732   .4029955    -0.43   0.671      -.96113    .6185835
       1 39  |  -.0750851   .3093958    -0.24   0.808    -.6814897    .5313196
       1 40  |  -.0239089   .1349085    -0.18   0.859    -.2883247    .2405068
       1 41  |  -.0068494   .0476274    -0.14   0.886    -.1001974    .0864985
       1 42  |  -.0018973   .0153713    -0.12   0.902    -.0320244    .0282298
       1 43  |  -.0005188   .0047427    -0.11   0.913    -.0098143    .0087768
       1 44  |  -.0001409    .001425    -0.10   0.921    -.0029339    .0026521
       1 45  |  -.0000381   .0004207    -0.09   0.928    -.0008626    .0007865
       2  1  |   .0174489    .010185     1.71   0.087    -.0025132    .0374111
       2  2  |   .0034532    .010611     0.33   0.745     -.017344    .0242504
       2  3  |   .0004614   .0028633     0.16   0.872    -.0051506    .0060734
       2  4  |   .0000597   .0005622     0.11   0.915    -.0010422    .0011617
       2  5  |   7.71e-06   .0000974     0.08   0.937    -.0001832    .0001986
       2  6  |   9.94e-07   .0000158     0.06   0.950    -.0000299    .0000319
       2  7  |   1.28e-07   2.45e-06     0.05   0.958    -4.67e-06    4.92e-06
       2  8  |   1.65e-08   3.69e-07     0.04   0.964    -7.07e-07    7.40e-07
       2  9  |   2.13e-09   5.45e-08     0.04   0.969    -1.05e-07    1.09e-07
       2 10  |   .0457722   .0187524     2.44   0.015     .0090181    .0825263
       2 11  |   .0115661   .0261384     0.44   0.658    -.0396642    .0627964
       2 12  |   .0019056   .0084831     0.22   0.822     -.014721    .0185321
       2 13  |   .0002969   .0019943     0.15   0.882    -.0036119    .0042058
       2 14  |   .0000459   .0004129     0.11   0.912    -.0007634    .0008551
       2 15  |   7.07e-06   .0000799     0.09   0.929    -.0001495    .0001637
       2 16  |   1.09e-06   .0000148     0.07   0.941     -.000028    .0000301
       2 17  |   1.68e-07   2.67e-06     0.06   0.950    -5.07e-06    5.40e-06
       2 18  |   2.59e-08   4.71e-07     0.05   0.956    -8.97e-07    9.49e-07
       2 19  |   .1056623   .0271752     3.89   0.000     .0523999    .1589248
       2 20  |    .036713   .0545886     0.67   0.501    -.0702786    .1437046
       2 21  |   .0076987   .0216537     0.36   0.722    -.0347417    .0501392
       2 22  |   .0014645    .006129     0.24   0.811    -.0105482    .0134772
       2 23  |   .0002721   .0015192     0.18   0.858    -.0027054    .0032496
       2 24  |   .0000502   .0003514     0.14   0.886    -.0006385     .000739
       2 25  |   9.26e-06   .0000779     0.12   0.905    -.0001434    .0001619
       2 26  |   1.71e-06   .0000168     0.10   0.919    -.0000312    .0000346
       2 27  |   3.14e-07   3.54e-06     0.09   0.929    -6.62e-06    7.25e-06
       2 28  |   .1826051    .044215     4.13   0.000     .0959452    .2692649
       2 29  |   .1000837   .0972555     1.03   0.303    -.0905336     .290701
       2 30  |   .0286991   .0488711     0.59   0.557    -.0670866    .1244847
       2 31  |   .0069019   .0168252     0.41   0.682    -.0260749    .0398787
       2 32  |   .0015741   .0050111     0.31   0.753    -.0082474    .0113957
       2 33  |   .0003521   .0013885     0.25   0.800    -.0023693    .0030736
       2 34  |   .0000781   .0003684     0.21   0.832    -.0006438    .0008001
       2 35  |   .0000173   .0000949     0.18   0.856    -.0001687    .0002032
       2 36  |   3.81e-06   .0000239     0.16   0.874    -.0000431    .0000507
       2 37  |   .1923933   .0847949     2.27   0.023     .0261984    .3585882
       2 38  |   .1712732   .4029955     0.43   0.671    -.6185835      .96113
       2 39  |   .0750851   .3093958     0.24   0.808    -.5313196    .6814897
       2 40  |   .0239089   .1349085     0.18   0.859    -.2405068    .2883247
       2 41  |   .0068494   .0476274     0.14   0.886    -.0864985    .1001974
       2 42  |   .0018973   .0153713     0.12   0.902    -.0282298    .0320244
       2 43  |   .0005188   .0047427     0.11   0.913    -.0087768    .0098143
       2 44  |   .0001409    .001425     0.10   0.921    -.0026521    .0029339
       2 45  |   .0000381   .0004207     0.09   0.928    -.0007865    .0008626
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.

.
.
.
. log close
      name:  <unnamed>
       log:  D:\Jason\workshop\interpreting, constructing, and  presenting interaction\2023\interpreting_2023.log
  log type:  text
```

```
 closed on:  23 Oct 2023, 11:23:22
-------------------------------------------------------------------------------------------------------------------------------------------------------
```