Assignment 9
MN Logit & Ordered Logit Models

The model

In the study of problems of the business, the most serious problem was the price-war. The analysis is trying to estimate the model that determines factors that have impact on the degree of seriousness of the problem.

$$Prob(y_i=j|X) = f(x_1, x_2, x_3, x_4)$$

where: y_i is categorical data = 0 for no problem, = 1 for less serious, …, and = 5 for very serious, and $i=1$ or 2.

x_1 is dummy variable = 0 for nonfamily firm and =1 for family firm.
x_2 is dummy variable = 0 for no brand and =1 for have own-brand name.
x_3 is dummy variable = 0 for low technology and =1 for high technology firm.
x_4 is log of the size of the firm.

Requirements: From data file – `Assign09.dta`:

1 Estimate the model using multinomial logit of y_i. Perform IIA test. Interpret your estimated result (overall test, individual test, pseudo R^2, counted R^2).

```
mlogit y x1 x2 x3 x4, b(0) nolog

Multinomial logistic regression                 Number of obs     =        152
                                                LR chi2(20)       =      50.72
                                                Prob > chi2       =     0.0002
Log likelihood = -203.28337                     Pseudo R2         =     0.1109

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |  (base outcome)
-------------+----------------------------------------------------------------
1            |
          x1 |  -.1220175   1.086872    -0.11   0.911    -2.252248    2.008213
          x2 |  -2.016388   1.349482    -1.49   0.135    -4.661323    .6285484
          x3 |   1.253423    1.23587     1.01   0.310    -1.168837    3.675683
          x4 |   1.307279   .5491571     2.38   0.017     .2309504    2.383607
       _cons |  -18.06503   8.062973    -2.24   0.025    -33.86817   -2.261896
-------------+----------------------------------------------------------------
2            |
          x1 |   .9699943    .991428     0.98   0.328    -.9731688    2.913157
          x2 |  -1.631037    1.27855    -1.28   0.202    -4.136949    .8748753
          x3 |  -1.034421   .9547311    -1.08   0.279    -2.905659     .836818
          x4 |   .2042703   .3925818     0.52   0.603    -.5651758    .9737165
       _cons |  -.9022321    5.40243    -0.17   0.867     -11.4908    9.686336
-------------+----------------------------------------------------------------
3            |
          x1 |  -.4040394    .938099    -0.43   0.667     -2.24268    1.434601
          x2 |  -.9533924   1.222189    -0.78   0.435    -3.348838    1.442053
```

```
         x3 |  -.1658373   .8733107    -0.19   0.849    -1.877495     1.54582
         x4 |   .2174653   .3490812     0.62   0.533    -.4667212    .9016518
      _cons |  -1.061943   4.802704    -0.22   0.825    -10.47507    8.351185
-------------+----------------------------------------------------------------
4           |
         x1 |   1.677905   .9300468     1.80   0.071    -.1449532    3.500763
         x2 |  -2.104352   1.212395    -1.74   0.083    -4.480602    .2718986
         x3 |  -1.209535   .8915675    -1.36   0.175    -2.956975    .5379055
         x4 |   .1831672   .3654684     0.50   0.616    -.5331376     .899472
      _cons |  -.0171095   5.005591    -0.00   0.997    -9.827887    9.793669
-------------+----------------------------------------------------------------
5           |
         x1 |   1.832363   .8632903     2.12   0.034     .1403452    3.524381
         x2 |  -2.368735   1.168139    -2.03   0.043    -4.658246    -.079224
         x3 |   .0976971   .8455682     0.12   0.908    -1.559586     1.75498
         x4 |   .4905651   .3468626     1.41   0.157     -.189273    1.170403
      _cons |  -4.204706   4.763082    -0.88   0.377    -13.54017    5.130762
------------------------------------------------------------------------------

. est store m1

. est restore m1
(results m1 are active now)

. fitstat

Measures of Fit for mlogit of y

Log-Lik Intercept Only:     -228.644     Log-Lik Full Model:         -203.283
D(122):                      406.567     LR(20):                       50.721
                                         Prob > LR:                     0.000
McFadden's R2:                 0.111     McFadden's Adj R2:            -0.020
Maximum Likelihood R2:         0.284     Cragg & Uhler's R2:            0.298
Count R2:                      0.086     Adj Count R2:                  0.021
AIC:                           3.070     AIC*n:                       466.567
BIC:                        -206.347     BIC':                         49.757

.
```

From the estimated result, overall test from LR chi-squared test has p-value of 0.002, suggesting that the model is significant. For individual test, only size of firm and base case can significantly explain when the price war is less serious (y = 1). When price war is very serious, being family or non-family brand and having brand name or not can significantly explain such incident.

Pseudo-R-squared and Counted-R-squared are quite low. Hence, this suggests limited explaining power of this model.

```
. mlogit y x1 x2 x3 x4 if y!=3, b(0) nolog

Multinomial logistic regression                   Number of obs     =        129
                                                  LR chi2(16)       =      32.43
                                                  Prob > chi2       =     0.0088
Log likelihood = -147.82992                       Pseudo R2         =     0.0989

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
0            |  (base outcome)
-------------+----------------------------------------------------------------
1            |
          x1 |  -.0345956   1.076916    -0.03   0.974    -2.145311     2.07612
          x2 |  -1.944929   1.348267    -1.44   0.149    -4.587483    .6976246
          x3 |   1.008411    1.20889     0.83   0.404    -1.360971    3.377792
          x4 |   1.173903   .5383718     2.18   0.029     .1187139    2.229093
       _cons |  -16.06881   7.865552    -2.04   0.041    -31.48501   -.6526125
-------------+----------------------------------------------------------------
2            |
          x1 |   .9993361   1.003331     1.00   0.319     -.967156    2.965828
          x2 |   -1.54066   1.271611    -1.21   0.226    -4.032971     .951652
          x3 |   -1.07311    .964317    -1.11   0.266    -2.963137    .8169163
          x4 |   .1708932   .3712134     0.46   0.645    -.5566718    .8984581
       _cons |  -.4976237     5.1088    -0.10   0.922    -10.51069     9.51544
-------------+----------------------------------------------------------------
4            |
          x1 |   1.712027   .9430093     1.82   0.069    -.1362369    3.560292
          x2 |  -1.984394   1.206891    -1.64   0.100    -4.349858    .3810699
          x3 |  -1.268538   .9054895    -1.40   0.161    -3.043265    .5061886
          x4 |   .1397741   .3466199     0.40   0.687    -.5395885    .8191367
       _cons |   .5172055   4.746061     0.11   0.913    -8.784904    9.819315
-------------+----------------------------------------------------------------
5            |
          x1 |    1.81674   .8680124     2.09   0.036     .1154673    3.518013
          x2 |  -2.242124   1.163729    -1.93   0.054    -4.522991    .0387429
          x3 |   .0269395   .8572861     0.03   0.975     -1.65331    1.707189
          x4 |   .4149522   .3281144     1.26   0.206    -.2281403    1.058045
       _cons |   -3.16993   4.505839    -0.70   0.482    -12.00121    5.661352
------------------------------------------------------------------------------

. est store m2

. hausman m2 m1, alleqs constant

Note: the rank of the differenced variance matrix (19) does not equal the number of
coefficients being tested (20); be sure this is
        what you expect, or there may be problems computing the test.  Examine the
output of your estimators for anything unexpected
        and possibly consider scaling your variables so that the coefficients are on a
similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       m2           m1         Difference          S.E.
-------------+----------------------------------------------------------------
1            |
          x1 |   -.0345956    -.1220175         .087422               .
          x2 |   -1.944929    -2.016388        .0714583               .
          x3 |    1.008411     1.253423       -.2450125               .
          x4 |    1.173903     1.307279       -.1333753               .
       _cons |   -16.06881    -18.06503        1.996222               .
-------------+----------------------------------------------------------------
2            |
          x1 |    .9993361     .9699943        .0293418        .1540878
          x2 |    -1.54066    -1.631037        .0903772               .
          x3 |    -1.07311    -1.034421       -.0386898        .1356314
```

```
          x4 |    .1708932     .2042703       -.0333771               .
       _cons |   -.4976237    -.9022321        .4046085               .
-------------+----------------------------------------------------------------
4            |
          x1 |    1.712027     1.677905        .0341224         .155819
          x2 |   -1.984394    -2.104352        .1199581               .
          x3 |   -1.268538    -1.209535       -.0590035        .1581729
          x4 |    .1397741     .1831672       -.0433931               .
       _cons |    .5172055    -.0171095        .5343149               .
-------------+----------------------------------------------------------------
5            |
          x1 |     1.81674     1.832363       -.0156229         .090417
          x2 |   -2.242124    -2.368735        .1266108               .
          x3 |    .0269395     .0976971       -.0707576        .1412581
          x4 |    .4149522     .4905651        -.075613               .
       _cons |    -3.16993    -4.204706        1.034776               .
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from mlogit
           B = inconsistent under Ha, efficient under Ho; obtained from mlogit

    Test:  Ho:  difference in coefficients not systematic

                 chi2(19) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        2.04
                Prob>chi2 =      1.0000
                (V_b-V_B is not positive definite)

. predict zero one two three four five
(option pr assumed; predicted probabilities)
(73 missing values generated)

. g yhat=0 if zero==max(zero,one,two,three,four,five)
(152 missing values generated)

. replace yhat=1 if one==max(zero,one,two,three,four,five)
(73 real changes made)

. replace yhat=2 if two==max(zero,one,two,three,four,five)
(73 real changes made)

. replace yhat=3 if three==max(zero,one,two,three,four,five)
(111 real changes made)

. replace yhat=4 if four==max(zero,one,two,three,four,five)
(79 real changes made)

. replace yhat=5 if five==max(zero,one,two,three,four,five)
(181 real changes made)

. tab y yhat

           |               yhat
         y |         3          4          5 |     Total
-----------+---------------------------------+----------
         0 |         6          0         23 |        29
         1 |         3          0         11 |        14
         2 |         5          1         21 |        27
         3 |        12          1         20 |        33
```

```
          4 |          5           2          28 |         35
          5 |          7           2          78 |         87
-----------+----------------------------------+----------
      Total |         38           6         181 |        225
```

.

From the Hausman-test, p-value is 1.000 which suggests that IIA assumption is valid.

2 Estimate the model using order logit of y_i. Interpret your estimated result (overall test, individual test, pseudo R^2, counted R^2).

```
. ologit y x1 x2 x3 x4

Iteration 0:   log likelihood = -228.64363
Iteration 1:   log likelihood = -216.35652
Iteration 2:   log likelihood =  -216.2376
Iteration 3:   log likelihood = -216.23748
Iteration 4:   log likelihood = -216.23748

Ordered logistic regression                       Number of obs     =        152
                                                  LR chi2(4)        =      24.81
                                                  Prob > chi2       =     0.0001
Log likelihood = -216.23748                       Pseudo R2         =     0.0543

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    1.26067   .3475145     3.63   0.000     .5795538    1.941786
          x2 |  -.8530234   .3508641    -2.43   0.015    -1.540705   -.1653424
          x3 |   .2068371   .3398536     0.61   0.543    -.4592637    .8729379
          x4 |   .1261028   .1511501     0.83   0.404    -.1701459    .4223515
-------------+----------------------------------------------------------------
       /cut1 |  -.8807685   2.139511                     -5.074134    3.312597
       /cut2 |  -.0328063   2.126237                     -4.200155    4.134542
       /cut3 |   .6557008   2.118367                     -3.496223    4.807624
       /cut4 |    1.48964   2.117389                     -2.660365    5.639646
       /cut5 |   2.283969   2.124223                     -1.879432    6.447371
------------------------------------------------------------------------------

. fitstat

Measures of Fit for ologit of y

variable cut1 not found
r(111);

. est store ologit1

. drop zero one two three four five yhat

. predict zero one two three four five
(option pr assumed; predicted probabilities)
(73 missing values generated)
```

```
.
. g yhat=0 if zero==max(zero,one,two,three,four,five)
(152 missing values generated)

.
. replace yhat=1 if one==max(zero,one,two,three,four,five)
(73 real changes made)

.
. replace yhat=2 if two==max(zero,one,two,three,four,five)
(73 real changes made)

.
. replace yhat=3 if three==max(zero,one,two,three,four,five)
(86 real changes made)

.
. replace yhat=4 if four==max(zero,one,two,three,four,five)
(73 real changes made)

.
. replace yhat=5 if five==max(zero,one,two,three,four,five)
(212 real changes made)

.
. tab y yhat

           |         yhat
         y |         3          5 |     Total
-----------+----------------------+----------
         0 |         2         27 |        29 
         1 |         0         14 |        14 
         2 |         3         24 |        27 
         3 |         4         29 |        33 
         4 |         2         33 |        35 
         5 |         2         85 |        87 
-----------+----------------------+----------
     Total |        13        212 |       225 
```

LR-chi-squared test has p-value of 0.0001, suggesting that the model is significant.

Pseudo-R-squared is 00543. Counted R-squared is 0.3956. They are both quite low which mean that the model can be better.

Individual test suggests that only being a family brand or not can significantly explain degree of price war.

3 From (a) and (b), compare the two models. Perform order logit test. Which model is more appropriated in this case? Why?

```
. gologit2 y x1 x2 x3 x4, pl sto(oprobit) link(p)

Generalized Ordered Probit Estimates              Number of obs     =        152
                                                  LR chi2(4)        =      23.50
                                                  Prob > chi2       =     0.0001
Log likelihood = -216.89508                       Pseudo R2         =     0.0514
```

```
 ( 1)  [0]x1 - [1]x1 = 0
 ( 2)  [0]x2 - [1]x2 = 0
 ( 3)  [0]x3 - [1]x3 = 0
 ( 4)  [0]x4 - [1]x4 = 0
 ( 5)  [1]x1 - [2]x1 = 0
 ( 6)  [1]x2 - [2]x2 = 0
 ( 7)  [1]x3 - [2]x3 = 0
 ( 8)  [1]x4 - [2]x4 = 0
 ( 9)  [2]x1 - [3]x1 = 0
 (10)  [2]x2 - [3]x2 = 0
 (11)  [2]x3 - [3]x3 = 0
 (12)  [2]x4 - [3]x4 = 0
 (13)  [3]x1 - [4]x1 = 0
 (14)  [3]x2 - [4]x2 = 0
 (15)  [3]x3 - [4]x3 = 0
 (16)  [3]x4 - [4]x4 = 0
------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |
          x1 |   .7194818   .2020884     3.56   0.000     .3233959    1.115568
          x2 |  -.5041496   .2049628    -2.46   0.014    -.9058693   -.1024299
          x3 |   .1109476   .2041695     0.54   0.587    -.2892173    .5111125
          x4 |   .0732426   .0867141     0.84   0.398    -.0967139    .2431991
       _cons |   .4623429   1.229346     0.38   0.707    -1.947131    2.871817
-------------+----------------------------------------------------------------
1            |
          x1 |   .7194818   .2020884     3.56   0.000     .3233959    1.115568
          x2 |  -.5041496   .2049628    -2.46   0.014    -.9058693   -.1024299
          x3 |   .1109476   .2041695     0.54   0.587    -.2892173    .5111125
          x4 |   .0732426   .0867141     0.84   0.398    -.0967139    .2431991
       _cons |   .0266402   1.224714     0.02   0.983    -2.373756    2.427036
-------------+----------------------------------------------------------------
2            |
          x1 |   .7194818   .2020884     3.56   0.000     .3233959    1.115568
          x2 |  -.5041496   .2049628    -2.46   0.014    -.9058693   -.1024299
          x3 |   .1109476   .2041695     0.54   0.587    -.2892173    .5111125
          x4 |   .0732426   .0867141     0.84   0.398    -.0967139    .2431991
       _cons |  -.3534276   1.220028    -0.29   0.772    -2.744639    2.037784
-------------+----------------------------------------------------------------
3            |
          x1 |   .7194818   .2020884     3.56   0.000     .3233959    1.115568
          x2 |  -.5041496   .2049628    -2.46   0.014    -.9058693   -.1024299
          x3 |   .1109476   .2041695     0.54   0.587    -.2892173    .5111125
          x4 |   .0732426   .0867141     0.84   0.398    -.0967139    .2431991
       _cons |  -.8395408   1.218495    -0.69   0.491    -3.227746    1.548665
-------------+----------------------------------------------------------------
4            |
          x1 |   .7194818   .2020884     3.56   0.000     .3233959    1.115568
          x2 |  -.5041496   .2049628    -2.46   0.014    -.9058693   -.1024299
          x3 |   .1109476   .2041695     0.54   0.587    -.2892173    .5111125
          x4 |   .0732426   .0867141     0.84   0.398    -.0967139    .2431991
       _cons |  -1.315206   1.220947    -1.08   0.281    -3.708217    1.077805
------------------------------------------------------------------------------

. help gologit2

. gologit2 y x1 x2 x3 x4, npl sto(goprobit) link(p)
```

```
Generalized Ordered Probit Estimates              Number of obs     =        152
                                                  LR chi2(20)       =      62.94
                                                  Prob > chi2       =     0.0000
Log likelihood = -197.17374                       Pseudo R2         =     0.1376

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
0            |
          x1 |   .3572168   .4029218     0.89   0.375    -.4324953    1.146929
          x2 |  -.8430554   .5215851    -1.62   0.106    -1.865344    .1792327
          x3 |   .2174726   .4699002     0.46   0.644    -.7035149     1.13846
          x4 |   .6301649   .2667108     2.36   0.018     .1074213    1.152909
       _cons |  -7.270173   3.882206    -1.87   0.061    -14.87916    .3388114
-------------+----------------------------------------------------------------
1            |
          x1 |   .3815073   .3018235     1.26   0.206     -.210056    .9730705
          x2 |  -.0159532   .3528003    -0.05   0.964    -.7074291    .6755227
          x3 |  -.4463186    .318717    -1.40   0.161    -1.070992    .1783554
          x4 |  -.3245584   .1577207    -2.06   0.040    -.6336852   -.0154316
       _cons |   5.945013   2.271297     2.62   0.009     1.493353    10.39667
-------------+----------------------------------------------------------------
2            |
          x1 |   .3404404   .2758876     1.23   0.217    -.2002895    .8811702
          x2 |   .0353617   .3074022     0.12   0.908    -.5671356     .637859
          x3 |  -.0702493   .2585965    -0.27   0.786     -.577089    .4365905
          x4 |  -.1951006   .1263031    -1.54   0.122    -.4426502    .0524489
       _cons |   3.376936   1.791931     1.88   0.059    -.1351848    6.889057
-------------+----------------------------------------------------------------
3            |
          x1 |   1.140714   .2586096     4.41   0.000     .6338481    1.647579
          x2 |  -.6973459   .2627334    -2.65   0.008    -1.212294   -.1823979
          x3 |  -.0515296   .2426607    -0.21   0.832    -.5271359    .4240766
          x4 |  -.0319761   .1198625    -0.27   0.790    -.2669022      .20295
       _cons |   .6640111   1.677911     0.40   0.692    -2.624635    3.952657
-------------+----------------------------------------------------------------
4            |
          x1 |   .7732183   .2551915     3.03   0.002     .2730522    1.273384
          x2 |  -.6291826    .243014    -2.59   0.010    -1.105481   -.1528838
          x3 |   .4068852   .2489172     1.63   0.102    -.0809836    .8947539
          x4 |   .1212267   .1142629     1.06   0.289    -.1027244    .3451778
       _cons |  -2.159693   1.595193    -1.35   0.176    -5.286213    .9668279
------------------------------------------------------------------------------

WARNING! 86 in-sample cases have an outcome with a predicted probability that is
less than 0. See the gologit2 help section on Warning Messages for more information.

. lrtest goprobit oprobit, stats

Likelihood-ratio test                                  LR chi2(16) =     39.44
(Assumption: oprobit nested in goprobit)               Prob > chi2 =    0.0009

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |          N   ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
```

```
     oprobit |        152  -228.6436  -216.8951       9   451.7902   479.0051
    goprobit |        152  -228.6436  -197.1737      25   444.3475   519.9445
-----------------------------------------------------------------------------
Note: BIC uses N = number of observations. See [R] BIC note.
```

From LR-test, p-value is 0.0009. H0 is rejected. It suggests that multinomial logit model is more appropriate.

4 Compute marginal effect at mean and median of both models.

```
. est restore m1
(results m1 are active now)

. margins, dydx(*) predict(outcome(1))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==1), predict(outcome(1))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0770801   .0429311    -1.80   0.073    -.1612236    .0070633
          x2 |  -.0090692   .0417711    -0.22   0.828    -.0909391    .0728007
          x3 |   .0862353   .0585697     1.47   0.141    -.0285593    .2010298
          x4 |   .0558661     .02814     1.99   0.047     .0007127    .1110196
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(0))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==0), predict(outcome(0))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.049448   .0394996    -1.25   0.211    -.1268658    .0279698
          x2 |   .0953594   .0625156     1.53   0.127     -.027169    .2178878
          x3 |   .0128947   .0388471     0.33   0.740    -.0632443    .0890336
          x4 |  -.0202353   .0163353    -1.24   0.215    -.0522519    .0117814
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(2))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==2), predict(outcome(2))
dy/dx w.r.t. : x1 x2 x3 x4
```

```
------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.010222   .0443173    -0.23   0.818    -.0970824    .0766384
          x2 |   .0162247   .0506471     0.32   0.749    -.0830418    .1154912
          x3 |  -.0705732    .048277    -1.46   0.144    -.1651944    .0240479
          x4 |  -.0146586   .0203981    -0.72   0.472    -.0546381    .0253209
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(3))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==3), predict(outcome(3))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.189127   .0587973    -3.22   0.001    -.3043675   -.0738865
          x2 |   .1043358   .0651863     1.60   0.109     -.023427    .2320986
          x3 |   .0071591   .0574438     0.12   0.901    -.1054288    .1197469
          x4 |  -.0209355   .0234814    -0.89   0.373    -.0669581    .0250872
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(4))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==4), predict(outcome(4))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .077112   .0601692     1.28   0.200    -.0408174    .1950415
          x2 |  -.0337673   .0612127    -0.55   0.581    -.1537419    .0862073
          x3 |  -.1532631   .0608112    -2.52   0.012    -.2724508   -.0340753
          x4 |  -.0312193   .0263643    -1.18   0.236    -.0828923    .0204538
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(5))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==5), predict(outcome(5))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
          x1 |   .2487651   .0737675     3.37   0.001     .1041835    .3933467
          x2 |  -.1730834   .0790483    -2.19   0.029    -.3280153   -.0181515
          x3 |   .1175473   .0846921     1.39   0.165    -.0484461    .2835406
          x4 |   .0311825   .0375786     0.83   0.407    -.0424701    .1048351
------------------------------------------------------------------------------

*model1 at median

. margins, dydx(*) predict(outcome(0)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==0), predict(outcome(0))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.049448   .0394996    -1.25   0.211    -.1268658    .0279698
          x2 |   .0953594   .0625156     1.53   0.127     -.027169    .2178878
          x3 |   .0128947   .0388471     0.33   0.740    -.0632443    .0890336
          x4 |  -.0202353   .0163353    -1.24   0.215    -.0522519    .0117814
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(1)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==1), predict(outcome(1))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0770801   .0429311    -1.80   0.073    -.1612236    .0070633
          x2 |  -.0090692   .0417711    -0.22   0.828    -.0909391    .0728007
          x3 |   .0862353   .0585697     1.47   0.141    -.0285593    .2010298
          x4 |   .0558661     .02814     1.99   0.047     .0007127    .1110196
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(2)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==2), predict(outcome(2))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.010222   .0443173    -0.23   0.818    -.0970824    .0766384
```

```
          x2 |   .0162247   .0506471     0.32   0.749    -.0830418    .1154912
          x3 |  -.0705732    .048277    -1.46   0.144    -.1651944    .0240479
          x4 |  -.0146586   .0203981    -0.72   0.472    -.0546381    .0253209
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(3)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==3), predict(outcome(3))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   -.189127   .0587973    -3.22   0.001    -.3043675   -.0738865
          x2 |   .1043358   .0651863     1.60   0.109     -.023427    .2320986
          x3 |   .0071591   .0574438     0.12   0.901    -.1054288    .1197469
          x4 |  -.0209355   .0234814    -0.89   0.373    -.0669581    .0250872
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(4)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==4), predict(outcome(4))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .077112   .0601692     1.28   0.200    -.0408174    .1950415
          x2 |  -.0337673   .0612127    -0.55   0.581    -.1537419    .0862073
          x3 |  -.1532631   .0608112    -2.52   0.012    -.2724508   -.0340753
          x4 |  -.0312193   .0263643    -1.18   0.236    -.0828923    .0204538
------------------------------------------------------------------------------

. margins, dydx(*) predict(outcome(5)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==5), predict(outcome(5))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .2487651   .0737675     3.37   0.001     .1041835    .3933467
          x2 |  -.1730834   .0790483    -2.19   0.029    -.3280153   -.0181515
          x3 |   .1175473   .0846921     1.39   0.165    -.0484461    .2835406
          x4 |   .0311825   .0375786     0.83   0.407    -.0424701    .1048351
```

```
*ologit at mean

. est restore ologit1
(results ologit1 are active now)

. margins, dydx(*) predict(outcome(1))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==1), predict(outcome(1))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0599322   .0226362    -2.65   0.008    -.1042983    -.015566
          x2 |   .0405527   .0197166     2.06   0.040     .0019088    .0791965
          x3 |   -.009833   .0162697    -0.60   0.546     -.041721     .022055
          x4 |  -.0059949   .0073186    -0.82   0.413    -.0203391    .0083493
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(0))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==0), predict(outcome(0))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0681609   .0273944    -2.49   0.013     -.121853   -.0144688
          x2 |   .0461206   .0233188     1.98   0.048     .0004166    .0918247
          x3 |  -.0111831   .0186422    -0.60   0.549    -.0477211    .0253549
          x4 |   -.006818   .0084411    -0.81   0.419    -.0233623    .0097263
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(2))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==2), predict(outcome(2))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0614076   .0202331    -3.04   0.002    -.1010639   -.0217514
          x2 |   .0415511   .0188187     2.21   0.027      .004667    .0784351
          x3 |  -.0100751   .0166518    -0.61   0.545    -.0427121    .0225619
```

```
          x4 |  -.0061425    .007391    -0.83   0.406    -.0206285    .0083435
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(3))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==3), predict(outcome(3))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0649197   .0193261    -3.36   0.001    -.1027982   -.0270412
          x2 |   .0439275   .0192343     2.28   0.022      .006229     .081626
          x3 |  -.0106513    .017627    -0.60   0.546    -.0451996    .0238969
          x4 |  -.0064938   .0078483    -0.83   0.408    -.0218763    .0088886
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(4))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==4), predict(outcome(4))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0206373   .0127601    -1.62   0.106    -.0456467     .004372
          x2 |   .0139641   .0092144     1.52   0.130    -.0040958     .032024
          x3 |   -.003386   .0059659    -0.57   0.570    -.0150789     .008307
          x4 |  -.0020643   .0027613    -0.75   0.455    -.0074764    .0033478
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(5))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==5), predict(outcome(5))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .2750578   .0661191     4.16   0.000     .1454667    .4046489
          x2 |  -.1861159   .0724194    -2.57   0.010    -.3280553   -.0441766
          x3 |   .0451285    .073977     0.61   0.542    -.0998638    .1901208
          x4 |   .0275136    .032782     0.84   0.401    -.0367379    .0917651
```

```
------------------------------------------------------------------------------

. *ologit at median

. margins, dydx(*) predict(outcome(0)) at((median))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==0), predict(outcome(0))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0681609   .0273944    -2.49   0.013     -.121853   -.0144688
          x2 |   .0461206   .0233188     1.98   0.048     .0004166    .0918247
          x3 |  -.0111831   .0186422    -0.60   0.549    -.0477211    .0253549
          x4 |   -.006818   .0084411    -0.81   0.419    -.0233623    .0097263
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(1)) at((median))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==1), predict(outcome(1))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0599322   .0226362    -2.65   0.008    -.1042983    -.015566
          x2 |   .0405527   .0197166     2.06   0.040     .0019088    .0791965
          x3 |   -.009833   .0162697    -0.60   0.546     -.041721     .022055
          x4 |  -.0059949   .0073186    -0.82   0.413    -.0203391    .0083493
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(2)) at((median))

Average marginal effects                          Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==2), predict(outcome(2))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0614076   .0202331    -3.04   0.002    -.1010639   -.0217514
          x2 |   .0415511   .0188187     2.21   0.027      .004667    .0784351
          x3 |  -.0100751   .0166518    -0.61   0.545    -.0427121    .0225619
          x4 |  -.0061425    .007391    -0.83   0.406    -.0206285    .0083435
```

```
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(3)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==3), predict(outcome(3))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0649197   .0193261    -3.36   0.001    -.1027982   -.0270412
          x2 |   .0439275   .0192343     2.28   0.022      .006229     .081626
          x3 |  -.0106513    .017627    -0.60   0.546    -.0451996    .0238969
          x4 |  -.0064938   .0078483    -0.83   0.408    -.0218763    .0088886
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(4)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==4), predict(outcome(4))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.0206373   .0127601    -1.62   0.106    -.0456467     .004372
          x2 |   .0139641   .0092144     1.52   0.130    -.0040958     .032024
          x3 |   -.003386   .0059659    -0.57   0.570    -.0150789     .008307
          x4 |  -.0020643   .0027613    -0.75   0.455    -.0074764    .0033478
------------------------------------------------------------------------------

.
. margins, dydx(*) predict(outcome(5)) at((median))

Average marginal effects                        Number of obs     =        152
Model VCE    : OIM

Expression   : Pr(y==5), predict(outcome(5))
dy/dx w.r.t. : x1 x2 x3 x4

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .2750578   .0661191     4.16   0.000     .1454667    .4046489
          x2 |  -.1861159   .0724194    -2.57   0.010    -.3280553   -.0441766
          x3 |   .0451285    .073977     0.61   0.542    -.0998638    .1901208
          x4 |   .0275136    .032782     0.84   0.401    -.0367379    .0917651
------------------------------------------------------------------------------
```