A2

Load data

```
data("margarine")
```

EX 1

Average and dispersion in product characteristics:

```
## 1 Parkay, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.1900  0.5000  0.5800  0.5184  0.6200  0.6700
```

```
## 2 BlueBonnett, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.1900  0.5000  0.5800  0.5432  0.6100  1.0100
```

```
## 3 Fleischmanns, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.950   0.990   0.990   1.015   1.080   1.160
```

```
## 4 house, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.1900  0.2900  0.4500  0.4371  0.5700  0.6400
```

```
## 5 generic, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.2500  0.3300  0.3300  0.3453  0.3600  0.5500
```

```
## 6 Imperial, stick
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3300  0.7200  0.7500  0.7808  0.8800  2.3000
```

```
## 7 Shed Spread, tub
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.5000  0.8000  0.8500  0.8251  0.8500  0.9800
```

```
## 8 Parkay, tub
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.980   1.070   1.090   1.077   1.090   1.240
```

```
## 9 Fleischmanns, tub
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.690   1.190   1.190   1.189   1.190   1.470
```

```
## 10 house, tub
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3300  0.5600  0.5900  0.5687  0.5900  1.2700
```

Market share(?) and market share by product characteristics.

```
## Number of household:  4470
```

```
##  Market share for each product choice
```

```
##            1       2       3       4       5       6       7       8
## num_choice "1766"  "699"   "243"   "593"   "315"   "74"    "319"   "203"
##            "0.395" "0.156" "0.054" "0.133" "0.070" "0.017" "0.071" "0.045"
##            9       10
## num_choice "225"   "33"
##            "0.050" "0.007"
```

The mapping between observed attributes and choices.

```
##       choice attributes            names
##  [1,] "1"    "Parkay, stick"       "PPk_Stk"
##  [2,] "2"    "BlueBonnett, stick"  "PBB_Stk"
##  [3,] "3"    "Fleischmanns, stick" "PFl_Stk"
##  [4,] "4"    "house, stick"        "PHse_Stk"
##  [5,] "5"    "generic, stick"      "PGen_Stk"
##  [6,] "6"    "Imperial, stick"     "PImp_Stk"
##  [7,] "7"    "Shed Spread, tub"    "PSS_Tub"
##  [8,] "8"    "Parkay, tub"         "PPk_Tub"
##  [9,] "9"    "Fleischmanns, tub"   "PFl_Tub"
## [10,] "10"   "house, tub"          "PHse_Tub"
```

EX2

The conditional logit model is used to capture the effect of price on demand. The probability that individual i chooses product j: $p_{ij} = \frac{e^{\beta x_{ij}}}{\sum_{k=1}^{m} e^{\beta x_{ik}}}$ The log likelihood: $LLH(\beta) = \sum_i \sum_j y_{ij} \log(p_{ij})$ where y_{ij} is the indicator that individual i chooses product j.

```
## [1] 11.321326 -2.427151
```

The coefficient on price is -2.4286596, it converges to a value between -2.427 and 2.428. This suggests that, everything else constant, a unit increase in price for a product will reduce the probability of people choosing that product.

EX3

The multinomial logit model is used to capture the effect of family income on demand.

```
##  [1] -3.829618 -1.034242  3.473943 -1.892759 -1.343535 -1.021989 -1.960246
##  [8]  1.181471  2.987107 -1.508848
```

The results indicate that, everything else constant, if the family income rises, people are more like to choose product 3, 4, 7, 8, 9, 10 but less likely to choose product 1, 2, 5, 6.

EX4

Compute marginal effect at the mean. First model:

```
##              [,1]         [,2]         [,3]        [,4]        [,5]
##  [1,] -0.28612391  0.042598666  0.013553831  0.05510569  0.06887030
##  [2,]  0.04259867 -0.271912212  0.012762854  0.05188982  0.06485115
##  [3,]  0.01355383  0.012762854 -0.095217705  0.01651004  0.02063402
##  [4,]  0.05510569  0.051889820  0.016510044 -0.33651107  0.08389154
##  [5,]  0.06887030  0.064851154  0.020634017  0.08389154 -0.39961182
```

```
##  [6,]  0.02393182  0.022535202  0.007170138  0.02915157  0.03643321
##  [7,]  0.02149155  0.020237337  0.006439015  0.02617904  0.03271820
##  [8,]  0.01164924  0.010969413  0.003490193  0.01419005  0.01773452
##  [9,]  0.00887716  0.008359105  0.002659658  0.01081335  0.01351437
## [10,]  0.04004566  0.037708662  0.011997954  0.04877997  0.06096451
##               [,6]         [,7]         [,8]         [,9]         [,10]
##  [1,]  0.023931821  0.021491545  0.011649242  0.008877160  0.040045655
##  [2,]  0.022535202  0.020237337  0.010969413  0.008359105  0.037708662
##  [3,]  0.007170138  0.006439015  0.003490193  0.002659658  0.011997954
##  [4,]  0.029151567  0.026179045  0.014190047  0.010813348  0.048779974
##  [5,]  0.036433211  0.032718196  0.017734517  0.013514368  0.060964514
##  [6,] -0.162634565  0.011369284  0.006162588  0.004696123  0.021184629
##  [7,]  0.011369284 -0.147210372  0.005534202  0.004217270  0.019024479
##  [8,]  0.006162588  0.005534202 -0.082328122  0.002285922  0.010311997
##  [9,]  0.004696123  0.004217270  0.002285922 -0.063281083  0.007858129
## [10,]  0.021184629  0.019024479  0.010311997  0.007858129 -0.257875994
```

The table represents the average change of probability for buying product j (rows) when price of product k (columns) increases by 1 unit. For example, [1, 1] and [1, 2] means that, ceteris paribus, if price of product 1 increases 1 unit, the probability of choosing product 1 is decreased by 0.2863.

Second model:

```
##  [1]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
##  [6]  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00 -1.763125e-66
```