USF UNIVERSITY OF SOUTH FLORIDA

Statistical and Econometric Methods

Assignment #7
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	Mininvan: 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 vehciles
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 lenght 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	Nosie change from last section (dBA)

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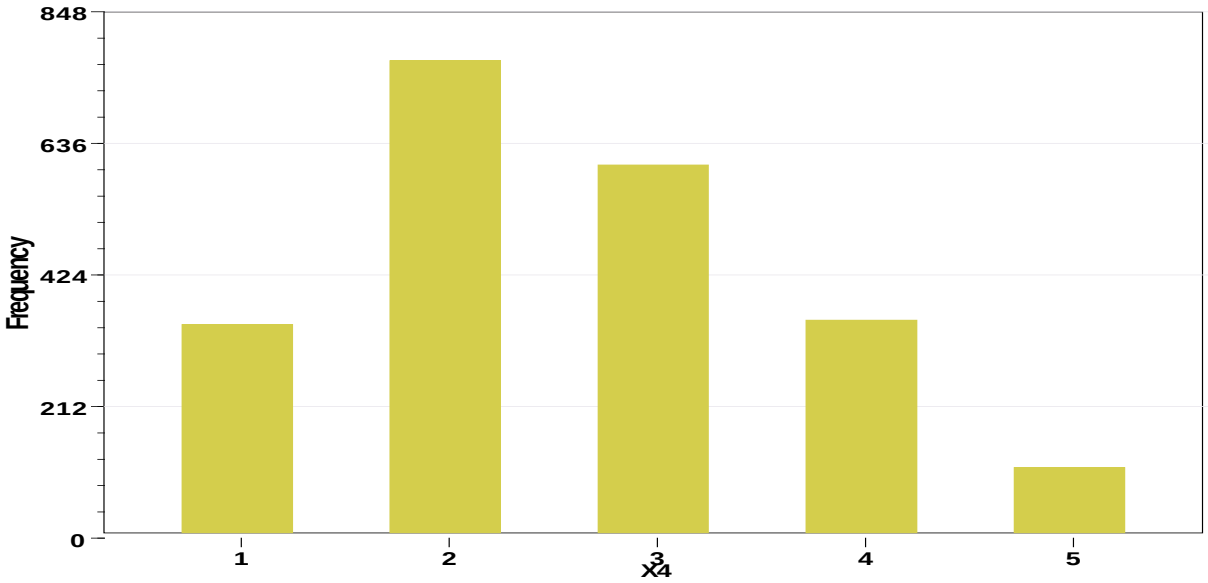
read;nvar=43;nobs=2240;file=C:\Users\Fred\Documents\Work\QUT-WEB\QUT\pavement-
pds.txt$
histogram;rhs=x4$
dstat;rhs=x4$
```




```
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 |
+---+

	Frequency		Cumulative < =		Cumulative > =	
Outcome	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

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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

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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 *.
--------+---------------------------------------------------------------------
        |     Partial                              Prob.      95% Confidence
     XX4|      Effect    Elasticity      z    |z|>Z*         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
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