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).
2. Estimate the model using order logit of y_i. Interpret your estimated result (overall test, individual test, pseudo R^2, counted R^2).
3. From (a) and (b), compare the two models. Perform order logit test. Which model is more appropriated in this case? Why?
4. Compute marginal effect at mean and median of both models.

By Tatre Jantarakolica

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis

      ___  ____  ____  ____  ____ (R)
     /__    /   ____/   /   ____/
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    Notes:
          1.  Unicode is supported; see help unicode advice.
          2.  More than 2 billion observations are allowed; see help obs_advice.
          3.  Maximum number of variables is set to 5000; see help set_maxvar.

  1 . use "C:\Users\a\Downloads\assign09.dta"

  2 . log using "C:\Users\a\Desktop\426\426-a9.smcl"
```

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).

```
  3 . mlogit y x1 x2 x3 x4, 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            |
              x1 |  -1.832363   .8632903    -2.12   0.034    -3.524381   -.1403452
              x2 |   2.368735   1.168139     2.03   0.043      .079224    4.658246
              x3 |  -.0976971   .8455682    -0.12   0.908     -1.75498    1.559586
              x4 |  -.4905651   .3468626    -1.41   0.157    -1.170403     .189273
           _cons |   4.204706   4.763082     0.88   0.377    -5.130762    13.54017
    -------------+----------------------------------------------------------------
    1            |
              x1 |  -1.954381    .814615    -2.40   0.016    -3.550997   -.3577647
              x2 |   .3523473    .782471     0.45   0.652    -1.181268    1.885962
              x3 |   1.155726   1.030763     1.12   0.262     -.864533    3.175985
              x4 |   .8167134   .4673336     1.75   0.081    -.0992436    1.732671
           _cons |  -13.86033   7.056818    -1.96   0.050    -27.69144   -.0292169
    -------------+----------------------------------------------------------------
    2            |
              x1 |  -.8623688   .6749745    -1.28   0.201    -2.185294    .4605568
              x2 |   .7376981   .6909685     1.07   0.286    -.6165753    2.091972
              x3 |  -1.132118   .6624929    -1.71   0.087     -2.43058    .1663445
              x4 |  -.2862948   .2878698    -0.99   0.320    -.8505092    .2779195
           _cons |   3.302474   4.043716     0.82   0.414    -4.623064    11.22801
    -------------+----------------------------------------------------------------
    3            |
              x1 |  -2.236402   .6199683    -3.61   0.000    -3.451518   -1.021287
              x2 |   1.415342   .6376614     2.22   0.026     .1655491    2.665136
              x3 |  -.2635344   .6026228    -0.44   0.662    -1.444653    .9175846
```

	x4	-.2730998	.2507716	-1.09	0.276	-.7646032	.2184035
	_cons	3.142763	3.534705	0.89	0.374	-3.785131	10.07066
4							
	x1	-.1544581	.5644404	-0.27	0.784	-1.260741	.9518248
	x2	.2643829	.5265539	0.50	0.616	-.7676439	1.29641
	x3	-1.307232	.5372575	-2.43	0.015	-2.360237	-.2542264
	x4	-.3073979	.2338932	-1.31	0.189	-.7658201	.1510242
	_cons	4.187597	3.285728	1.27	0.202	-2.252312	10.62751
5		(base outcome)					

4 . est store m1

5 . mlogit y x1 x2 x3 x4 if y!=4, nolog

Multinomial logistic regression

Number of obs	127
LR chi2(16)	43.84
Prob > chi2	0.0002
Pseudo R2	0.1364

Log likelihood = -138.77638

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0						
x1	-1.917478	.8656523	-2.22	0.027	-3.614125	-.2208305
x2	2.399049	1.184989	2.02	0.043	.0765135	4.721585
x3	-.0750429	.8626823	-0.09	0.931	-1.765869	1.615783
x4	-.4760917	.3418197	-1.39	0.164	-1.146046	.1938626
_cons	4.002073	4.712976	0.85	0.396	-5.235191	13.23934
1						
x1	-1.887951	.8108206	-2.33	0.020	-3.47713	-.2987722
x2	.4256484	.7803751	0.55	0.585	-1.103859	1.955155
x3	1.13251	1.04128	1.09	0.277	-.9083626	3.173382
x4	.7670503	.4586998	1.67	0.094	-.1319848	1.666086
_cons	-13.20158	6.968	-1.89	0.058	-26.85861	.455447
2						
x1	-.902955	.6677474	-1.35	0.176	-2.211716	.4058058
x2	.746173	.6920624	1.08	0.281	-.6102444	2.10259
x3	-1.134476	.6573489	-1.73	0.084	-2.422856	.1539042
x4	-.2704256	.2800586	-0.97	0.334	-.8193303	.2784791
_cons	3.098155	3.947385	0.78	0.433	-4.638579	10.83489
3						
x1	-2.273025	.6227095	-3.65	0.000	-3.493514	-1.052537
x2	1.445561	.6553098	2.21	0.027	.1611778	2.729945
x3	-.2614692	.6184131	-0.42	0.672	-1.473537	.9505983
x4	-.277248	.2489175	-1.11	0.265	-.7651174	.2106213
_cons	3.19799	3.521038	0.91	0.364	-3.703118	10.0991
5	(base outcome)					

```
6 . est store m2

7 . 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) m2	(B) m1	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
0				
x1	**-1.917478**	**-1.832363**	**-.0851147**	**.0639035**
x2	**2.399049**	**2.368735**	**.0303146**	**.1991226**
x3	**-.0750429**	**-.0976971**	**.0226542**	**.1709826**
x4	**-.4760917**	**-.4905651**	**.0144735**	**.**
_cons	**4.002073**	**4.204706**	**-.2026339**	**.**
1				
x1	**-1.887951**	**-1.954381**	**.0664294**	**.**
x2	**.4256484**	**.3523473**	**.0733011**	**.**
x3	**1.13251**	**1.155726**	**-.0232167**	**.1476198**
x4	**.7670503**	**.8167134**	**-.0496631**	**.**
_cons	**-13.20158**	**-13.86033**	**.6587452**	**.**
2				
x1	**-.902955**	**-.8623688**	**-.0405861**	**.**
x2	**.746173**	**.7376981**	**.0084748**	**.0388948**
x3	**-1.134476**	**-1.132118**	**-.0023583**	**.**
x4	**-.2704256**	**-.2862948**	**.0158692**	**.**
_cons	**3.098155**	**3.302474**	**-.2043196**	**.**
3				
x1	**-2.273025**	**-2.236402**	**-.036623**	**.0583652**
x2	**1.445561**	**1.415342**	**.030219**	**.1510594**
x3	**-.2614692**	**-.2635344**	**.0020652**	**.1388544**
x4	**-.277248**	**-.2730998**	**-.0041482**	**.**
_cons	**3.19799**	**3.142763**	**.0552263**	**.**

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)
= **1.74**
Prob>chi2 = **1.0000**
(V_b-V_B is not positive definite)

> 0.05 ; H_0 accepted ; IIA valid with choice 4 being eliminated ; Multinomial Logit is appropriated

```
8 . mlogit y x1 x2 x3 x4, 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**

all x can be used ; significant; overall χ^2 test together to explain y

↓ loglikelihood value & Pseudo R^2

individual test

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0						
x1	-1.832363	.8632903	-2.12	0.034	-3.524381	-.1403452
x2	2.368735	1.168139	2.03	0.043	.079224	4.658246
x3	-.0976971	.8455682	-0.12	0.908	-1.75498	1.559586
x4	-.4905651	.3468626	-1.41	0.157	-1.170403	.189273
_cons	4.204706	4.763082	0.88	0.377	-5.130762	13.54017
1						
x1	-1.954381	.814615	-2.40	0.016	-3.550997	-.3577647
x2	.3523473	.782471	0.45	0.652	-1.181268	1.885962
x3	1.155726	1.030763	1.12	0.262	-.864533	3.175985
x4	.8167134	.4673336	1.75	0.081	-.0992436	1.732671
_cons	-13.86033	7.056818	-1.96	0.050	-27.69144	-.0292169
2						
x1	-.8623688	.6749745	-1.28	0.201	-2.185294	.4605568
x2	.7376981	.6909685	1.07	0.286	-.6165753	2.091972
x3	-1.132118	.6624929	-1.71	0.087	-2.43058	.1663445
x4	-.2862948	.2878698	-0.99	0.320	-.8505092	.2779195
_cons	3.302474	4.043716	0.82	0.414	-4.623064	11.22801
3						
x1	-2.236402	.6199683	-3.61	0.000	-3.451518	-1.021287
x2	1.415342	.6376614	2.22	0.026	.1655491	2.665136
x3	-.2635344	.6026228	-0.44	0.662	-1.444653	.9175846
x4	-.2730998	.2507716	-1.09	0.276	-.7646032	.2184035
_cons	3.142763	3.534705	0.89	0.374	-3.785131	10.07066
4						
x1	-.1544581	.5644404	-0.27	0.784	-1.260741	.9518248
x2	.2643829	.5265539	0.50	0.616	-.7676439	1.29641
x3	-1.307232	.5372575	-2.43	0.015	-2.360237	-.2542264
x4	-.3073979	.2338932	-1.31	0.189	-.7658201	.1510242
_cons	4.187597	3.285728	1.27	0.202	-2.252312	10.62751
5	(base outcome)					

```
9 . fitstat
```

	mlogit
Log-likelihood	
Model	-203.283
Intercept-only	-228.644
Chi-square	
Deviance(df=127)	406.567
LR(df=20)	50.721
p-value	0.000
R2	
McFadden	0.111
McFadden(adjusted)	0.002
Cox-Snell/ML	0.284
Cragg-Uhler/Nagelkerke	0.298
Count	0.500
Count(adjusted)	0.062
IC	
AIC	456.567
AIC divided by N	3.004

Pseudo R^2 ≥ Adj Pseudo R^2

Counted R^2

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

BIC(df=25)	**532.164**

```
10 . ologit y x1 x2 x3 x4, nolog
```

Ordered logistic regression — Number of obs = **152**
LR chi2(4) = **24.81** — overall test ; significant
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**

individual test

; X_1 & X_2 significant under 95% confidence level

```
11 . fitstat
```

	ologit
Log-likelihood	
Model	**-216.237**
Intercept-only	**-228.644**
Chi-square	
Deviance(df=143)	**432.475**
LR(df=4)	**24.812**
p-value	**0.000**
R2	
McFadden	**0.054**
McFadden(adjusted)	**0.015**
McKelvey & Zavoina	**0.157**
Cox-Snell/ML	**0.151**
Cragg-Uhler/Nagelkerke	**0.158**
Count	**0.480**
Count(adjusted)	**0.025**
IC	
AIC	**450.475**
AIC divided by N	**2.964**
BIC(df=9)	**477.690**
Variance of	
e	**3.290**
y-star	**3.904**

Pseudo R^2 ≥ Adj Pseudo R^2

Counted R^2

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

```
12 . tabulate y
```

y	Freq.	Percent	Cum.
0	**29**	**12.89**	**12.89**
1	**14**	**6.22**	**19.11**
2	**27**	**12.00**	**31.11**
3	**33**	**14.67**	**45.78**
4	**35**	**15.56**	**61.33**
5	**87**	**38.67**	**100.00**
Total	**225**	**100.00**	

```
13 . g y0=y>0

14 . g y1=y>1

15 . g y2=y>2

16 . g y3=y>3

17 . g y4=y>4

18 . logit y0 x1 x2 x3 x4, nolog

Logistic regression                             Number of obs     =        152
                                                LR chi2(4)        =       7.37
                                                Prob > chi2       =     0.1176
Log likelihood =  -30.48377                     Pseudo R2         =     0.1078
```

y0	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	**1.097122**	**.8131273**	**1.35**	**0.177**	**-.4965782**	**2.690822**
x2	**-1.82336**	**1.123595**	**-1.62**	**0.105**	**-4.025566**	**.3788458**
x3	**-.3069072**	**.7827279**	**-0.39**	**0.695**	**-1.841026**	**1.227211**
x4	**.3527502**	**.3128234**	**1.13**	**0.259**	**-.2603725**	**.9658728**
_cons	**-1.099312**	**4.270594**	**-0.26**	**0.797**	**-9.469521**	**7.270898**

```
19 . est store logit0

20 . logit y1 x1 x2 x3 x4, nolog

Logistic regression                             Number of obs     =        152
                                                LR chi2(4)        =       7.13
                                                Prob > chi2       =     0.1291
Log likelihood = -53.702831                     Pseudo R2         =     0.0623
```

y1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	**1.264527**	**.5686274**	**2.22**	**0.026**	**.1500381**	**2.379017**
x2	**-.7792338**	**.6125997**	**-1.27**	**0.203**	**-1.979907**	**.4214395**
x3	**-.8053988**	**.6138821**	**-1.31**	**0.190**	**-2.008586**	**.397788**
x4	**-.2074297**	**.2514683**	**-0.82**	**0.409**	**-.7002985**	**.2854392**
_cons	**5.389609**	**3.618029**	**1.49**	**0.136**	**-1.701598**	**12.48082**

```
21 . est store logit1

22 . logit y2 x1 x2 x3 x4, nolog

Logistic regression                             Number of obs     =        152
                                                LR chi2(4)        =       6.04
                                                Prob > chi2       =     0.1960
Log likelihood = -76.508097                     Pseudo R2         =     0.0380

------------------------------------------------------------------------------
          y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .864886    .445494     1.94   0.052    -.0082663    1.738038
          x2 |  -.6170464   .4655784    -1.33   0.185    -1.529563    .2954705
          x3 |  -.0281734   .4522084    -0.06   0.950    -.9144856    .8581388
          x4 |  -.0449685   .1921363    -0.23   0.815    -.4215487    .3316117
       _cons |   1.899683   2.723582     0.70   0.485    -3.438441    7.237806
------------------------------------------------------------------------------

23 . est store logit2

24 . logit y3 x1 x2 x3 x4, nolog

Logistic regression                             Number of obs     =        152
                                                LR chi2(4)        =      26.27
                                                Prob > chi2       =     0.0000
Log likelihood = -86.898823                     Pseudo R2         =     0.1313

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.679889   .4162286     4.04   0.000     .8640956    2.495682
          x2 |  -1.051402   .4278995    -2.46   0.014     -1.89007   -.2127347
          x3 |  -.1154448    .419182    -0.28   0.783    -.9370264    .7061368
          x4 |   .0623465   .1773535     0.35   0.725    -.2852601     .409953
       _cons |  -.4960081   2.501373    -0.20   0.843    -5.398609    4.406593
------------------------------------------------------------------------------

25 . est store logit3

26 . logit y4 x1 x2 x3 x4, nolog

Logistic regression                             Number of obs     =        152
                                                LR chi2(4)        =      24.72
                                                Prob > chi2       =     0.0001
Log likelihood = -92.667503                     Pseudo R2         =     0.1177

------------------------------------------------------------------------------
          y4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.213482    .399205     3.04   0.002     .4310541    1.995909
          x2 |  -.8226954   .3937515    -2.09   0.037    -1.594434   -.0509566
          x3 |    .672316   .4099034     1.64   0.101    -.1310799    1.475712
          x4 |   .2113165    .176731     1.20   0.232    -.1350699    .5577028
       _cons |  -3.847181   2.497949    -1.54   0.124    -8.743071    1.048709
------------------------------------------------------------------------------
```

```
27 . est store logit4

28 . suest logit0 logit1 logit2 logit3 logit4

Simultaneous results for logit0, logit1, logit2, logit3, logit4

                                                  Number of obs     =        152
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
logit0_y0						
x1	1.097122	.9033857	1.21	0.225	-.6734812	2.867725
x2	-1.82336	1.135405	-1.61	0.108	-4.048713	.4019928
x3	-.3069072	.803698	-0.38	0.703	-1.882126	1.268312
x4	.3527502	.3544918	1.00	0.320	-.3420409	1.047541
_cons	-1.099312	4.856106	-0.23	0.821	-10.6171	8.418481
logit1_y1						
x1	1.264527	.5825003	2.17	0.030	.1228478	2.406207
x2	-.7792338	.604258	-1.29	0.197	-1.963558	.4050901
x3	-.8053988	.6052151	-1.33	0.183	-1.991599	.380801
x4	-.2074297	.3082284	-0.67	0.501	-.8115462	.3966868
_cons	5.389609	4.422033	1.22	0.223	-3.277416	14.05663
logit2_y2						
x1	.864886	.4721274	1.83	0.067	-.0604667	1.790239
x2	-.6170464	.4658079	-1.32	0.185	-1.530013	.2959203
x3	-.0281734	.4629933	-0.06	0.951	-.9356237	.8792769
x4	-.0449685	.2176813	-0.21	0.836	-.4716161	.3816791
_cons	1.899683	3.086536	0.62	0.538	-4.149816	7.949182
logit3_y3						
x1	1.679889	.4359289	3.85	0.000	.8254838	2.534294
x2	-1.051402	.4339843	-2.42	0.015	-1.901996	-.2008088
x3	-.1154448	.4385046	-0.26	0.792	-.974898	.7440085
x4	.0623465	.1817055	0.34	0.732	-.2937897	.4184826
_cons	-.4960081	2.567482	-0.19	0.847	-5.52818	4.536164
logit4_y4						
x1	1.213482	.3980963	3.05	0.002	.4332271	1.993736
x2	-.8226954	.3994092	-2.06	0.039	-1.605523	-.0398677
x3	.672316	.4147506	1.62	0.105	-.1405801	1.485212
x4	.2113165	.1907187	1.11	0.268	-.1624853	.5851183
_cons	-3.847181	2.713683	-1.42	0.156	-9.165902	1.471539

```
29 . test [logit0_y0]x1 = [logit1_y1]x1 = [logit2_y2]x1 = [logit3_y3]x1 = [logit4_y4]x1

 ( 1)  [logit0_y0]x1 - [logit1_y1]x1 = 0
 ( 2)  [logit0_y0]x1 - [logit2_y2]x1 = 0
 ( 3)  [logit0_y0]x1 - [logit3_y3]x1 = 0
 ( 4)  [logit0_y0]x1 - [logit4_y4]x1 = 0

           chi2(  4) =    6.95
         Prob > chi2 =    0.1384
```

> 0.05 ; Accept H_0 that they are equal

one set of β we have in this case

∴ they are ordered

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

At mean

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(1)

```
30 . mlogit y x1 x2 x3 x4, rrr 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	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0						
x1	.1600349	.1381566	-2.12	0.034	.02947	.8690582
x2	10.68387	12.48024	2.03	0.043	1.082447	105.4509
x3	.9069236	.7668658	-0.12	0.908	.1729106	4.756852
x4	.6122803	.2123771	-1.41	0.157	.3102418	1.208371
_cons	67.00092	319.1309	0.88	0.377	.0059121	759317.1
1						
x1	.1416522	.115392	-2.40	0.016	.028696	.6992376
x2	1.422402	1.112989	0.45	0.652	.3068895	6.592695
x3	3.176329	3.274044	1.12	0.262	.4212482	23.95041
x4	2.26305	1.057599	1.75	0.081	.9055221	5.655737
_cons	9.56e-07	6.75e-06	-1.96	0.050	9.41e-13	.9712058
2						
x1	.4221609	.2849478	-1.28	0.201	.1124446	1.584956
x2	2.091116	1.444896	1.07	0.286	.5397899	8.100871
x3	.3223499	.2135545	-1.71	0.087	.0879858	1.18098
x4	.7510412	.216202	-0.99	0.320	.4271973	1.32038
_cons	27.17981	109.9074	0.82	0.414	.0098227	75207.99
3						
x1	.1068422	.0662388	-3.61	0.000	.0316975	.3601312
x2	4.117896	2.625823	2.22	0.026	1.180041	14.3699
x3	.7683312	.4630139	-0.44	0.662	.2358278	2.503237
x4	.7610168	.1908414	-1.09	0.276	.4655186	1.244089
_cons	23.1678	81.89134	0.89	0.374	.0227059	23639.1
4						
x1	.8568794	.4836574	-0.27	0.784	.2834439	2.590432
x2	1.302627	.6859033	0.50	0.616	.4641053	3.656146
x3	.270568	.1453647	-2.43	0.015	.0943978	.7755162
x4	.7353579	.1719952	-1.31	0.189	.4649525	1.163025
_cons	65.86432	216.4123	1.27	0.202	.1051558	41254.12
5	(base outcome)					

Note: **_cons** estimates baseline relative risk for each outcome.

```
31 . 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**

When X_1 and X_4 (X_2 and X_3) increase, the probability of choosing choice 0 decrease (increase)

```
------------------------------------------------------------------------------
             |            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
------------------------------------------------------------------------------
```

```
32 . 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
------------------------------------------------------------------------------
```

When X_1 and X_2 (X_4 and X_3) increase, the probability of choosing choice 1 decrease (increase).

```
33 . 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
------------------------------------------------------------------------------
```

```
34 . 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
------------------------------------------------------------------------------
```

```
35 . 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
```

	dy/dx	Delta-method 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

```
36 . 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
```

	dy/dx	Delta-method 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

(2)

```
37 . ologit y x1 x2 x3 x4, nolog

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

```
38 . 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
```

	dy/dx	Delta-method 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

```
39 . 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
```

	dy/dx	Delta-method 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

```
40 . 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
```

	dy/dx	Delta-method 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

```
41 . 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
```

	dy/dx	Delta-method 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

```
42 . 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
```

	dy/dx	Delta-method 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

```
43 . 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
```

	dy/dx	Delta-method 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

at median

```
61 . mlogit y x1 x2 x3 x4, rrr nolog
```

Multinomial logistic regression

Number of obs	= 152
LR chi2(20)	= 50.72
Prob > chi2	= 0.0002
Pseudo R2	= 0.1109

Log likelihood = -203.28337

y	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0						
x1	.1600349	.1381566	-2.12	0.034	.02947	.8690582
x2	10.68387	12.48024	2.03	0.043	1.082447	105.4509
x3	.9069236	.7668658	-0.12	0.908	.1729106	4.756852
x4	.6122803	.2123771	-1.41	0.157	.3102418	1.208371
_cons	67.00092	319.1309	0.88	0.377	.0059121	759317.1
1						
x1	.1416522	.115392	-2.40	0.016	.028696	.6992376
x2	1.422402	1.112989	0.45	0.652	.3068895	6.592695
x3	3.176329	3.274044	1.12	0.262	.4212482	23.95041
x4	2.26305	1.057599	1.75	0.081	.9055221	5.655737
_cons	9.56e-07	6.75e-06	-1.96	0.050	9.41e-13	.9712058
2						
x1	.4221609	.2849478	-1.28	0.201	.1124446	1.584956
x2	2.091116	1.444896	1.07	0.286	.5397899	8.100871
x3	.3223499	.2135545	-1.71	0.087	.0879858	1.18098
x4	.7510412	.216202	-0.99	0.320	.4271973	1.32038
_cons	27.17981	109.9074	0.82	0.414	.0098227	75207.99
3						
x1	.1068422	.0662388	-3.61	0.000	.0316975	.3601312
x2	4.117896	2.625823	2.22	0.026	1.180041	14.3699
x3	.7683312	.4630139	-0.44	0.662	.2358278	2.503237
x4	.7610168	.1908414	-1.09	0.276	.4655186	1.244089
_cons	23.1678	81.89134	0.89	0.374	.0227059	23639.1
4						
x1	.8568794	.4836574	-0.27	0.784	.2834439	2.590432
x2	1.302627	.6859033	0.50	0.616	.4641053	3.656146
x3	.270568	.1453647	-2.43	0.015	.0943978	.7755162

x4	.7353579	.1719952	-1.31	0.189	.4649525	1.163025
_cons	65.86432	216.4123	1.27	0.202	.1051558	41254.12
5	(base outcome)					

Note: **_cons** estimates baseline relative risk for each outcome.

```
65 . margins, dydx(*) at ((median)) 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
```

	dy/dx	Delta-method 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

```
66 . margins, dydx(*) at ((median)) 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
```

	dy/dx	Delta-method 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

```
67 . margins, dydx(*) at ((median)) 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

```
68 . margins, dydx(*) at ((median)) 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

```
69 . margins, dydx(*) at ((median)) 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

```
70 . margins, dydx(*) at ((median)) 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

(2)

```
72 . ologit y x1 x2 x3 x4, nolog

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

```
73 . margins, dydx(*) at ((median)) 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

```
74 . margins, dydx(*) at ((median)) 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

```
75 . margins, dydx(*) at ((median)) 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

```
76 . margins, dydx(*) at ((median)) 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

```
77 . margins, dydx(*) at ((median)) 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

```
78 . margins, dydx(*) at ((median)) 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

```
79 . log close
      name:  <unnamed>
       log:  C:\Users\a\Desktop\426\426-a9.smcl
  log type:  smcl
 closed on:  31 Mar 2021, 16:57:30
-------------------------------------------------------------------------------

80 .
```