

PAF 573
Advanced Regression
Ordered Logit and Ordered Probit for Ordinal Outcomes

```
log: C:\Documents and Settings\Mark Hugo Lopez\My Documents\wvs 508b\ordered logit and
probit.log
log type: text
opened on: 19 Apr 2004, 17:34:13
```

```
. do "C:\DOCUME~1\MARKHU~1\LOCALS~1\Temp\STD000000.tmp"

. #delimit;
delimiter now ;
. set more 1;

. *this log file demonstrates the ordered logit/probit;
. *the outcome measure should be ordinal;
. *consider a sample of young people from 2002;
. *The outcome of interest is whether young people feel they can make;
. *a difference in their community;
. *First, tab the dependent variable;
. tab makediff;
```

can you make a difference in your community	Freq.	Percent	Cum.
no difference at all	113	7.68	7.68
almost no difference	216	14.68	22.37
a little difference	457	31.07	53.43
some difference	511	34.74	88.17
a great deal of difference	174	11.83	100.00
Total	1471	100.00	

```
. tab makediff, nolabel;
```

can you make a difference in your community	Freq.	Percent	Cum.
1	113	7.68	7.68
2	216	14.68	22.37
3	457	31.07	53.43
4	511	34.74	88.17
5	174	11.83	100.00
Total	1471	100.00	

```
. *notice that the value of the outcome rises and is ordinal the greater a young person
> feels about;
. *their chances of making a difference;
```

```

. *OLS approach;
. *as a first approach, you might think to use OLS;
. *while this "works" it is incorrect and assumes a linear and constant structure to t
> he outcome variable;
. reg makediff reg_vote rep dem ed_success ed_less_success black hispanic asian other u
> rb rural;

```

Source	SS	df	MS	Number of obs =	1085
Model	143.732701	11	13.0666092	F(11, 1073) =	12.01
Residual	1167.36407	1073	1.08794415	Prob > F =	0.0000
				R-squared =	0.1096
				Adj R-squared =	0.1005
Total	1311.09677	1084	1.20949887	Root MSE =	1.043

makediff	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
reg_vote	.4818427	.0708422	6.80	0.000	.3428378 .6208476
rep	.2763767	.0804863	3.43	0.001	.1184484 .434305
dem	.1991614	.080773	2.47	0.014	.0406706 .3576523
ed_success	.4522446	.1241242	3.64	0.000	.2086909 .6957982
ed_less_su~s	.1896318	.1159858	1.63	0.102	-.0379529 .4172165
black	-.0505149	.0914175	-0.55	0.581	-.2298923 .1288625
hispanic	-.2283588	.0902292	-2.53	0.012	-.4054044 -.0513131
asian	-.1175384	.2566993	-0.46	0.647	-.621228 .3861511
other	.2176464	.1604768	1.36	0.175	-.0972375 .5325303
urb	.0388908	.072682	0.54	0.593	-.1037241 .1815057
rural	.0638567	.0879384	0.73	0.468	-.1086941 .2364075
_cons	2.654421	.1201355	22.10	0.000	2.418694 2.890148

```

. *alternatively, try the ordered logit;
. ologit makediff reg_vote rep dem ed_success ed_less_success black hispanic asian other
urb rural;
Iteration 0: log likelihood = -1585.3506
Iteration 1: log likelihood = -1519.6517
Iteration 2: log likelihood = -1518.9755
Iteration 3: log likelihood = -1518.9748

```

Ordered logit estimates	Number of obs =	1085
	LR chi2(11) =	132.75
	Prob > chi2 =	0.0000
Log likelihood = -1518.9748	Pseudo R2 =	0.0419

makediff	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
reg_vote	.8620159	.1252862	6.88	0.000	.6164595 1.107572
rep	.5144854	.1415548	3.63	0.000	.2370432 .7919276
dem	.3278404	.1416077	2.32	0.021	.0502945 .6053863
ed_success	.8517988	.2179241	3.91	0.000	.4246755 1.278922
ed_less_su~s	.345469	.2017778	1.71	0.087	-.0500083 .7409463
black	-.1001189	.1605222	-0.62	0.533	-.4147366 .2144988
hispanic	-.4024098	.1584828	-2.54	0.011	-.7130304 -.0917892
asian	-.2291489	.4486293	-0.51	0.610	-1.108446 .6501485
other	.5037629	.2943009	1.71	0.087	-.0730562 1.080582
urb	.0814372	.1260734	0.65	0.518	-.1656621 .3285365
rural	.133463	.1544832	0.86	0.388	-.1693185 .4362446

_cut1	-1.455992	.2247726	(Ancillary parameters)		
_cut2	-.1991542	.2114985			
_cut3	1.280473	.2154955			
_cut4	3.299067	.2341109			

```

. *this produces the above results using maximum likelihood estimation;
. *unfortunately the coefficients are not easily interpreted as constant marginal
effects since these models are non-linear;
. *you could also estimate the ordered probit;
. oprobit makediff reg_vote rep dem ed_success ed_less_success black hispanic asian oth
> er urb rural;

```

```

Iteration 0: log likelihood = -1585.3506
Iteration 1: log likelihood = -1522.0499
Iteration 2: log likelihood = -1522.0106

```

```

Ordered probit estimates                               Number of obs   =       1085
                                                       LR chi2(11)    =       126.68
                                                       Prob > chi2    =       0.0000
Log likelihood = -1522.0106                          Pseudo R2     =       0.0400

```

makediff	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
reg_vote	.4792624	.0720308	6.65	0.000	.3380847 .6204402
rep	.2950627	.0817259	3.61	0.000	.1348828 .4552426
dem	.2061559	.0818681	2.52	0.012	.0456974 .3666143
ed_success	.459877	.1257	3.66	0.000	.2135095 .7062445
ed_less_su~s	.1728381	.1170673	1.48	0.140	-.0566096 .4022858
black	-.0314519	.0924866	-0.34	0.734	-.2127224 .1498186
hispanic	-.2190587	.0911539	-2.40	0.016	-.397717 -.0404004
asian	-.1152872	.2587292	-0.45	0.656	-.6223871 .3918127
other	.2460101	.1637198	1.50	0.133	-.0748748 .566895
urb	.0451345	.0735222	0.61	0.539	-.0989664 .1892353
rural	.0701383	.0888834	0.79	0.430	-.1040699 .2443465
(Ancillary parameters)					
_cut1	-.8487435	.1275031			
_cut2	-.1728506	.1233623			
_cut3	.7101812	.1245005			
_cut4	1.892617	.1318343			

```
. *to get marginal effects, after either oprobit or ologit, using the mfx compute
command;
. *in this case, you must estimate the marginal effects for each outcome;
. mfx compute, predict(outcome(1));
```

Marginal effects after oprobit

```
y = Pr(makediff==1) (predict, outcome(1))
= .06385621
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
reg_vote*	-.067215	.01213	-5.54	0.000	-.090997 -.043433	.646083
rep*	-.0327989	.00848	-3.87	0.000	-.049416 -.016182	.232258
dem*	-.0237428	.00887	-2.68	0.007	-.041121 -.006364	.234101
ed_suc~s*	-.0515573	.01336	-3.86	0.000	-.077748 -.025367	.329032
ed_les~s*	-.0221114	.01541	-1.43	0.151	-.052315 .008093	.580645
black*	.0039974	.01194	0.33	0.738	-.019413 .027408	.162212
hispanic*	.0306286	.01428	2.14	0.032	.002639 .058618	.164055
asian*	.0156829	.03813	0.41	0.681	-.059059 .090425	.015668
other*	-.0258622	.01438	-1.80	0.072	-.054052 .002327	.042396
urb*	-.0055889	.00903	-0.62	0.536	-.023278 .0121	.354839
rural*	-.0084782	.0104	-0.82	0.415	-.028866 .01191	.181567

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. mfx compute, predict(outcome(2));
```

Marginal effects after oprobit

```
y = Pr(makediff==2) (predict, outcome(2))
= .13455995
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
reg_vote*	-.0735969	.01209	-6.09	0.000	-.097289 -.049905	.646083
rep*	-.0438105	.012	-3.65	0.000	-.067328 -.020293	.232258
dem*	-.03099	.01217	-2.55	0.011	-.054849 -.007131	.234101
ed_suc~s*	-.0677938	.01812	-3.74	0.000	-.103312 -.032276	.329032
ed_les~s*	-.0265944	.01814	-1.47	0.143	-.062143 .008954	.580645
black*	.0048445	.01429	0.34	0.735	-.023167 .032856	.162212
hispanic*	.0341057	.01449	2.35	0.019	.005707 .062505	.164055
asian*	.0179357	.04064	0.44	0.659	-.061722 .097593	.015668
other*	-.0360402	.02264	-1.59	0.111	-.080411 .008331	.042396
urb*	-.0069165	.01124	-0.62	0.538	-.028952 .015119	.354839
rural*	-.010692	.01346	-0.79	0.427	-.037069 .015685	.181567

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. mfx compute, predict(outcome(3));
```

Marginal effects after oprobit

```
y = Pr(makediff==3) (predict, outcome(3))
= .31583886
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
reg_vote*	-.0475359	.00775	-6.13	0.000	-.062735 -.032337	.646083
rep*	-.0405691	.01293	-3.14	0.002	-.065912 -.015226	.232258
dem*	-.0273512	.01206	-2.27	0.023	-.050983 -.00372	.234101
ed_suc~s*	-.0623451	.01918	-3.25	0.001	-.099947 -.024744	.329032
ed_les~s*	-.0200762	.01324	-1.52	0.129	-.046027 .005875	.580645
black*	.0036916	.01061	0.35	0.728	-.017107 .024491	.162212
hispanic*	.0219654	.00766	2.87	0.004	.006961 .03697	.164055
asian*	.0121567	.02339	0.52	0.603	-.033682 .057995	.015668
other*	-.0357073	.02751	-1.30	0.194	-.08963 .018215	.042396
urb*	-.0054915	.00908	-0.60	0.545	-.023285 .012302	.354839
rural*	-.0088027	.01166	-0.76	0.450	-.03165 .014045	.181567

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. mfx compute, predict(outcome(4));
```

Marginal effects after oprobit

```
y = Pr(makediff==4) (predict, outcome(4))
= .37416641
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
reg_vote*	.1044354	.01718	6.08	0.000	.070754 .138117	.646083
rep*	.0555911	.01413	3.93	0.000	.027897 .083285	.232258
dem*	.040254	.01506	2.67	0.008	.01074 .069768	.234101
ed_suc~s*	.085606	.02093	4.09	0.000	.044579 .126633	.329032
ed_les~s*	.0364839	.02501	1.46	0.145	-.01254 .085508	.580645
black*	-.0066358	.01972	-0.34	0.736	-.045284 .032013	.162212
hispanic*	-.0487068	.02148	-2.27	0.023	-.090805 -.006609	.164055
asian*	-.0253398	.05948	-0.43	0.670	-.141916 .091237	.015668
other*	.0443164	.02445	1.81	0.070	-.003605 .092237	.042396
urb*	.009354	.01514	0.62	0.537	-.020317 .039025	.354839
rural*	.0142838	.01766	0.81	0.419	-.020332 .0489	.181567

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. mfx compute, predict(outcome(5));
```

Marginal effects after oprobit

```
y = Pr(makediff==5) (predict, outcome(5))
= .11157857
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
reg_vote*	.0839124	.01238	6.78	0.000	.059654	.10817	.646083	
rep*	.0615873	.01878	3.28	0.001	.024782	.098393	.232258	
dem*	.04183	.01776	2.35	0.019	.007013	.076647	.234101	
ed_suc~s*	.0960902	.02897	3.32	0.001	.039317	.152863	.329032	
ed_les~s*	.0322981	.0216	1.50	0.135	-.010031	.074627	.580645	
black*	-.0058977	.01712	-0.34	0.730	-.039453	.027658	.162212	
hispanic*	-.0379929	.0145	-2.62	0.009	-.066404	-.009582	.164055	
asian*	-.0204356	.04265	-0.48	0.632	-.104022	.063151	.015668	
other*	.0532934	.03993	1.33	0.182	-.024965	.131551	.042396	
urb*	.0086428	.0142	0.61	0.543	-.019182	.036468	.354839	
rural*	.0136891	.01782	0.77	0.442	-.021241	.04862	.181567	

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. *if you run an ologit, you can obtain odds ratios easily;
. ologit makediff reg_vote rep dem ed_success ed_less_success black hispanic asian othe
> r urb rural;
```

```
Iteration 0: log likelihood = -1585.3506
Iteration 1: log likelihood = -1519.6517
Iteration 2: log likelihood = -1518.9755
Iteration 3: log likelihood = -1518.9748
```

```
Ordered logit estimates                                Number of obs   =      1085
LR chi2(11)                                           =      132.75
Prob > chi2                                           =      0.0000
Pseudo R2                                             =      0.0419
Log likelihood = -1518.9748
```

makediff	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
reg_vote	.8620159	.1252862	6.88	0.000	.6164595 1.107572
rep	.5144854	.1415548	3.63	0.000	.2370432 .7919276
dem	.3278404	.1416077	2.32	0.021	.0502945 .6053863
ed_success	.8517988	.2179241	3.91	0.000	.4246755 1.278922
ed_less_su~s	.345469	.2017778	1.71	0.087	-.0500083 .7409463
black	-.1001189	.1605222	-0.62	0.533	-.4147366 .2144988
hispanic	-.4024098	.1584828	-2.54	0.011	-.7130304 -.0917892
asian	-.2291489	.4486293	-0.51	0.610	-1.108446 .6501485
other	.5037629	.2943009	1.71	0.087	-.0730562 1.080582
urb	.0814372	.1260734	0.65	0.518	-.1656621 .3285365
rural	.133463	.1544832	0.86	0.388	-.1693185 .4362446
(Ancillary parameters)					
_cut1	-1.455992	.2247726			
_cut2	-.1991542	.2114985			
_cut3	1.280473	.2154955			
_cut4	3.299067	.2341109			

```
. listcoef, help;
```

```
ologit (N=1085): Factor Change in Odds
```

```
Odds of: >m vs <=m
```

makediff	b	z	P> z	e^b	e^bStdX	SDofX
reg_vote	0.86202	6.880	0.000	2.3679	1.5104	0.4784
rep	0.51449	3.635	0.000	1.6728	1.2428	0.4225
dem	0.32784	2.315	0.021	1.3880	1.1490	0.4236
ed_success	0.85180	3.909	0.000	2.3439	1.4924	0.4701
ed_less_su~s	0.34547	1.712	0.087	1.4127	1.1860	0.4937
black	-0.10012	-0.624	0.533	0.9047	0.9637	0.3688
hispanic	-0.40241	-2.539	0.011	0.6687	0.8615	0.3705
asian	-0.22915	-0.511	0.610	0.7952	0.9719	0.1242
other	0.50376	1.712	0.087	1.6549	1.1069	0.2016
urb	0.08144	0.646	0.518	1.0848	1.0398	0.4787
rural	0.13346	0.864	0.388	1.1428	1.0528	0.3857

```
b = raw coefficient  
z = z-score for test of b=0  
P>|z| = p-value for z-test  
e^b = exp(b) = factor change in odds for unit increase in X  
e^bStdX = exp(b*SD of X) = change in odds for SD increase in X  
SDofX = standard deviation of X
```

```
. *or you could obtain percent changes in the odds ratio;
```

```
. listcoef, help percent;
```

```
ologit (N=1085): Percentage Change in Odds
```

```
Odds of: >m vs <=m
```

makediff	b	z	P> z	%	%StdX	SDofX
reg_vote	0.86202	6.880	0.000	136.8	51.0	0.4784
rep	0.51449	3.635	0.000	67.3	24.3	0.4225
dem	0.32784	2.315	0.021	38.8	14.9	0.4236
ed_success	0.85180	3.909	0.000	134.4	49.2	0.4701
ed_less_su~s	0.34547	1.712	0.087	41.3	18.6	0.4937
black	-0.10012	-0.624	0.533	-9.5	-3.6	0.3688
hispanic	-0.40241	-2.539	0.011	-33.1	-13.9	0.3705
asian	-0.22915	-0.511	0.610	-20.5	-2.8	0.1242
other	0.50376	1.712	0.087	65.5	10.7	0.2016
urb	0.08144	0.646	0.518	8.5	4.0	0.4787
rural	0.13346	0.864	0.388	14.3	5.3	0.3857

```
b = raw coefficient  
z = z-score for test of b=0  
P>|z| = p-value for z-test  
% = percent change in odds for unit increase in X  
%StdX = percent change in odds for SD increase in X  
SDofX = standard deviation of X
```

```

. *you could alternatively consider predicted probabilities;
. *as a first step, you could examine the overall distribution of predicted probabiliti
> es;
. predict nodiff almostno alittle somediff greatdiff;
(option p assumed; predicted probabilities)
(393 missing values generated)

. *also notice that the probit or logit is a special case of the oprobit or ologit;
. *consider the simple measure of make a difference or not;
. tab makediff_binary;

```

makediff_bi nary	Freq.	Percent	Cum.
0	786	53.43	53.43
1	685	46.57	100.00
Total	1471	100.00	

```

. oprobit makediff_binary reg_vote rep dem ed_success ed_less_success black hispanic as
> ian other urb rural;

```

```

Iteration 0: log likelihood = -751.67709
Iteration 1: log likelihood = -697.22971
Iteration 2: log likelihood = -697.04959
Iteration 3: log likelihood = -697.04958

```

```

Ordered probit estimates                Number of obs   =      1085
                                         LR chi2(11)     =      109.26
                                         Prob > chi2     =      0.0000
Log likelihood = -697.04958             Pseudo R2      =      0.0727

```

makediff_b~y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
reg_vote	.5619791	.0875822	6.42	0.000	.390321 .7336371
rep	.2341002	.0991661	2.36	0.018	.0397382 .4284622
dem	.2365921	.0996165	2.38	0.018	.0413474 .4318368
ed_success	.5737476	.1583678	3.62	0.000	.2633525 .8841428
ed_less_su~s	.2379232	.1493838	1.59	0.111	-.0548637 .53071
black	-.0920415	.1135653	-0.81	0.418	-.3146254 .1305424
hispanic	-.1563306	.111685	-1.40	0.162	-.3752291 .0625679
asian	-.1093326	.3165172	-0.35	0.730	-.7296949 .5110297
other	.3666009	.1974979	1.86	0.063	-.0204878 .7536897
urb	-.0123536	.0900948	-0.14	0.891	-.1889362 .1642289
rural	.0722595	.1086109	0.67	0.506	-.140614 .2851331
_cut1	.8212272	.1559334			(Ancillary parameter)

```
. probit makediff_binary reg_vote rep dem ed_success ed_less_success black hispanic asi
> an other urb rural;
```

```
Iteration 0: log likelihood = -751.67709
Iteration 1: log likelihood = -697.22971
Iteration 2: log likelihood = -697.04959
Iteration 3: log likelihood = -697.04958
```

```
Probit estimates                               Number of obs   =       1085
                                                LR chi2(11)    =       109.26
                                                Prob > chi2    =       0.0000
Log likelihood = -697.04958                    Pseudo R2      =       0.0727
```

```
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```

makediff_b~y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
reg_vote	.5619791	.0875822	6.42	0.000	.390321	.7336371
rep	.2341002	.0991661	2.36	0.018	.0397382	.4284622
dem	.2365921	.0996165	2.38	0.018	.0413474	.4318368
ed_success	.5737476	.1583678	3.62	0.000	.2633525	.8841428
ed_less_su~s	.2379232	.1493838	1.59	0.111	-.0548637	.53071
black	-.0920415	.1135653	-0.81	0.418	-.3146254	.1305424
hispanic	-.1563306	.111685	-1.40	0.162	-.3752291	.0625679
asian	-.1093326	.3165172	-0.35	0.730	-.7296949	.5110297
other	.3666009	.1974979	1.86	0.063	-.0204878	.7536897
urb	-.0123536	.0900948	-0.14	0.891	-.1889362	.1642289
rural	.0722595	.1086109	0.67	0.506	-.140614	.2851331
_cons	-.8212272	.1559334	-5.27	0.000	-1.126851	-.5156034

```
-----+-----
```

```
.
end of do-file
```

```
. log close
log: C:\Documents and Settings\Mark Hugo Lopez\My Documents\wws 508b\ordered lo
> git and probit.log
log type: text
closed on: 19 Apr 2004, 17:38:17
-----+-----
```