Queensland University of Technology
Transport Data Analysis and Modeling Methodologies

Lab Session #4
(Discrete Data – Multinomial Logit Analysis)

You are given 151 observations of a travel survey collected in State College Pennsylvania (same data as in Lab Session #1). All of the households in the sample are making the morning commute to work. They are all departing from the same origin (a large residential complex in the suburbs) and going to work in the Central Business District. They have the choice of three alternate routes; 1) a four-lane arterial (speed limit = 35mph, 2 lanes each direction), 2) a two-lane rural road (speed limit = 35mph, 1 lane each direction) and 3) a limited access four-lane freeway (speed limit = 55mph, 2 lanes each direction).

Your task is to estimate a model of ***Route Choice*** (i.e., the likelihood of an individual traveler taking one of the three routes). Your solution to this problem should include:

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.

For reference, see Example 13.1 on page 319 of the text.

Variables available for your specification are (in file LOGIT-A1.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

```
--> RESET
--> read;nvar=17;nobs=453;file=D:\old_drive_d\new_laptop\CE697N-disk\LOGIT-A1...
--> create;cage=86-x15$
--> nlogit;lhs=x1;choices=arterial,rural,freeway;model:
    u(arterial)=dist*x7/
    u(rural)=rural*one+dist*x7+cager*cage/
    u(freeway)=freeway*one+dist*x7+malef*x11+cagef*cage$
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	-97.57331
Log-L for Choice model =	-97.5733

R2=1-LogL/LogL*	Log-L fncn	R-sqrd	RsqAdj
No coefficients	-165.8905	.41182	.39990
Constants only	-124.2267	.21455	.19863

Chi-squared[4] =	53.30671
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
DIST	-.1673145591	.29977601E-01	-5.581	.0000	
RURAL	.1564120383	.33257409	.470	.6381	
CAGER	.1284640446	.67959177E-01	1.890	.0587	
FREEWAY	-.6375159104E-01	.72232611	-.088	.9297	
MALEF	.5531403558	.63151383	.876	.3811	
CAGEF	.2349166646	.84507861E-01	2.780	.0054	

```
--> nlogit;lhs=x1;choices=arterial,rural,freeway;model:
    u(arterial)=dista*x7/
    u(rural)=rural*one+distr*x7+cager*cage/
    u(freeway)=freeway*one+distf*x7+malef*x11+cagef*cage
    ;prob=proute
    ;effects:x7(arterial)/x7(rural)/x7(freeway)/x11(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	6
Log likelihood function	-94.44041
Log-L for Choice model =	-94.4404

R2=1-LogL/LogL*	Log-L fncn	R-sqrd	RsqAdj
No coefficients	-165.8905	.43071	.41522
Constants only	-124.2267	.23977	.21909

Chi-squared[6] =	59.57252
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
DISTA	-.1229123028	.30118043E-01	-4.081	.0000	
RURAL	2.813533253	1.3993516	2.011	.0444	
DISTR	-.1773693236	.30658999E-01	-5.785	.0000	
CAGER	.1236866754	.68641818E-01	1.802	.0716	
FREEWAY	-2.686471424	2.7277919	-.985	.3247	
DISTF	-.9565023653E-01	.47357666E-01	-2.020	.0434	
MALEF	.5991743946	.66098363	.906	.3647	
CAGEF	.2268755237	.84562574E-01	2.683	.0073	

Elasticity Averaged over observations.
Attribute is X7 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
*	Choice=ARTERIAL	.000	.000	.000	-5.238	-5.238
	Choice=RURAL	.000	.000	.000	1.353	1.353
	Choice=FREEWAY	.000	.000	.000	1.353	1.353

Elasticity Averaged over observations.
Attribute is X7 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
	Choice=ARTERIAL	.000	.000	.000	5.387	5.387
*	Choice=RURAL	.000	.000	.000	-3.016	-3.016
	Choice=FREEWAY	.000	.000	.000	5.387	5.387

Elasticity Averaged over observations.
Attribute is X7 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
	Choice=ARTERIAL	.000	.000	.000	.666	.666
	Choice=RURAL	.000	.000	.000	.666	.666
*	Choice=FREEWAY	.000	.000	.000	-5.630	-5.630

Elasticity Averaged over observations.
Attribute is X11 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
	Choice=ARTERIAL	.000	.000	.000	-.040	-.040
	Choice=RURAL	.000	.000	.000	-.040	-.040
*	Choice=FREEWAY	.000	.000	.000	.302	.302