Caroline Nelson

Cn8764

# Homework 1: Choice Based Conjoint Analysis

1. Using the given data, and setting salmon and farm raised/genetically modified as baselines, I filled in a matrix with these formulas:

Since the ‘buy’ variable is binomial,

where *buy* is an indicator variable of whether or not the customer would buy those items.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| id | task | buy | Utility | Exp\_U | Prob | LH | LogLH | TotalLH |
| 1 | 1 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 | -679.9774 |
| 1 | 2 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 3 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 4 | 0 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 5 | 0 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 6 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 7 | 0 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 8 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |
| 1 | 9 | 1 | 0 | 1 | 0.5 | 0.5 | -0.6931472 |  |

After maximizing the TotalLogLikelihood with Excel Solver, I obtained the matrix and coefficients given below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| intercept | tuna | halibut | wild | farm | price (in $10's) |
| -0.50011 | -0.312537 | -0.46308 | 2.234768 | 0.949925 | -0.948188 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| id | task | buy | Utility | Exp\_U | Prob | LH | LogLH | TotLH |
| 1 | 1 | 1 | -1.758 | 0.1724 | 0.1470 | 0.1470 | -1.917 | -477.1 |
| 1 | 2 | 1 | -2.290 | 0.1012 | 0.0910 | 0.0910 | -2.386 |  |
| 1 | 3 | 1 | -0.624 | 0.5359 | 0.3489 | 0.3489 | -1.053 |  |
| 1 | 4 | 0 | 0.1237 | 1.1317 | 0.5309 | 0.4691 | -0.757 |  |
| 1 | 5 | 0 | -2.396 | 0.0911 | 0.0835 | 0.9165 | -0.087 |  |
| 1 | 6 | 1 | 0.0956 | 1.1003 | 0.5239 | 0.5239 | -0.647 |  |
| 1 | 7 | 0 | -0.877 | 0.4162 | 0.2939 | 0.7061 | -0.348 |  |
| 1 | 8 | 1 | -2.424 | 0.0886 | 0.0814 | 0.0814 | -2.509 |  |
| 1 | 9 | 1 | -1.624 | 0.1971 | 0.1646 | 0.1646 | -1.804 |  |

2. Curiously, the probabilities for each individual are the same for each task.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| id | task | Probability | id | task | Probability | id | task | Probability |
| 1 | 1 | 0.147021 | 50 | 1 | 0.147021 | 100 | 1 | 0.147021 |
| 1 | 2 | 0.091978 | 50 | 2 | 0.091978 | 100 | 2 | 0.091978 |
| 1 | 3 | 0.348905 | 50 | 3 | 0.348905 | 100 | 3 | 0.348905 |
| 1 | 4 | 0.530881 | 50 | 4 | 0.530881 | 100 | 4 | 0.530881 |
| 1 | 5 | 0.083513 | 50 | 5 | 0.083513 | 100 | 5 | 0.083513 |
| 1 | 6 | 0.523882 | 50 | 6 | 0.523882 | 100 | 6 | 0.523882 |
| 1 | 7 | 0.293861 | 50 | 7 | 0.293861 | 100 | 7 | 0.293861 |
| 1 | 8 | 0.081389 | 50 | 8 | 0.081389 | 100 | 8 | 0.081389 |
| 1 | 9 | 0.164621 | 50 | 9 | 0.164621 | 100 | 9 | 0.164621 |

3. The table below shows the exponentiated utility for each attribute (coefficients from part 1):

|  |  |  |
| --- | --- | --- |
|  | Tuna | -0.31253728 |
| Fish | Halibut | -0.46308285 |
|  | Salmon | 0 |
|  | Wild | 2.234767541 |
| Type | Farm | 0.94992536 |
|  | GMO/Farm | 0 |
|  | 1.399 | -1.32651449 |
| Price | 1.699 | -1.61097078 |
|  | 1.999 | -1.89542706 |

Using this table, I can compute the percent importance of each attribute:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Max Utility | Min Utility | Diff | %Importance |
| Fish | 0 | -0.46308 | 0.46308 | 0.141755876 |
| Type | 2.23477 | 0 | 2.23477 | 0.684092347 |
| Price | -1.32651 | -1.89543 | 0.56891 | 0.174151777 |
|  |  |  | 3.26676 |  |

4. Given the options below, we can calculate the product share of each product (exponentiated utility) at the prices given below, while experimenting with price changes of product 1.

|  |  |  |  |
| --- | --- | --- | --- |
| Product | Fish | Type | Price |
| 1 | Tuna | Wild | 19.99 |
| 2 | Salmon | Wild | 15.99 |
| 3 | Salmon | Farm | 13.99 |
| None |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Price of Prod1 | 13.99 | 15.99 | 17.99 | 19.99 |
| Product 1 | 1.100320572 | 0.91025003 | 0.753012475 | 0.622936302 |
| Product 2 | 1.24421066 | 1.24421066 | 1.24421066 | 1.24421066 |
| Product 3 | 0.416152568 | 0.416152568 | 0.416152568 | 0.416152568 |
| None | 1 | 1 | 1 | 1 |
| Sum | 3.7606838 | 3.570613258 | 3.413375703 | 3.28329953 |

Then, we can find the market shares of each product by dividing each product share by the sum of the product shares at each price.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Price of prod1 | 13.99 | 15.99 | 17.99 | 19.99 |
| Product 1 | 0.29258524 | 0.254928205 | 0.220606385 | 0.189728746 |
| Product 2 | 0.330846922 | 0.348458534 | 0.364510317 | 0.378951311 |
| Product 3 | 0.11065875 | 0.116549326 | 0.121918184 | 0.12674828 |
| None | 0.265909088 | 0.280063935 | 0.292965113 | 0.304571664 |

As the price of product 1 increases, its market share decreases, while the market shares of products 2 and 3 increase, as expected. From this table, we can calculate the elasticity of each product using the formula below.

|  |  |  |
| --- | --- | --- |
|  |  | Elasticity |
| Product 1 | -0.42651259 | -1.20774149 |
| Product 2 | 0.135543839 | 0.383814969 |
| Product 3 | 0.135543839 | 0.383814969 |
| None | 0.135543839 | 0.383814969 |
| Price | 0.353148911 | 1 |

In this table, we see that products 2, 3 and the None option are changing in market share at the same rate and have equal elasticities, which was surprising.

5. Taking the partial derivatives of with respect to xi1, xi2, andxi3:

Notice that the derivatives of xi2 andxi3 are almost identical.