Statistical and Econometric Methods for Transportation Data Analysis

Chapter 13 – Discrete Outcome Models

Example 13.1a
Discrete Outcome Data – Multinomial Logit Model Assessment

Using the information from assignment 13-1, perform the following:

1. Develop a new model with a price variable in all three choice alternatives. The price variable is created as: set price = ((distance/10)/mpg)*1.05

2. Calculate direct elasticities for all continuous variables using the Limdep "effects" command (see software command-file downloads for assignment #3). Briefly comment on your findings.

3. Perform a likelihood ratio test to determine if men and women should be modeled separately. The test statistic is (see page 282 in the text):

$$-2[LL(\beta_T) - LL(\beta_M) - LL(\beta_F)]$$

   where $LL(\beta_T)$ is the log-likelihood at convergence of the model estimated with the data (males and females), $LL(\beta_M)$ is the log-likelihood at convergence of the model using only male data (use Limdep commands: **reject;x11=0$**; then return to full sample with **include;x11=0$**), and $LL(\beta_F)$ is the log-likelihood at convergence of the model using only female data (**reject;x11=1$**; **include;x11=0$**). This statistic is χ^2 distributed with degrees of freedom equal to the summation of the number of estimated parameters in individual male and female models minus the number of estimated parameters in the overall model. The resulting χ^2 statistic provides the probability that the models have different parameters. Confidence levels for this can be read from Table C.3 on page 379 of the text. Briefly comment on your findings.

4. Using all data again (male and female), determine if the price variable should have separate parameters in the alternatives or if they should be the across alternatives. The test statistic is:

$$-2[LL(\beta_{same}) - LL(\beta_{dif})]$$

   where $LL(\beta_{same})$ is the log-likelihood at convergence of the model estimated with the same betas for price and $LL(\beta_{dif})$ is the log-likelihood at convergence using different betas for price. This statistic is χ^2 distributed with degrees of freedom equal to the number of estimated parameters in the "different" model minus the number of estimated parameters in the "same" model.

Variables available for your specification are (in file Ex13-1a.txt):

Variable Number	Explanation
x1	Route chosen, rows: 1 - arterial, 2 - rural road, 3 - freeway
x2	Arterial row indicator; 1 for arterial row, 0 for others
x3	Rural row indicator; 1 for rural row, 0 for others
x4	Freeway row indicator; 1 for freeway row, 0 for others
x5	Traffic flow rate
x6	Number of traffic signals
x7	Distance in tenths of miles
x8	Seat belts: 1 - if wear, 0 - if not
x9	Number of passengers in car
x10	Driver age in years: 1 - 18 to 23, 2 - 24 to 29, 3 - 30 to 39, 4 - 40 to 49, 5 - 50 and above
x11	Gender: 1 - male, 0 - female
x12	Marital status: 1 - single, 0 - married
x13	Number of children
x14	Annual income: 1 - less than 20000, 2 - 20000 to 29999, 3 - 30000 to 39999, 4 - 40000 to 49999, 5 - more than 50000
x15	Model year of car (e.g. 86 = 1986)
x16	Origin of car: 1 - domestic, 0 - foreign
x17	Fuel efficiency in miles per gallon

```
--> read;nvar=17;nobs=453;file=D:As13-1a.txt$
--> create;cage=86-x15$
--> create;price=(x7/10)/x17*1.05$
--> nlogit;lhs=x1;choices=arterial,rural,freeway;model:
    u(arterial)=pricea*price/
    u(rural)=rural*one+pricer*price+cager*cage/
    u(freeway)=freeway*one+pricef*price+malef*x11+cagef*cage
    ;effects:price(arterial,rural,freeway)$

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Discrete choice (multinomial logit) model   |
| Maximum Likelihood Estimates                |
| Dependent variable               Choice     |
| Weighting variable                  ONE     |
| Number of observations              151     |
| Iterations completed                  7     |
| Log likelihood function       -93.08420     |
| Log-L for Choice   model =     -93.0842     |
| R2=1-LogL/LogL*  Log-L fncn  R-sqrd  RsqAdj |
| No coefficients   -165.8905  .43888  .42361 |
| Constants only    -124.2267  .25069  .23030 |
| Chi-squared[ 6]          =     62.28493     |
| Significance for chi-squared =  1.00000     |
| Response data are given as ind. choice.     |
| Number of obs.=   151, skipped   0 bad obs. |
+---------------------------------------------+

+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 PRICEA   -27.59844150      5.9577684       -4.632   .0000
 RURAL     1.955464369      .96933973        2.017   .0437
 PRICER   -36.12375952      5.9886626       -6.032   .0000
 CAGER     .2050962666      .79571545E-01    2.578   .0100
 FREEWAY  -2.680384373      1.4163297       -1.892   .0584
 PRICEF   -21.41617741      5.8457065       -3.664   .0002
 MALEF     .4913420715      .66134595         .743   .4575
 CAGEF     .2518958209      .97354563E-01    2.587   .0097
```

Elasticity Averaged over observations.
Attribute is PRICE in choice ARTERIAL
Effects on probabilities of all choices in the model:
* indicates direct Elasticity effect of the attribute.

	Decomposition of Effect				Total
	Trunk	Limb	Branch	Choice	Effect
Trunk=Trunk{1}					
Limb=Lmb[1:1]					
Branch=B(1:1,1)					
* Choice=ARTERIAL	.000	.000	.000	-6.035	-6.035
Choice=RURAL	.000	.000	.000	1.517	1.517
Choice=FREEWAY	.000	.000	.000	1.517	1.517

Elasticity Averaged over observations.
Attribute is PRICE in choice RURAL
Effects on probabilities of all choices in the model:
* indicates direct Elasticity effect of the attribute.

	Decomposition of Effect				Total
	Trunk	Limb	Branch	Choice	Effect
Trunk=Trunk{1}					
Limb=Lmb[1:1]					
Branch=B(1:1,1)					
Choice=ARTERIAL	.000	.000	.000	5.538	5.538
* Choice=RURAL	.000	.000	.000	-3.181	-3.181
Choice=FREEWAY	.000	.000	.000	5.538	5.538

Elasticity Averaged over observations.
Attribute is PRICE in choice FREEWAY
Effects on probabilities of all choices in the model:
* indicates direct Elasticity effect of the attribute.

	Decomposition of Effect				Total
	Trunk	Limb	Branch	Choice	Effect
Trunk=Trunk{1}					
Limb=Lmb[1:1]					
Branch=B(1:1,1)					
Choice=ARTERIAL	.000	.000	.000	.830	.830
Choice=RURAL	.000	.000	.000	.830	.830
* Choice=FREEWAY	.000	.000	.000	-6.356	-6.356