Choice of Residential Telephone Services Case

MNL with Generic Attributes

Files to use with BIOGEME:
Model file: *MNL_generic_tel.mod*
Data file: *tel.dat*

In the next example we model the household's choice of service option for local telephone services. The choice variables (dependent variable) includes the following alternatives: budget measured (BM), standard measured (SM), local flat(LF), extended flat(EF) and metro flat(MF). (A detailed description of the dataset can be found in the appendix). In this first model we assume that the cost of the calling plans are the only factor influencing the choice of the calling plan. We also assume that the coefficients of the explanatory variables are generic, i.e. they do not vary among the alternatives. The expressions of the utilities for this simple model can be expressed as:

$$\begin{aligned} V_{BM} &= ASC_{BM} + \beta_1 \ln(cost_{BM}) \\ V_{SM} &= \beta_1 \ln(cost_{SM}) \\ V_{LF} &= ASC_{LF} + \beta_1 \ln(cost_{LF}) \\ V_{EF} &= ASC_{EF} + \beta_1 \ln(cost_{EF}) \\ V_{MF} &= ASC_{MF} + \beta_1 \ln(cost_{MF}) \end{aligned}$$

The estimation results are reported in table 1. The results indicate that all the rest being equal, the budget measured (BM) alternative is the least desired option and the metro area flat (MF) is the most preferred option. The alternative specific constant for the extended flat (EF) option is not significantly different from zero, as shown by the related t-test value. The sign of the cost coefficient β_1 is negative, as expected, meaning that the utility of an alternative decreases with increase in cost.

MNL with Alternative-Specific Attributes

Files to use with BIOGEME:
Model file: *MNL_alt_spec_tel.mod*
Data file: *tel.dat*

In this second specification we relax the hypothesis of generic coefficients. To illustrate this idea two different cost coefficients are introduced, one for the flat alternatives and the other for the measured alternatives. The corresponding utility functions are reported below:

$$\begin{aligned} V_{BM} &= ASC_{BM} + \beta_M \ln(cost_{BM}) \\ V_{SM} &= \beta_M \ln(cost_{SM}) \\ V_{LF} &= ASC_{LF} + \beta_F \ln(cost_{LF}) \\ V_{EF} &= ASC_{EF} + \beta_F \ln(cost_{EF}) \\ V_{MF} &= ASC_{MF} + \beta_F \ln(cost_{MF}) \end{aligned}$$

The estimation results are reported in table 2. In this case both the cost coefficients for flat and measured alternatives are estimated. Both their signs are negative, as expected, and the larger absolute value for β_M indicates that people are more sensitive to cost in case of measured alternatives. The value and the sign for the budget measured alternative specific constant still indicate that this option is the least desired, all the rest remaining constant. The other values of the ASCs for the flat options are not significant.

Generic vs Specific Test

The likelihood ratio test can be used to test the generic vs. the alternative-specific model specifications. The likelihood ratio test statistic for the null hypothesis of generic attributes is

$$-2(L(\beta_R) - L(\beta_U))$$

where R and U denote the restricted (generic) and unrestricted (alternative-specific) models, respectively. It is χ^2 distributed with the number of degrees of freedom equal to the number of restrictions $(K_U - K_R)$, with K_U and K_R the numbers of estimated coefficients in the unrestricted and restricted models, respectively. In this case, $-2(-477.557 + 476.608) = 1.898$. Since $\chi^2_{0.95,1} = 3.841$ at 95% level of confidence, we can conclude that the null hypothesis of a generic cost coefficient cannot be rejected.

Inclusion of Socio-Economic Characteristics

Files to use with BIOGEME:
Model file: *MNL_socio_econ_tel.mod*
Data file: *tel.dat*

The previous two models only include variables that are attribute of the alternatives. We now introduce a socio-economic characteristic, namely the number of users in the house (*users*), in the utility of the flat options. It should be noted that the socio-economic variables do not vary among the alternatives and are individual specific. The utility functions can be written now as follows:

$$
\begin{aligned}
V_{BM} &= ASC_{BM} + \beta_M \ln(cost_{BM}) \\
V_{SM} &= \beta_M \ln(cost_{SM}) \\
V_{LF} &= ASC_{LF} + \beta_F \ln(cost_{LF}) + \beta_{user} users \\
V_{EF} &= ASC_{EF} + \beta_F \ln(cost_{EF}) + \beta_{user} users \\
V_{MF} &= ASC_{MF} + \beta_F \ln(cost_{MF}) + \beta_{user} users
\end{aligned}
$$

The estimation results are reported in table 3. The coefficient of the *users* variable is statistically significant different from zero and indicates that people have higher preference towards flat options if the number of users is higher (as expected). The interpretation of the other coefficients rest the same as in the previous model specifications.

MNL with generic attributes				
Variable number	Variable name	Coefficient estimate	Robust standard error	Robust *t statistic*
1	ASC_{BM}	-0.721	0.151	-4.759
2	ASC_{LF}	1.201	0.158	7.562
3	ASC_{EF}	0.999	0.703	1.421
4	ASC_{MF}	1.736	0.267	6.515
5	β_1	-2.026	0.212	-9.548
Summary statistics				
Number of observations $= 434$				
$\mathcal{L}(0) = -560.25$				
$\mathcal{L}(\hat{\beta}) = -477.557$				
$\bar{\rho}^2 = 0.1476$				

Table 1: MNL with generic attributes

MNL with alternative specific attributes				
Variable number	Variable name	Coefficient estimate	Robust standard error	Robust *t statistic*
1	ASC_{BM}	-0.747	0.155	-4.822
2	ASC_{LF}	0.155	0.691	0.224
3	ASC_{EF}	-0.092	1.000	-0.092
4	ASC_{MF}	0.479	0.817	0.587
5	β_F	-1.709	0.273	-6.253
6	β_M	-2.165	0.243	-8.903
Summary statistics				
Number of observations $= 434$				
$\mathcal{L}(0) = -560.25$				
$\mathcal{L}(\hat{\beta}) = -476.608$				
$\bar{\rho}^2 = 0.1492$				

Table 2: MNL with alternative-specific attributes

MNL with socio-economic characteristics				
Variable number	Variable name	Coefficient estimate	Robust standard error	Robust *t statistic*
1	ASC_{BM}	-0.731	0.153	-4.773
2	ASC_{LF}	-0.087	0.699	-0.124
3	ASC_{EF}	-0.319	1.025	-0.312
4	ASC_{MF}	0.274	0.830	0.330
5	β_{user}	0.394	0.108	3.633
6	β_{M}	-1.958	0.286	-6.245
7	β_{F}	-1.789	0.021	-5.241
Summary statistics				
Number of observations $= 434$				
$\mathcal{L}(0) = -560.25$				
$\mathcal{L}(\hat{\beta}) = -468.791$				
$\bar{\rho}^2 = 0.1632$				

Table 3: MNL with socio-economic characteristics