

Mixed Logit Models: Accuracy and Software Choice

Appendix

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1. Actual Choice Data

To further investigate how ML estimates differ across software packages, we utilize the data collected by Chang et al. (2009) in which consumers (hypothetically) chose between buying one of four beef product options at different price levels. The choice sets also contained a fifth “no purchase” option. As in Chang et al. (2009), alternative-specific constants for each option (relative to no purchase) were each specified as univariate normal, and the price coefficient was specified as non-random to facilitate convergence. The data set consists of 235 choices made by 47 people (each person made 5 choices between brands at varying price levels). Because SAS does not have the capability to model the repeated nature of the data, this aspect of the choices was ignored in all three software packages. Thus, each choice was assumed independent.

Table A1 reports the parameter estimates from each software package. SAS and NLOGIT generated similar estimates, but estimates from Hole’s module for Stata were quite different. For example, the mean estimates for “Fresh” brand (β_1) were 6.976 and 6.970 in SAS and NLOGIT, respectively, but 8.126 in Stata. Despite the similarities in the mean estimates in SAS and NLOGIT, the estimates of the standard errors diverge considerably. For example, the standard error for the price coefficient is about 7.7% higher in SAS as compared to NLOGIT (1.443 vs. 1.330). Moreover, although all of the mean parameter estimates are indicated to be statistically significant in SAS and NLOGIT at the 10% level or lower, none of the estimates are indicated to be statistically significant at this level in Stata.

The estimates from the ML model are of little direct practical relevance. Thus, to assess the differences in practical implications, the estimates in table A1 were used to

calculate willingness-to-pay (WTP) estimates for each brand relative to “no purchase” and the market share for each option assuming a price of \$3 for each option. The results are in table A2. The WTP estimates were identical up to the penny for SAS and NLOGIT. However, using Hole’s module for Stata, WTP estimates for all brands were \$0.04 to \$0.09 (1.1% to 4.2%) lower than those for SAS and NLOGIT. Market share estimates for all three packages are the same up to the first two decimal places. Thus, the results seem to suggest that the practical implications of the differences in parameter estimates observed in table A1 are relatively minor.

It is important to note that the findings in tables A1 and A2 may not be general. Chang et al. (2009) also collected data on choices in other experimental treatments and for other sets of goods. Interestingly, for many of these other data sets, we could not achieve convergence in all three software packages, and sometimes the estimates at the final iterations differed by orders of magnitude across software packages. NLOGIT was the only package to consistently achieve convergence. Thus, in many ways, the comparisons we report in tables A1 and A2 are a best-case scenario in which all three packages converged.

References

Chang, J.B., J.L. Lusk, and F.B. Norwood. 2009. "How Closely Do Hypothetical Surveys and Laboratory Experiments Predict Field Behavior?" *American Journal of Agricultural Economics* 91:518-34.

Table A1. Comparison of Mixed Logit Estimates by Software Packages with Real Data

Parameter	Software Package		
	SAS	NLOGIT	Hole's Module for Stata
<i>Mean Estimate</i>			
β_1 , Fresh	6.976** (3.487) ^a	6.970** (3.247)	8.126 (6.134)
β_2 , Lean	8.993* (4.727)	8.983** (4.432)	10.610 (8.437)
β_3 , Diet Lean	6.526** (3.295)	6.520** (3.036)	7.531 (5.690)
β_4 , Organic	5.286* (2.865)	5.281** (2.605)	6.030 (4.569)
β_{price}	-2.486* (1.433)	-2.483* (1.330)	-2.963 (2.497)
<i>Standard Deviation</i>			
σ_1	1.850 (2.046)	1.845 (1.894)	2.483 (3.208)
σ_2	2.670 (2.129)	2.667 (1.902)	3.199 (3.266)
σ_3	2.633 (2.194)	2.628 (2.134)	3.443 (3.694)
σ_4	3.359 (2.662)	3.353 (2.600)	4.262 (4.445)
Log likelihood	-282.877	-282.884	-282.822
Run-time (minutes)	00:45.17	2:59.87	3:38.36

Note: Single asterisk (*) and double asterisks (**) denote values are statistically significant at the 10% and 5% level, respectively. All estimations were conducted with 500 Halton draws.

^a Numbers in parentheses are standard errors.

Table A2. Willingness-to-Pay and Market Share Estimates from Mixed Logit Models Estimated by Three Software Packages

	Software Package		
	SAS	NLOGIT	Hole's Module for Stata
<i>Willingness-to-Pay for . . .</i>			
Fresh	\$2.81	\$2.81	\$2.74
Lean	\$3.62	\$3.62	\$3.58
Diet Lean	\$2.62	\$2.63	\$2.54
Organic	\$2.13	\$2.13	\$2.04
<i>Market Share for . . .</i>			
Fresh	0.14200	0.14182	0.14222
Lean	0.47186	0.47195	0.47205
Diet Lean	0.15110	0.15115	0.15242
Organic	0.11300	0.11298	0.11335
No purchase	0.12204	0.12210	0.11995