



Statistical and Econometric Methods

Assignment #6 Ordered Probit with Random Effects

A survey of 56 subjects was conducted on freeways in the Seattle area (see text pages 352-357). Each subject drove a vehicle over 40 freeway segments (thus each subject can generate as many as 40 observations if there is no missing data). As they drove over the test segments, they were asked: “How would you rank the roughness of the road on a scale from one to five – with one being the smoothest (or the best) and five being the roughest (or the worst)?” Data were collected on the type of vehicle being used (minivan, pickup, etc.), in-vehicle-cabin noise (dBA), vehicle speed (km/h), socioeconomic information, IRI measurement, age of the roadway surface, information on patching, and the Pavement Structural Condition (PSC). This last term is calculated separately for flexible and rigid pavements based on the amount and severity of various distresses and its values range from 100 (excellent pavement condition) to zero (completely deteriorated pavement).

Your task is to estimate a model of the ordered response of roughness perception while accounting for repeat observations from individual subjects:

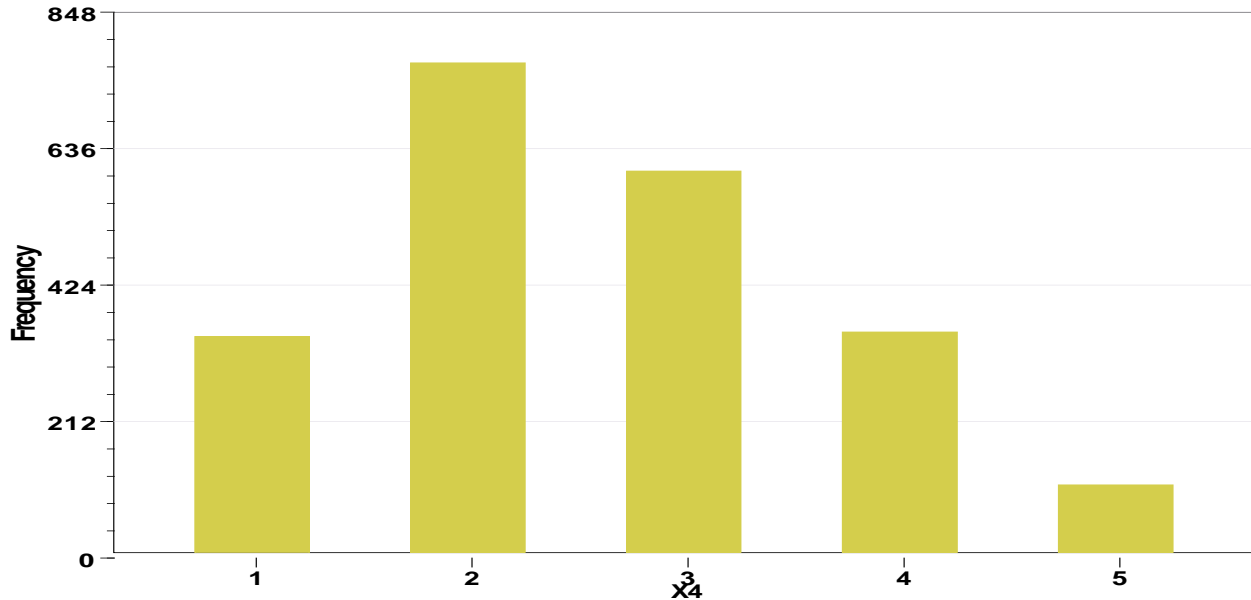
1. The results of your best model specification.
2. A discussion of the logical process that led you to the selection of your final specification. (e.g. Discuss the theory behind the inclusion of your selected variables). Include t -statistics and justify the sign of your variables.

Variables available for your specification are (in file pavement-pds.txt):

Variable Number	Explanation
1	Individual number
2	Roadway segment number
3	pds for Limdep random effects
4	Ruffness ranking: 1 = very smooth; 5 = very rough
5	Sedan: 1 if yes, 0 if no
6	Sport utility vehicle: 1 if yes, 0 if no
7	Pickup: 1 if yes, 0 if no
8	Minivan: 1 if yes, 0 if no
9	Nosie dBA reading
10	Speed in miles per hour
11	Level of service: A=1, B=2, C=3,D=4,E=5,F=6
12	User regularly uses I-5: 1 if yes, 0 if no
13	User regularly uses I-90: 1 if yes, 0 if no
14	User regularly uses I-405: 1 if yes, 0 if no
15	User regularly uses SR-520: 1 if yes, 0 if no
16	Female: 1 if yes, 0 if no
17	Married: 1 if yes, 0 if no
18	Age: 0 = Less than 21; 1 = 21 - 25; 2 = 26-30; 3=31-35; 4 = 36 - 40; 5 = 41 - 45; 6 = 46 - 50; 7 = 51 - 55; 8 = 56 - 60; 9 = 61 - 65; 10 = 66 - 70; 11 = Over 70
19	Income: 0 = no income; 1 = under \$15,000; 2 = \$15,000 - \$24,999; 3 = \$25,000 - \$34,999; 4 = \$35,000 - \$44,999; 5 = \$45,000 - \$54,999; 6 = \$55,000 - \$64,999; 7 = \$65,000 - \$74,999; 8 = \$75,000 - \$84,999; 9 = \$85,000 - \$99,999; 10 = \$100,000 - \$150,000; 11 = over \$150,000

20	Education: 1 = some high school; 2 = high school diploma; 3 = technical college degree (AA); 4 = college degree (BS or BA) 5 = post-graduate degree
21	Vehicle type normally driven: (miscoded, do not use)
22	Number of household vehicles
23	Household size
24	Number of household infants
25	Number of household children
26	Number of workers
27	International roughness index (IRI) in m/km
28	Roadway surface age
29	Visible wear: 1 if yes, 0 if no
30	Visible joints: 1 if yes, 0 if no
31	Visible patching: 1 if yes, 0 if no
32	Bridge in section: 1 if yes, 0 if no
33	Surface type: 1 if concrete, 0 if asphalt
34	Rut depth in mm
35	Pavement structural condition index (PSC)
36	Section length in miles
37	Number of lanes
38	Cracking present: 1 if yes, 0 if no
39	Scaling present: 1 if yes, 0 if no
40	Faulting present: 1 if yes, 0 if no
41	Spalling present: 1 if yes, 0 if no
42	IRI change from last section (m/km)
43	Noise change from last section (dBA)

```
read;nvar=43;nobs=2240;file=C:\Users\Fred\Documents\Work\QUT-WEB\QUT\pavement-
pds.txt$
histogram;rhs=x4$
dstat;rhs=x4$
```



```
create;if(x4=1)xx4=0$
create;if(x4=2)xx4=1$
create;if(x4=3)xx4=2$
create;if(x4=4)xx4=3$
create;if(x4=5)xx4=4$
reject;x4=-999$
ordered;lhs=xx4;rhs=one,x16,x27,x28,x43
;pds=x3;margin$
```

CELL FREQUENCIES FOR ORDERED CHOICES						
Outcome	Frequency		Cumulative < =		Cumulative > =	
	Count	Percent	Count	Percent	Count	Percent
XX4=00	344	15.7871	344	15.7871	2179	100.0000
XX4=01	769	35.2914	1113	51.0785	1835	84.2129
XX4=02	601	27.5815	1714	78.6599	1066	48.9215
XX4=03	351	16.1083	2065	94.7682	465	21.3401
XX4=04	114	5.2318	2179	100.0000	114	5.2318

```
Ordered Probability Model
Dependent variable          XX4
Log likelihood function     -2634.96097
Restricted log likelihood   -3187.27406
Chi squared [ 4](P= .000)  1104.62618
Significance level          .00000
McFadden Pseudo R-squared  .1732870
Estimation based on N =   2179, K =   8
Inf.Cr.AIC = 5285.9 AIC/N = 2.426
```

Underlying probabilities based on Normal

XX4	Coefficient	Standard Error	z	Prob. z >Z*	95% Confidence Interval	
Index function for probability.....						
Constant	-.29190***	.06466	-4.51	.0000	-.41863	-.16518
X16	-.16405***	.04716	-3.48	.0005	-.25649	-.07162
X27	.72778***	.04217	17.26	.0000	.64513	.81042
X28	.01589***	.00244	6.51	.0000	.01111	.02068
X43	.04592***	.00885	5.19	.0000	.02857	.06327
Threshold parameters for index.....						
Mu(01)	1.31576***	.03132	42.01	.0000	1.25437	1.37714
Mu(02)	2.42433***	.03621	66.95	.0000	2.35335	2.49530
Mu(03)	3.57284***	.05623	63.54	.0000	3.46263	3.68305

***, **, * ==> Significance at 1%, 5%, 10% level.

Model was estimated on Oct 15, 2015 at 02:27:23 PM

Iterative procedure has converged

Normal exit: 22 iterations. Status=0, F= .2371419D+04

Random Effects Ordered Probability Model

Dependent variable XX4

Log likelihood function -2371.41946

Restricted log likelihood -2634.96097

Chi squared [1](P= .000) 527.08303

Significance level .00000

(Cannot compute pseudo R2. Use RHS=one

to obtain the required restricted logL)

Estimation based on N = 2179, K = 9

Inf.Cr.AIC = 4760.8 AIC/N = 2.185

Underlying probabilities based on Normal

Unbalanced panel has 56 individuals

XX4	Coefficient	Standard Error	z	Prob. z >Z*	95% Confidence Interval	
Index function for probability.....						
Constant	-.36009**	.15418	-2.34	.0195	-.66227	-.05791
X16	-.21013	.20237	-1.04	.2991	-.60676	.18650
X27	.87936***	.04824	18.23	.0000	.78482	.97390
X28	.01875***	.00296	6.33	.0000	.01294	.02456
X43	.05625***	.01039	5.41	.0000	.03589	.07661
Threshold parameters for index model.....						
Mu(01)	1.57913***	.04124	38.29	.0000	1.49830	1.65996
Mu(02)	2.89761***	.03799	76.27	.0000	2.82315	2.97208
Mu(03)	4.29242***	.04838	88.72	.0000	4.19760	4.38724
Std. Deviation of random effect.....						
Sigma	.66709***	.08628	7.73	.0000	.49799	.83618

***, **, * ==> Significance at 1%, 5%, 10% level.

Model was estimated on Oct 15, 2015 at 02:27:51 PM

 Marginal effects for ordered probability model
 M.E.s for dummy variables are $\Pr[y|x=1]-\Pr[y|x=0]$
 Names for dummy variables are marked by *.

XX4	Partial Effect	Elasticity	z	Prob. z >Z*	95% Confidence Interval	
-----[Partial effects on Prob[Y=00] at means]-----						
*X16	.02943	.32137	1.04	.2983	-.02603	.08490
X27	-.12035***	-2.54496	-7.80	.0000	-.15057	-.09012
X28	-.00257***	-.50828	-5.02	.0000	-.00357	-.00156
X43	-.00770***	-.00228	-4.55	.0000	-.01102	-.00438
-----[Partial effects on Prob[Y=01] at means]-----						
*X16	.04021	.10016	1.04	.2968	-.03533	.11575
X27	-.17145***	-.82709	-6.85	.0000	-.22051	-.12238
X28	-.00366***	-.16519	-5.32	.0000	-.00500	-.00231
X43	-.01097***	-.00074	-4.73	.0000	-.01551	-.00643
-----[Partial effects on Prob[Y=02] at means]-----						
*X16	-.03140	-.08563	-1.05	.2920	-.08982	.02701
X27	.12882***	.68035	6.58	.0000	.09043	.16722
X28	.00275***	.13588	4.94	.0000	.00166	.00384
X43	.00824***	.00061	4.47	.0000	.00463	.01185
-----[Partial effects on Prob[Y=03] at means]-----						
*X16	-.03275	-.25659	-1.04	.2989	-.09454	.02904
X27	.13921***	2.11251	7.56	.0000	.10311	.17531
X28	.00297***	.42191	5.49	.0000	.00191	.00403
X43	.00890***	.00189	4.84	.0000	.00530	.01251
-----[Partial effects on Prob[Y=04] at means]-----						
*X16	-.00549	-.43768	-.99	.3225	-.01638	.00539
X27	.02376***	3.66571	4.91	.0000	.01426	.03325
X28	.00051***	.73212	3.75	.0002	.00024	.00077
X43	.00152***	.00328	3.57	.0004	.00069	.00235

 z, prob values and confidence intervals are given for the partial effect
 ***, **, * ==> Significance at 1%, 5%, 10% level.
 Model was estimated on Oct 15, 2015 at 02:27:55 PM
