Consumer WTP for Carbon Offsets

Summary Statistics for respondents

```
##                         Variable                Group Frequency Percentage
## 1                       Location              England      1073      84.09
## 2                       Location      NorthernIreland        20       1.57
## 3                       Location             Scotland       102       7.99
## 4                       Location                Wales        81       6.35
## 5                            Age                18-24       136      10.66
## 6                            Age                25-34       255      19.98
## 7                            Age                35-44       265      20.77
## 8                            Age                45-54       219      17.16
## 9                            Age                55-64       224      17.55
## 10                           Age                  65+       177      13.87
## 11                        Gender                  Man       580      45.45
## 12                        Gender                Woman       689      54.00
## 13                        Gender           Non-binary         7       0.55
## 14                          Diet          Flexitarian       173      13.56
## 15                          Diet            Omnivorous       969      75.94
## 16                          Diet           Pescatarian        21       1.65
## 17                          Diet                Vegan        26       2.04
## 18                          Diet           Vegetarian        79       6.19
## 19                          Diet               Others         8       0.63
## 20              Meat Consumption    Twice a day or more        58       4.55
## 21              Meat Consumption           Once a day       179      14.03
## 22              Meat Consumption       3-5 times weekly       611      47.88
## 23              Meat Consumption        2 times weekly       313      24.53
## 24              Meat Consumption                Never       115       9.01
## 25            Climate is Important        1-Not Important        54       4.23
## 26            Climate is Important                    2        79       6.19
## 27            Climate is Important                    3       331      25.94
## 28            Climate is Important                    4       420      32.92
## 29            Climate is Important       5-Very Important       392      30.72
## 30  Familiar with Climate Change        1-Not Familiar         4       0.31
## 31  Familiar with Climate Change                    2        75       5.88
## 32  Familiar with Climate Change                    3       549      43.03
## 33  Familiar with Climate Change                    4       478      37.46
## 34  Familiar with Climate Change       5-Very Familiar       170      13.32
## 35           Climate Change Cause Both human and natural       905      70.92
## 36           Climate Change Cause                Human       242      18.97
## 37           Climate Change Cause              Natural        64       5.02
## 38           Climate Change Cause     No Climate Change        27       2.12
## 39           Climate Change Cause             Not Know        38       2.98
## 40 I am environmentally friendly        Strongly agree       127       9.95
## 41 I am environmentally friendly                Agree       520      40.75
## 42 I am environmentally friendly              Neutral       488      38.24
```
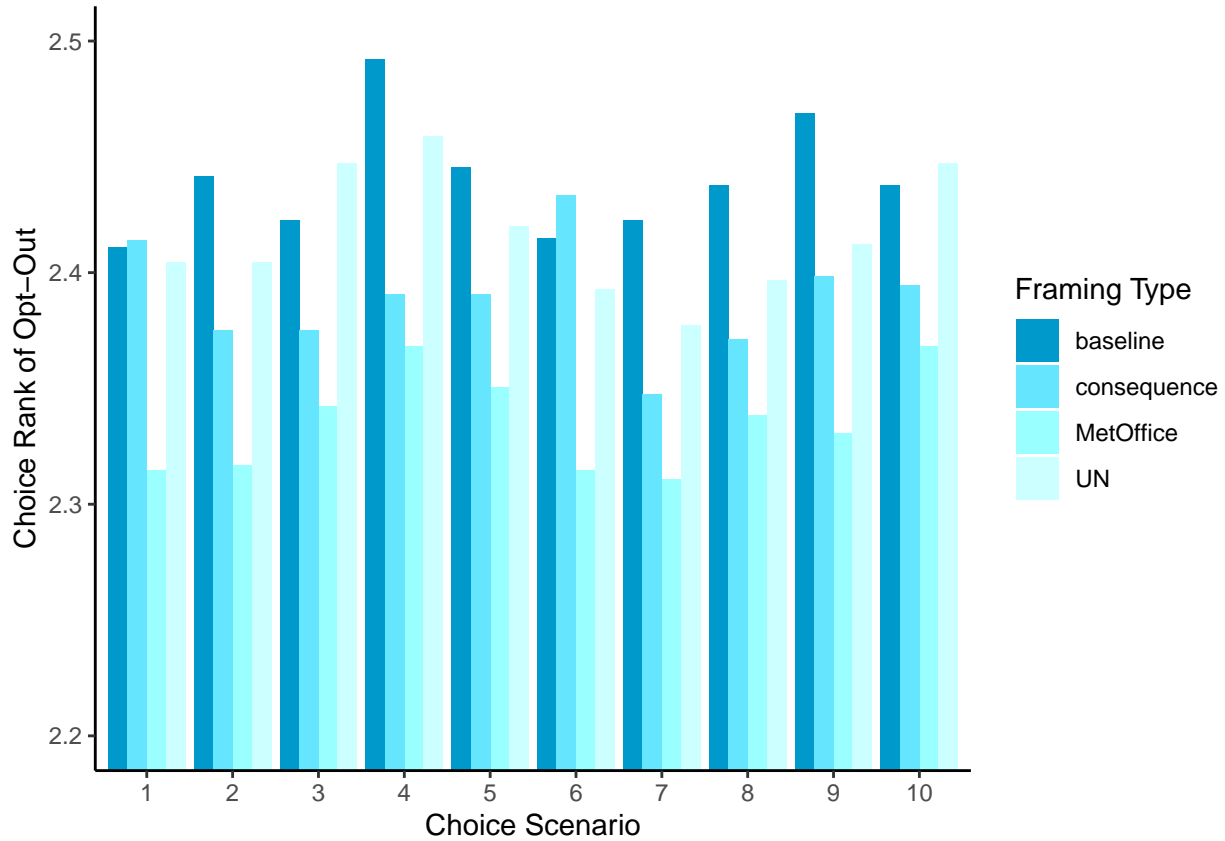
1

```
## 43 I am environmentally friendly            Disagree  102    7.99
## 44 I am environmentally friendly   Strongly disagree   39    3.06
## 45    Concerned with environment      Strongly agree  157   12.30
## 46    Concerned with environment               Agree  486   38.09
## 47    Concerned with environment             Neutral  404   31.66
## 48    Concerned with environment            Disagree  178   13.95
## 49    Concerned with environment   Strongly disagree   51    4.00
## 50                     Education     No qualifications  24    1.88
## 51                     Education          GCSE/O-Level 243   19.04
## 52                     Education   A-Level/Higher/BTEC  241   18.89
## 53                     Education   Degree or equivalent 410  32.13
## 54                     Education            Vocational  149   11.68
## 55                     Education          Postgraduate  202   15.83
## 56                     Education                 Other    7    0.55
## 57                Household Size                     0    2    0.16
## 58                Household Size                     1  277   21.71
## 59                Household Size                     2  424   33.23
## 60                Household Size                     3  263   20.61
## 61                Household Size                     4  211   16.54
## 62                Household Size                     5   74    5.80
## 63                Household Size                     6   17    1.33
## 64                Household Size                     7    5    0.39
## 65                Household Size                     8    1    0.08
## 66                Household Size                    10    2    0.16
## 67            Number of Children                     0  835   65.44
## 68            Number of Children                     1  219   17.16
## 69            Number of Children                     2  158   12.38
## 70            Number of Children                     3   50    3.92
## 71            Number of Children                     4   13    1.02
## 72            Number of Children                     6    1    0.08
## 73            Is the main shopper                   No  289   22.65
## 74            Is the main shopper                  Yes  987   77.35
## 75                        Income             < £10,000   80    6.27
## 76                        Income   £10,001 - £20,000   173   13.56
## 77                        Income   £20,001 - £30,000   254   19.91
## 78                        Income   £30,001 - £40,000   225   17.63
## 79                        Income   £40,001 - £50,000   172   13.48
## 80                        Income   £50,001 - £60,000   142   11.13
## 81                        Income            > £60,001  165   12.93
## 82                        Income         Not Specified   65    5.09
## 83             Where do you live            Citycentre  292   22.88
## 84             Where do you live             Ruralarea  235   18.42
## 85             Where do you live          Townorsuburb  749   58.70
```

Opt-out Rank by Information Treatment

```
## `summarise()` has grouped output by 'framing_effect'. You can override using
## the `.groups` argument.
```

The above table presents the rank of opt-out for each chocie scenario by information treatment. Lower the rank, higher the preference for opt-out. The summary shows that Met Office has a poitive effect on the preference for opt-out, and equivalently, the endorsement has a negative effect on the preference for carbon offset.

Summary of PCA

for Q9

Factor loadings for Q9:

```
## Standard deviations (1, .., p=15):
##  [1] 2.5046346 1.7952538 0.8671802 0.8420678 0.7698472 0.7499137 0.6646755
##  [8] 0.6494582 0.6258234 0.5907576 0.5752403 0.5206952 0.5121747 0.4780786
## [15] 0.4365870
##
## Rotation (n x k) = (15 x 15):
##                 PC1         PC2          PC3          PC4          PC5
## Q9_1   -0.26098102 -0.13947880 -0.141173639 -0.5490800870  0.46368515
## Q9_2   -0.28183132 -0.08571622 -0.183406691 -0.3050513081  0.03875071
## Q9_3   -0.24644270 -0.13408089 -0.311182863 -0.4564107461 -0.56434719
## Q9_4   -0.27811523 -0.13793053  0.123332810  0.0657696856  0.57992532
## Q9_5   -0.32621198 -0.15226000  0.003682632  0.2203336821 -0.06031717
## Q9_6   -0.30234797 -0.18905754  0.081783868  0.3091446625 -0.03217584
## Q9_7   -0.30399505 -0.19184414 -0.036034623  0.2499616037 -0.21605320
```

```
## Q9_8   -0.29403431 -0.18861084 -0.065481096  0.2126700612  0.02092486
## Q9_9   -0.29489436 -0.18791037  0.035688703  0.1652629142 -0.09105797
## Q9_10   0.02006298 -0.34296215  0.809090556 -0.3029946938 -0.20034042
## Q9_11   0.20479717 -0.35836712  0.140385963 -0.0683700881  0.08072307
## Q9_12   0.20859987 -0.36465396 -0.137606913  0.0403247251 -0.08048169
## Q9_13   0.20663986 -0.38452148 -0.239210739 -0.0003796819  0.07028499
## Q9_14   0.24912124 -0.35162034 -0.157236096  0.0529014932  0.10209055
## Q9_15   0.24514851 -0.34505842 -0.213559692  0.1130254166  0.01091991
##                 PC6          PC7          PC8          PC9         PC10         PC11
## Q9_1   -0.016725398  0.24140964 -0.519586399  0.01025151 -0.02325895  0.15570764
## Q9_2   -0.685277437 -0.03518415  0.460483012 -0.07433010  0.09466117 -0.24762226
## Q9_3    0.450329732 -0.25643526  0.064447313 -0.01672457 -0.05000204 -0.05566534
## Q9_4    0.347918515 -0.41975122  0.414214820 -0.05103479  0.03230021  0.10340659
## Q9_5    0.022668372 -0.14740420  0.012146157 -0.16856484 -0.09620125  0.18776913
## Q9_6   -0.078142497 -0.14948412 -0.420267929 -0.17324641  0.15335186 -0.13466700
## Q9_7   -0.289415224 -0.19330567 -0.238389549 -0.13919729 -0.08981062  0.15091835
## Q9_8    0.256567133  0.38483126  0.038030306  0.28100068  0.42694307 -0.52662665
## Q9_9    0.006452393  0.48235556  0.236538692  0.33638815 -0.53473164  0.27653501
## Q9_10   0.006745816  0.14951185  0.081516966 -0.19880355  0.15051977  0.03920506
## Q9_11  -0.098332599 -0.39456729 -0.166882831  0.48725858 -0.41183631 -0.40354006
## Q9_12  -0.152172723 -0.13157794  0.018163104  0.44998139  0.49994924  0.44460508
## Q9_13   0.094394314  0.09723500  0.093472143 -0.14797595  0.04966207  0.23556619
## Q9_14   0.087266375  0.11175758 -0.005639873 -0.30816439 -0.16367187 -0.16422634
## Q9_15  -0.024985623  0.13797268  0.087551456 -0.35394041 -0.08018505 -0.16172121
##                 PC12         PC13         PC14         PC15
## Q9_1   -0.131175524 -0.03874019  0.0117488015 -0.0612089626
## Q9_2    0.110080376 -0.00236371  0.0764042080  0.0915251060
## Q9_3    0.006297199  0.12878218  0.0494180608  0.0006775114
## Q9_4   -0.048471503  0.22465809 -0.0897790936 -0.0611798815
## Q9_5   -0.233943496 -0.73363172  0.3391965919  0.1220212012
## Q9_6    0.417425495  0.35297424  0.4375908799  0.0498479424
## Q9_7   -0.195481930  0.10303915 -0.6871285639 -0.1057006176
## Q9_8   -0.072937503 -0.16606097 -0.2017129341 -0.0220423741
## Q9_9    0.069098465  0.23643960  0.1256001626  0.0130638128
## Q9_10  -0.020651487 -0.01585671 -0.0404689500 -0.0181324131
## Q9_11   0.057623371 -0.16225442 -0.0001613794 -0.0775118148
## Q9_12  -0.226497053  0.13186163  0.1607098918  0.1051337172
## Q9_13   0.690083852 -0.29903437 -0.2387922471 -0.1329122830
## Q9_14  -0.181255327  0.14521734 -0.0756590472  0.7401557875
## Q9_15  -0.356213163  0.14163028  0.2411663207 -0.6099539417
```

Importance of components:

```
## Importance of components:
##                          PC1     PC2     PC3     PC4     PC5     PC6     PC7
## Standard deviation     2.5046  1.7953 0.86718 0.84207 0.76985 0.74991 0.66468
## Proportion of Variance 0.4182  0.2149 0.05013 0.04727 0.03951 0.03749 0.02945
## Cumulative Proportion  0.4182  0.6331 0.68321 0.73048 0.76999 0.80748 0.83694
##                          PC8     PC9    PC10    PC11    PC12    PC13    PC14
## Standard deviation     0.64946 0.62582 0.59076 0.57524 0.52070 0.51217 0.47808
## Proportion of Variance 0.02812 0.02611 0.02327 0.02206 0.01807 0.01749 0.01524
## Cumulative Proportion  0.86506 0.89117 0.91443 0.93649 0.95457 0.97206 0.98729
##                         PC15
## Standard deviation     0.43659
```

```
## Proportion of Variance 0.01271
## Cumulative Proportion  1.00000
```

for Q10

Factor loadings for Q10:

```
## Standard deviations (1, .., p=13):
##  [1] 3.0243643 0.8395952 0.7202235 0.6679623 0.6186940 0.5485075 0.5353138
##  [8] 0.5047338 0.4881521 0.4700284 0.4271656 0.4220006 0.3723855
##
## Rotation (n x k) = (13 x 13):
##                PC1         PC2         PC3         PC4         PC5          PC6
## Q10_1   0.2370513  0.69356557 -0.02474160 -0.03411143  0.48173407 -0.091076815
## Q10_2   0.2691922  0.46827847 -0.02013810  0.17952818 -0.01720555 -0.002396548
## Q10_3   0.2784583  0.16344673 -0.04587311  0.41639953 -0.49409887 -0.050696278
## Q10_4   0.2905954 -0.01702847 -0.03948003  0.27264797 -0.38909305 -0.036862237
## Q10_5   0.2665058  0.10009869  0.53241734 -0.31895518 -0.25377960  0.487887408
## Q10_6   0.2826167 -0.12331273  0.42442319 -0.11273764  0.03543716 -0.092212390
## Q10_7   0.2831621 -0.27745605  0.18392991  0.16139527  0.17342374 -0.466922443
## Q10_8   0.2803305 -0.19094595  0.31483152 -0.05511677  0.21648468 -0.341043083
## Q10_9   0.2904598 -0.10047419 -0.19930722 -0.09241954 -0.09068704  0.023239599
## Q10_10  0.2575699  0.04742038 -0.39148891 -0.73666752 -0.25892823 -0.263566382
## Q10_11  0.2924052 -0.19192607 -0.30736056  0.12692325  0.15360482  0.119274721
## Q10_12  0.2911465 -0.20176574 -0.32226941  0.08767093  0.15686316  0.149023846
## Q10_13  0.2805667 -0.21004878 -0.08632445  0.01832960  0.32563693  0.548146195
##                PC7         PC8         PC9        PC10         PC11          PC12
## Q10_1    0.1729206 -0.34431357  0.07298375 -0.25663830 -0.02553074 -0.0061551914
## Q10_2   -0.2953424  0.61811370 -0.22922459  0.36486303  0.06064831 -0.1289453328
## Q10_3   -0.1294670 -0.26335468  0.34425290  0.10946265 -0.20242613  0.4637196680
## Q10_4    0.2533791 -0.22549800 -0.10269516 -0.10946819  0.43478749 -0.5986810960
## Q10_5    0.3253549  0.02510767 -0.15354141  0.02952990 -0.31547619 -0.0008321537
## Q10_6   -0.4554798 -0.09539279 -0.25120734 -0.29795699  0.46716653  0.3295657434
## Q10_7   -0.1396737 -0.16700139 -0.28478071  0.07882260 -0.57733471 -0.2558436737
## Q10_8    0.3667549  0.25426428  0.52793941  0.27241620  0.23674426  0.0611138021
## Q10_9   -0.1166823  0.43089884  0.32459628 -0.68556801 -0.23211005 -0.1355011951
## Q10_10  -0.1089320 -0.16092614 -0.01464656  0.24318129  0.02517767 -0.0127875034
## Q10_11   0.2211968  0.05129454 -0.33031957 -0.06257224  0.05194914  0.2515664607
## Q10_12   0.3106830  0.06659471 -0.21412057  0.08096066  0.02629080  0.2903953157
## Q10_13  -0.4045247 -0.24139512  0.32563327  0.25954168  0.02493111 -0.2567797852
##                PC13
## Q10_1   -0.017380977
## Q10_2   -0.006885015
## Q10_3    0.030456863
## Q10_4   -0.039716385
## Q10_5    0.029273810
## Q10_6   -0.083754024
## Q10_7   -0.037198627
## Q10_8    0.088027891
## Q10_9   -0.040231970
## Q10_10   0.032293620
## Q10_11   0.706181824
## Q10_12  -0.691219746
```

```
## Q10_13  0.031656758
```

Importance of components:

```
## Importance of components:
##                             PC1     PC2    PC3     PC4     PC5     PC6     PC7
## Standard deviation       3.0244 0.83960 0.7202 0.66796 0.61869 0.54851 0.53531
## Proportion of Variance 0.7036 0.05422 0.0399 0.03432 0.02944 0.02314 0.02204
## Cumulative Proportion  0.7036 0.75782 0.7977 0.83205 0.86149 0.88463 0.90668
##                             PC8     PC9    PC10    PC11    PC12    PC13
## Standard deviation       0.5047 0.48815 0.47003 0.42717 0.4220 0.37239
## Proportion of Variance 0.0196 0.01833 0.01699 0.01404 0.0137 0.01067
## Cumulative Proportion  0.9263 0.94460 0.96160 0.97563 0.9893 1.00000
```

for Q12

Factor loadings for Q12:

```
## Standard deviations (1, .., p=6):
## [1] 1.7131814 0.9744303 0.8245069 0.7197747 0.7098894 0.6431679
##
## Rotation (n x k) = (6 x 6):
##              PC1        PC2        PC3         PC4         PC5          PC6
## Q12_1  0.3770140 -0.5647208  0.1148863 -0.69272761  0.19551259 -0.08749459
## Q12_2 -0.4268324 -0.3576664  0.1797303 -0.15691516 -0.72359224  0.33072308
## Q12_3 -0.3780827 -0.3826240 -0.7435457  0.04332475  0.03845367 -0.39298406
## Q12_4  0.4385955 -0.2933678 -0.4051160  0.33168174  0.01933992  0.66862809
## Q12_5  0.4369500 -0.3150497  0.2230641  0.48725558 -0.39000880 -0.52013063
## Q12_6 -0.3865704 -0.4705774  0.4333144  0.38235883  0.53313180  0.10455180
```

Importance of components:

```
## Importance of components:
##                             PC1    PC2    PC3     PC4     PC5     PC6
## Standard deviation       1.7132 0.9744 0.8245 0.71977 0.70989 0.64317
## Proportion of Variance 0.4892 0.1583 0.1133 0.08635 0.08399 0.06894
## Cumulative Proportion  0.4892 0.6474 0.7607 0.84707 0.93106 1.00000
```

Basic Logit Model

Basic Logit Model Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mnl", method = "nr")
##
## Frequencies of categories:
##
```

```
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:7s
##
## Coefficients:
##                      Estimate Std. Error  z-value  Pr(>|z|)
## I                  -0.9858758  0.0355302 -27.7476 < 2.2e-16 ***
## price              -0.0318596  0.0018653 -17.0803 < 2.2e-16 ***
## location_EU        -0.0193157  0.0179737  -1.0747    0.2825
## location_UK         0.1726739  0.0178102   9.6952 < 2.2e-16 ***
## certificate_NGO     0.0993108  0.0182718   5.4352 5.474e-08 ***
## certificate_UK      0.3372772  0.0185896  18.1433 < 2.2e-16 ***
## project_renewable   0.1324178  0.0209696   6.3148 2.706e-10 ***
## project_landfill   -0.2605849  0.0230259 -11.3170 < 2.2e-16 ***
## project_manure     -0.1361997  0.0209358  -6.5056 7.740e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by Newton-Raphson maximisation
## Log Likelihood: -20883
## Number of observations: 12760
## Number of iterations: 4
## Exit of MLE: gradient close to zero (gradtol)
```

Basic Logit Model Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                      Estimate Std. Error  t-value  Pr(>|t|)
## I                   -30.94442    2.76300 -11.1996 < 2.2e-16 ***
## location_EU          -0.60628    0.56778  -1.0678    0.2856
## location_UK           5.41985    0.64571   8.3936 < 2.2e-16 ***
## certificate_NGO       3.11714    0.60496   5.1526 2.569e-07 ***
## certificate_UK       10.58637    0.94537  11.1981 < 2.2e-16 ***
## project_renewable     4.15630    0.68590   6.0597 1.364e-09 ***
## project_landfill     -8.17917    0.89143  -9.1753 < 2.2e-16 ***
## project_manure       -4.27500    0.66996  -6.3809 1.760e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mixed Logit Model

Mixed Logit Model Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
```

```
##      R = 2000, haltons = NA, panel = T, method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:22m:31s
##
## Coefficients:
##                        Estimate Std. Error  z-value  Pr(>|z|)
## price                 -0.0566953  0.0026145 -21.6852 < 2.2e-16 ***
## I                     -2.3087007  0.0640344 -36.0541 < 2.2e-16 ***
## location_EU           -0.0348243  0.0246893  -1.4105    0.1584
## location_UK            0.3656202  0.0248577  14.7085 < 2.2e-16 ***
## certificate_NGO        0.1969127  0.0247100   7.9690 1.554e-15 ***
## certificate_UK         0.6176641  0.0274737  22.4820 < 2.2e-16 ***
## project_renewable      0.2507852  0.0285017   8.7990 < 2.2e-16 ***
## project_landfill      -0.4877729  0.0331036 -14.7347 < 2.2e-16 ***
## project_manure        -0.2526061  0.0293147  -8.6171 < 2.2e-16 ***
## sd.I                   2.9160525  0.0769373  37.9017 < 2.2e-16 ***
## sd.location_EU         0.6330962  0.0381528  16.5937 < 2.2e-16 ***
## sd.location_UK         0.8182854  0.0371775  22.0102 < 2.2e-16 ***
## sd.certificate_NGO     0.5366750  0.0441214  12.1636 < 2.2e-16 ***
## sd.certificate_UK      0.6198115  0.0389616  15.9083 < 2.2e-16 ***
## sd.project_renewable   0.8285760  0.0429289  19.3011 < 2.2e-16 ***
## sd.project_landfill    0.6180166  0.0510129  12.1149 < 2.2e-16 ***
## sd.project_manure      0.8137545  0.0417698  19.4819 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16722
## Number of observations: 12760
## Number of iterations: 38
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

Mixed Logit Model Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                        Estimate Std. Error  t-value  Pr(>|t|)
## I                     -40.72122    2.76497 -14.7276 < 2.2e-16 ***
## location_EU            -0.61424    0.43944  -1.3978    0.1622
## location_UK             6.44887    0.54963  11.7330 < 2.2e-16 ***
## certificate_NGO         3.47318    0.47492   7.3132 2.609e-13 ***
## certificate_UK         10.89446    0.78485  13.8809 < 2.2e-16 ***
## project_renewable       4.42339    0.52780   8.3807 < 2.2e-16 ***
## project_landfill       -8.60341    0.74085 -11.6129 < 2.2e-16 ***
## project_manure         -4.45551    0.52792  -8.4397 < 2.2e-16 ***
## sd.I                   51.43379    2.87065  17.9171 < 2.2e-16 ***
```

```
## sd.location_EU          11.16665    0.92067  12.1289 < 2.2e-16 ***
## sd.location_UK          14.43305    1.00596  14.3475 < 2.2e-16 ***
## sd.certificate_NGO        9.46596    0.94210  10.0478 < 2.2e-16 ***
## sd.certificate_UK       10.93233    0.92275  11.8476 < 2.2e-16 ***
## sd.project_renewable    14.61455    1.10346  13.2443 < 2.2e-16 ***
## sd.project_landfill     10.90067    1.08531  10.0438 < 2.2e-16 ***
## sd.project_manure       14.35313    1.06609  13.4634 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption

mixed logit + co2 consumption Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctr_e, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1         2         3         4         5         6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:28m:24s
##
## Coefficients:
##                            Estimate  Std. Error   z-value   Pr(>|z|)
## price                    -0.05654390  0.00260875 -21.6747 < 2.2e-16 ***
## I                        -2.59610283  0.08398051 -30.9132 < 2.2e-16 ***
## location_EU              -0.01400703  0.04049285  -0.3459 0.7294076
## location_UK               0.47578771  0.03965356  11.9986 < 2.2e-16 ***
## certificate_NGO           0.30034662  0.04034475   7.4445 9.726e-14 ***
## certificate_UK            0.68517300  0.04288756  15.9760 < 2.2e-16 ***
## project_renewable         0.25020629  0.04595092   5.4451 5.178e-08 ***
## project_landfill         -0.60168140  0.05349095 -11.2483 < 2.2e-16 ***
## project_manure           -0.32213100  0.04775785  -6.7451 1.529e-11 ***
## I.co2_value               0.20169695  0.03218652   6.2665 3.692e-10 ***
## location_EU.co2_value    -0.01355635  0.01984155  -0.6832 0.4944611
## location_UK.co2_value    -0.07461066  0.01873876  -3.9816 6.845e-05 ***
## certificate_NGO.co2_value -0.06681580  0.01962825  -3.4041 0.0006639 ***
## certificate_UK.co2_value  -0.04382327  0.01996544  -2.1950 0.0281667 *
## project_renewable.co2_value -0.00022583 0.02194946  -0.0103 0.9917911
## project_landfill.co2_value  0.07378631  0.02562846   2.8791 0.0039884 **
## project_manure.co2_value    0.04415989  0.02315591   1.9071 0.0565118 .
## sd.I                      2.90656420  0.07695297  37.7707 < 2.2e-16 ***
## sd.location_EU            0.63355281  0.03830623  16.5392 < 2.2e-16 ***
## sd.location_UK            0.81893373  0.03770799  21.7178 < 2.2e-16 ***
## sd.certificate_NGO        0.52734596  0.04456089  11.8343 < 2.2e-16 ***
```

```
## sd.certificate_UK             0.61124872  0.03936717  15.5269 < 2.2e-16 ***
## sd.project_renewable          0.82290309  0.04299883  19.1378 < 2.2e-16 ***
## sd.project_landfill           0.60656876  0.05175610  11.7198 < 2.2e-16 ***
## sd.project_manure             0.81115005  0.04190579  19.3565 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16708
## Number of observations: 12760
## Number of iterations: 41
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

Note that the coefficient for "I.co2_value" measures the utility for opt-out conditional on co2 consumption. This coefficient is positive means lower baseline utility for carbon offsetting.

mixed logit + co2 consumption Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                              Estimate  Std. Error  t-value  Pr(>|t|)
## I                         -45.9130501   3.1462364 -14.5930 < 2.2e-16 ***
## location_EU                -0.2477196   0.7169734  -0.3455 0.7297130
## location_UK                 8.4144838   0.8232108  10.2215 < 2.2e-16 ***
## certificate_NGO             5.3117424   0.7682719   6.9139 4.716e-12 ***
## certificate_UK            12.1175409   1.0232953  11.8417 < 2.2e-16 ***
## project_renewable           4.4249919   0.8292583   5.3361 9.498e-08 ***
## project_landfill          -10.6409608   1.0955786  -9.7126 < 2.2e-16 ***
## project_manure             -5.6970073   0.8631328  -6.6004 4.101e-11 ***
## I.co2_value                 3.5670860   0.5926035   6.0193 1.751e-09 ***
## location_EU.co2_value      -0.2397492   0.3510885  -0.6829 0.4946866
## location_UK.co2_value      -1.3195175   0.3382106  -3.9015 9.561e-05 ***
## certificate_NGO.co2_value  -1.1816624   0.3526752  -3.3506 0.0008065 ***
## certificate_UK.co2_value   -0.7750310   0.3558102  -2.1782 0.0293901 *
## project_renewable.co2_value -0.0039938   0.3881852  -0.0103 0.9917911
## project_landfill.co2_value   1.3049384   0.4575387   2.8521 0.0043434 **
## project_manure.co2_value     0.7809842   0.4113982   1.8984 0.0576479 .
## sd.I                       51.4036756   2.8739322  17.8862 < 2.2e-16 ***
## sd.location_EU            11.2046186   0.9261326  12.0983 < 2.2e-16 ***
## sd.location_UK            14.4831495   1.0173555  14.2361 < 2.2e-16 ***
## sd.certificate_NGO          9.3263106   0.9470515   9.8477 < 2.2e-16 ***
## sd.certificate_UK         10.8101624   0.9261396  11.6723 < 2.2e-16 ***
## sd.project_renewable      14.5533491   1.1043075  13.1787 < 2.2e-16 ***
## sd.project_landfill       10.7273954   1.0947671   9.7988 < 2.2e-16 ***
## sd.project_manure         14.3454922   1.0691193  13.4180 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + framing effect

mixed logit + framing effect Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctrl_f, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:29m:42s
##
## Coefficients:
##                                         Estimate Std. Error  z-value  Pr(>|z|)
## price                                 -0.0567011  0.0026150 -21.6829 < 2.2e-16 ***
## I                                     -2.4051778  0.0997483 -24.1125 < 2.2e-16 ***
## location_EU                            0.0586052  0.0562328   1.0422 0.2973243
## location_UK                            0.4158360  0.0549578   7.5665 3.841e-14 ***
## certificate_NGO                        0.1872555  0.0553873   3.3808 0.0007226 ***
## certificate_UK                         0.6217519  0.0593334  10.4789 < 2.2e-16 ***
## project_renewable                      0.2443827  0.0633107   3.8601 0.0001134 ***
## project_landfill                      -0.5139291  0.0747136  -6.8787 6.042e-12 ***
## project_manure                        -0.3546322  0.0662622  -5.3520 8.701e-08 ***
## I.framing_effectconsequence           -0.1133359  0.1218870  -0.9298 0.3524519
## I.framing_effectMetOffice              0.2120373  0.1031619   2.0554 0.0398420 *
## I.framing_effectUN                    -0.0026007  0.1201287  -0.0216 0.9827277
## location_EU.framing_effectconsequence -0.0916926  0.0787856  -1.1638 0.2444953
## location_EU.framing_effectMetOffice   -0.1357801  0.0675733  -2.0094 0.0444975 *
## location_EU.framing_effectUN          -0.1036988  0.0787782  -1.3163 0.1880601
## location_UK.framing_effectconsequence -0.1082280  0.0769819  -1.4059 0.1597569
## location_UK.framing_effectMetOffice   -0.0430491  0.0656822  -0.6554 0.5122002
## location_UK.framing_effectUN          -0.0406622  0.0757156  -0.5370 0.5912411
## certificate_NGO.framing_effectconsequence  0.0233037  0.0786311   0.2964 0.7669498
## certificate_NGO.framing_effectMetOffice    0.0105095  0.0671651   0.1565 0.8756610
## certificate_NGO.framing_effectUN           0.0044858  0.0778144   0.0576 0.9540292
## certificate_UK.framing_effectconsequence  -0.0385091  0.0813694  -0.4733 0.6360255
## certificate_UK.framing_effectMetOffice     0.0149383  0.0696794   0.2144 0.8302457
## certificate_UK.framing_effectUN           -0.0131673  0.0808431  -0.1629 0.8706171
## project_renewable.framing_effectconsequence  0.0973237  0.0903183   1.0776 0.2812284
## project_renewable.framing_effectMetOffice   -0.0822648  0.0763485  -1.0775 0.2812611
## project_renewable.framing_effectUN           0.0975909  0.0886033   1.1014 0.2707065
## project_landfill.framing_effectconsequence   0.0736738  0.1049719   0.7018 0.4827774
## project_landfill.framing_effectMetOffice    -0.0080229  0.0896247  -0.0895 0.9286717
## project_landfill.framing_effectUN            0.0691378  0.1029094   0.6718 0.5016910
## project_manure.framing_effectconsequence     0.0899468  0.0926874   0.9704 0.3318312
## project_manure.framing_effectMetOffice       0.1628706  0.0795047   2.0486 0.0405046 *
## project_manure.framing_effectUN              0.1036882  0.0922537   1.1239 0.2610359
```

```
## sd.I                                        2.8893123  0.0765411  37.7485 < 2.2e-16 ***
## sd.location_EU                              0.6306618  0.0383360  16.4509 < 2.2e-16 ***
## sd.location_UK                              0.8203273  0.0371909  22.0572 < 2.2e-16 ***
## sd.certificate_NGO                          0.5347654  0.0438317  12.2004 < 2.2e-16 ***
## sd.certificate_UK                           0.6191049  0.0390368  15.8595 < 2.2e-16 ***
## sd.project_renewable                        0.8201365  0.0430001  19.0729 < 2.2e-16 ***
## sd.project_landfill                         0.6153003  0.0510482  12.0533 < 2.2e-16 ***
## sd.project_manure                           0.8104552  0.0418911  19.3467 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16714
## Number of observations: 12760
## Number of iterations: 46
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + framing effect Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                           Estimate Std. Error   t-value  Pr(>|t|)
## I                                       -42.418529   3.131848  -13.5442 < 2.2e-16 ***
## location_EU                               1.033580   0.991331    1.0426 0.2971246
## location_UK                               7.333825   1.040362    7.0493 1.798e-12 ***
## certificate_NGO                           3.302501   0.993044    3.3256 0.0008822 ***
## certificate_UK                           10.965427   1.215538    9.0210 < 2.2e-16 ***
## project_renewable                         4.310016   1.125862    3.8282 0.0001291 ***
## project_landfill                         -9.063828   1.402890   -6.4608 1.041e-10 ***
## project_manure                           -6.254414   1.187324   -5.2677 1.382e-07 ***
## I.framing_effectconsequence              -1.998830   2.153275   -0.9283 0.3532653
## I.framing_effectMetOffice                 3.739562   1.825997    2.0480 0.0405643 *
## I.framing_effectUN                       -0.045867   2.118669   -0.0216 0.9827280
## location_EU.framing_effectconsequence    -1.617122   1.392511   -1.1613 0.2455204
## location_EU.framing_effectMetOffice      -2.394663   1.199051   -1.9971 0.0458109 *
## location_EU.framing_effectUN             -1.828867   1.392193   -1.3137 0.1889611
## location_UK.framing_effectconsequence    -1.908746   1.360680   -1.4028 0.1606798
## location_UK.framing_effectMetOffice      -0.759229   1.159158   -0.6550 0.5124785
## location_UK.framing_effectUN             -0.717132   1.335892   -0.5368 0.5913930
## certificate_NGO.framing_effectconsequence 0.410991   1.387007    0.2963 0.7669894
## certificate_NGO.framing_effectMetOffice   0.185348   1.184560    0.1565 0.8756625
## certificate_NGO.framing_effectUN          0.079114   1.372396    0.0576 0.9540304
## certificate_UK.framing_effectconsequence -0.679160   1.435347   -0.4732 0.6360934
## certificate_UK.framing_effectMetOffice    0.263457   1.228949    0.2144 0.8302538
## certificate_UK.framing_effectUN          -0.232223   1.425708   -0.1629 0.8706110
## project_renewable.framing_effectconsequence 1.716434 1.595860    1.0756 0.2821267
## project_renewable.framing_effectMetOffice -1.450850  1.348002   -1.0763 0.2817943
## project_renewable.framing_effectUN        1.721147   1.565664    1.0993 0.2716339
## project_landfill.framing_effectconsequence 1.299336  1.852696    0.7013 0.4831024
## project_landfill.framing_effectMetOffice  -0.141494   1.580654   -0.0895 0.9286719
## project_landfill.framing_effectUN         1.219337   1.815903    0.6715 0.5019168
```

```
## project_manure.framing_effectconsequence      1.586333   1.637139   0.9690 0.3325619
## project_manure.framing_effectMetOffice         2.872441   1.409681   2.0377 0.0415846 *
## project_manure.framing_effectUN                1.828680   1.628711   1.1228 0.2615319
## sd.I                                           50.956890   2.847997  17.8922 < 2.2e-16 ***
## sd.location_EU                                 11.122566   0.921554  12.0694 < 2.2e-16 ***
## sd.location_UK                                 14.467569   1.008437  14.3465 < 2.2e-16 ***
## sd.certificate_NGO                              9.431303   0.937047  10.0649 < 2.2e-16 ***
## sd.certificate_UK                              10.918743   0.923324  11.8255 < 2.2e-16 ***
## sd.project_renewable                           14.464206   1.099558  13.1546 < 2.2e-16 ***
## sd.project_landfill                            10.851645   1.085342   9.9984 < 2.2e-16 ***
## sd.project_manure                              14.293462   1.065448  13.4154 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption + framing effect

mixed logit + co2 consumption + framing effect Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctrl_ef, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:35m:33s
##
## Coefficients:
##                                      Estimate  Std. Error  z-value   Pr(>|z|)
## price                              -0.05651981  0.00260902 -21.6633 < 2.2e-16 ***
## I                                  -2.68215135  0.11300019 -23.7358 < 2.2e-16 ***
## location_EU                         0.07458409  0.06390540   1.1671 0.2431694
## location_UK                         0.53913769  0.06237044   8.6441 < 2.2e-16 ***
## certificate_NGO                     0.28490181  0.06313142   4.5128 6.397e-06 ***
## certificate_UK                      0.68638455  0.06712155  10.2260 < 2.2e-16 ***
## project_renewable                   0.24656755  0.07220467   3.4148 0.0006382 ***
## project_landfill                   -0.62679786  0.08486867  -7.3855 1.519e-13 ***
## project_manure                     -0.41703503  0.07521362  -5.5447 2.945e-08 ***
## I.co2_value                         0.21220235  0.03230951   6.5678 5.106e-11 ***
## I.framing_effectconsequence        -0.18490422  0.12194513  -1.5163 0.1294460
## I.framing_effectMetOffice           0.22884590  0.10304475   2.2208 0.0263618 *
## I.framing_effectUN                  0.00686357  0.12006232   0.0572 0.9544124
## location_EU.co2_value              -0.01238052  0.01985709  -0.6235 0.5329683
## location_EU.framing_effectconsequence -0.08890881  0.07870672  -1.1296 0.2586357
## location_EU.framing_effectMetOffice -0.13224441  0.06748742  -1.9595 0.0500494 .
## location_EU.framing_effectUN       -0.10004740  0.07875628  -1.2703 0.2039629
```

```
## location_UK.co2_value                        -0.07642822  0.01877194  -4.0714 4.673e-05 ***
## location_UK.framing_effectconsequence        -0.11561250  0.07680957  -1.5052 0.1322769
## location_UK.framing_effectMetOffice          -0.05780051  0.06551100  -0.8823 0.3776133
## location_UK.framing_effectUN                 -0.05218670  0.07552855  -0.6910 0.4895949
## certificate_NGO.co2_value                     -0.06590338  0.01966305  -3.3516 0.0008034 ***
## certificate_NGO.framing_effectconsequence      0.02578773  0.07849791   0.3285 0.7425224
## certificate_NGO.framing_effectMetOffice        0.01709290  0.06705509   0.2549 0.7987939
## certificate_NGO.framing_effectUN               0.01174897  0.07771622   0.1512 0.8798354
## certificate_UK.co2_value                      -0.04418181  0.01997914  -2.2114 0.0270083 *
## certificate_UK.framing_effectconsequence      -0.03041914  0.08119715  -0.3746 0.7079333
## certificate_UK.framing_effectMetOffice         0.01764233  0.06951591   0.2538 0.7996590
## certificate_UK.framing_effectUN               -0.00702314  0.08070727  -0.0870 0.9306557
## project_renewable.co2_value                    0.00070152  0.02197470   0.0319 0.9745325
## project_renewable.framing_effectconsequence    0.09301744  0.09023179   1.0309 0.3026008
## project_renewable.framing_effectMetOffice     -0.08806715  0.07624685  -1.1550 0.2480795
## project_renewable.framing_effectUN             0.10027039  0.08859862   1.1317 0.2577447
## project_landfill.co2_value                     0.07410465  0.02567466   2.8863 0.0038981 **
## project_landfill.framing_effectconsequence     0.07173761  0.10477122   0.6847 0.4935287
## project_landfill.framing_effectMetOffice      -0.01280449  0.08943450  -0.1432 0.8861545
## project_landfill.framing_effectUN              0.06480529  0.10269863   0.6310 0.5280249
## project_manure.co2_value                       0.04325890  0.02319668   1.8649 0.0621990 .
## project_manure.framing_effectconsequence       0.08727852  0.09255894   0.9430 0.3457061
## project_manure.framing_effectMetOffice         0.15489473  0.07938697   1.9511 0.0510409 .
## project_manure.framing_effectUN                0.09296383  0.09207416   1.0097 0.3126570
## sd.I                                           2.89309445  0.07691874  37.6123 < 2.2e-16 ***
## sd.location_EU                                 0.63356922  0.03865070  16.3922 < 2.2e-16 ***
## sd.location_UK                                 0.82160720  0.03772922  21.7764 < 2.2e-16 ***
## sd.certificate_NGO                             0.52456617  0.04414867  11.8818 < 2.2e-16 ***
## sd.certificate_UK                              0.60974293  0.03938647  15.4810 < 2.2e-16 ***
## sd.project_renewable                           0.81485474  0.04293701  18.9779 < 2.2e-16 ***
## sd.project_landfill                            0.60693251  0.05161894  11.7579 < 2.2e-16 ***
## sd.project_manure                              0.80663644  0.04199659  19.2072 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16699
## Number of observations: 12760
## Number of iterations: 55
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

The effect of co2 consumption is statistically significant and negative. However, the effect of framing effect is largely not statistically significant, and Met Office has a adverse effect on the preference for carbon offsetting and only shift the overall preference, not the preference for carbon offsetting features.

mixed logit + co2 consumption + framing effect Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                                Estimate Std. Error  t-value  Pr(>|t|)
## I                                            -47.455064   3.467141 -13.6871 < 2.2e-16 ***
```

```
## location_EU                                        1.319610   1.130404   1.1674 0.2430576
## location_UK                                        9.538915   1.207875   7.8973 2.887e-15 ***
## certificate_NGO                                    5.040742   1.148956   4.3872 1.148e-05 ***
## certificate_UK                                    12.144141   1.370933   8.8583 < 2.2e-16 ***
## project_renewable                                  4.362498   1.286161   3.3919 0.0006942 ***
## project_landfill                                 -11.089879   1.609317  -6.8910 5.538e-12 ***
## project_manure                                    -7.378564   1.357612  -5.4350 5.481e-08 ***
## I.co2_value                                        3.754477   0.597212   6.2867 3.243e-10 ***
## I.framing_effectconsequence                       -3.271494   2.165773  -1.5105 0.1309049
## I.framing_effectMetOffice                          4.048950   1.831300   2.2110 0.0270379 *
## I.framing_effectUN                                 0.121436   2.124163   0.0572 0.9544105
## location_EU.co2_value                             -0.219047   0.351474  -0.6232 0.5331369
## location_EU.framing_effectconsequence             -1.573056   1.395335  -1.1274 0.2595872
## location_EU.framing_effectMetOffice               -2.339789   1.200715  -1.9487 0.0513358 .
## location_EU.framing_effectUN                      -1.770130   1.396010  -1.2680 0.2048008
## location_UK.co2_value                             -1.352238   0.339309  -3.9853 6.740e-05 ***
## location_UK.framing_effectconsequence             -2.045522   1.362497  -1.5013 0.1332772
## location_UK.framing_effectMetOffice               -1.022659   1.160447  -0.8813 0.3781753
## location_UK.framing_effectUN                      -0.923335   1.337249  -0.6905 0.4898966
## certificate_NGO.co2_value                         -1.166023   0.353343  -3.3000 0.0009669 ***
## certificate_NGO.framing_effectconsequence          0.456260   1.389163   0.3284 0.7425773
## certificate_NGO.framing_effectMetOffice            0.302423   1.186487   0.2549 0.7988083
## certificate_NGO.framing_effectUN                   0.207874   1.375152   0.1512 0.8798463
## certificate_UK.co2_value                          -0.781705   0.356253  -2.1942 0.0282181 *
## certificate_UK.framing_effectconsequence          -0.538203   1.436733  -0.3746 0.7079564
## certificate_UK.framing_effectMetOffice             0.312144   1.230049   0.2538 0.7996766
## certificate_UK.framing_effectUN                   -0.124260   1.427895  -0.0870 0.9306532
## project_renewable.co2_value                        0.012412   0.388795   0.0319 0.9745324
## project_renewable.framing_effectconsequence        1.645749   1.599284   1.0291 0.3034544
## project_renewable.framing_effectMetOffice         -1.558164   1.350702  -1.1536 0.2486661
## project_renewable.framing_effectUN                 1.774075   1.570890   1.1293 0.2587528
## project_landfill.co2_value                         1.311127   0.458600   2.8590 0.0042501 **
## project_landfill.framing_effectconsequence         1.269247   1.855086   0.6842 0.4938498
## project_landfill.framing_effectMetOffice          -0.226549   1.582371  -0.1432 0.8861556
## project_landfill.framing_effectUN                  1.146594   1.817892   0.6307 0.5282187
## project_manure.co2_value                           0.765376   0.412218   1.8567 0.0633500 .
## project_manure.framing_effectconsequence           1.544211   1.640067   0.9416 0.3464212
## project_manure.framing_effectMetOffice             2.740539   1.411395   1.9417 0.0521705 .
## project_manure.framing_effectUN                    1.644801   1.630377   1.0088 0.3130481
## sd.I                                              51.187262   2.866433  17.8575 < 2.2e-16 ***
## sd.location_EU                                    11.209684   0.931531  12.0336 < 2.2e-16 ***
## sd.location_UK                                    14.536623   1.021163  14.2354 < 2.2e-16 ***
## sd.certificate_NGO                                 9.281102   0.940100   9.8725 < 2.2e-16 ***
## sd.certificate_UK                                 10.788127   0.925935  11.6511 < 2.2e-16 ***
## sd.project_renewable                              14.417152   1.098714  13.1218 < 2.2e-16 ***
## sd.project_landfill                               10.738403   1.093915   9.8165 < 2.2e-16 ***
## sd.project_manure                                 14.271747   1.068443  13.3575 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA for Q9 and Q10 + reduced demographic controls

Here we included the first component for Q9 and Q10. Q9 was about respondents' attitude towards carbon offsetting, and Q10 was about respondents' attitude towards climate change.

mixed logit + 1 PCA for Q9 and Q10 + reduced demographic controls Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:03 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1rd, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:39m:59s
##
## Coefficients:
##                                    Estimate  Std. Error  z-value  Pr(>|z|)
## price                           -0.05670913  0.00261178 -21.7128 < 2.2e-16 ***
## I                               -1.85444549  0.10755058 -17.2425 < 2.2e-16 ***
## location_EU                     -0.03345607  0.06344361  -0.5273 0.5979606
## location_UK                      0.15629300  0.06255689   2.4984 0.0124750 *
## certificate_NGO                  0.06227585  0.06421592   0.9698 0.3321520
## certificate_UK                   0.44887672  0.06577791   6.8241 8.846e-12 ***
## project_renewable                0.31154205  0.07270703   4.2849 1.828e-05 ***
## project_landfill                -0.55301698  0.08514684  -6.4949 8.311e-11 ***
## project_manure                  -0.39731239  0.07524737  -5.2801 1.291e-07 ***
## I.Q9_PC1                        -0.54332508  0.02183042 -24.8884 < 2.2e-16 ***
## I.Q10_PC1                       -0.01473301  0.01301584  -1.1319 0.2576641
## I.age_group35_54                -0.37442085  0.09069746  -4.1282 3.656e-05 ***
## I.age_group55_                  -0.40903453  0.10963694  -3.7308 0.0001909 ***
## I.is_women                      -0.15604851  0.07778471  -2.0062 0.0448393 *
## I.income_level30_50k            -0.33057590  0.08889597  -3.7187 0.0002003 ***
## I.income_level50_               -0.26017100  0.09649557  -2.6962 0.0070136 **
## location_EU.Q9_PC1               0.03397927  0.01072676   3.1677 0.0015364 **
## location_EU.Q10_PC1              0.00753381  0.00842591   0.8941 0.3712552
## location_EU.age_group35_54      -0.01296771  0.05874692  -0.2207 0.8252960
## location_EU.age_group55_         0.00945384  0.07160538   0.1320 0.8949630
## location_EU.is_women            -0.02433925  0.05031663  -0.4837 0.6285833
## location_EU.income_level30_50k   0.04146652  0.05777095   0.7178 0.4728963
## location_EU.income_level50_      0.03705563  0.06209696   0.5967 0.5506822
## location_UK.Q9_PC1               0.02488688  0.01062872   2.3415 0.0192077 *
## location_UK.Q10_PC1              0.04886789  0.00829196   5.8934 3.783e-09 ***
## location_UK.age_group35_54       0.21870927  0.05729869   3.8170 0.0001351 ***
## location_UK.age_group55_         0.37342733  0.06998999   5.3354 9.531e-08 ***
```

```
## location_UK.is_women                     0.00696219 0.04900169   0.1421 0.8870163
## location_UK.income_level30_50k           0.05813927 0.05608910   1.0366 0.2999447
## location_UK.income_level50_              0.00554147 0.06079529   0.0911 0.9273736
## certificate_NGO.Q9_PC1                   0.06422941 0.01071290   5.9955 2.028e-09 ***
## certificate_NGO.Q10_PC1                  0.00656710 0.00849959   0.7726 0.4397372
## certificate_NGO.age_group35_54           0.08223369 0.05883985   1.3976 0.1622378
## certificate_NGO.age_group55_             0.03471424 0.07106589   0.4885 0.6252101
## certificate_NGO.is_women                 0.08257564 0.05044776   1.6369 0.1016609
## certificate_NGO.income_level30_50k       0.19221143 0.05768567   3.3320 0.0008621 ***
## certificate_NGO.income_level50_         -0.02590308 0.06256723  -0.4140 0.6788712
## certificate_UK.Q9_PC1                    0.07111845 0.01120938   6.3445 2.231e-10 ***
## certificate_UK.Q10_PC1                   0.00357993 0.00865103   0.4138 0.6790092
## certificate_UK.age_group35_54            0.11593813 0.06030936   1.9224 0.0545567 .
## certificate_UK.age_group55_              0.14891638 0.07368676   2.0209 0.0432862 *
## certificate_UK.is_women                  0.11744245 0.05151783   2.2796 0.0226287 *
## certificate_UK.income_level30_50k        0.08407196 0.05929333   1.4179 0.1562202
## certificate_UK.income_level50_          -0.04291950 0.06373905  -0.6734 0.5007166
## project_renewable.Q9_PC1                 0.01236890 0.01214451   1.0185 0.3084515
## project_renewable.Q10_PC1               0.00063971 0.00956308   0.0669 0.9466664
## project_renewable.age_group35_54        -0.09875941 0.06662229  -1.4824 0.1382398
## project_renewable.age_group55_          -0.17361001 0.08152872  -2.1294 0.0332184 *
## project_renewable.is_women               0.05285181 0.05721108   0.9238 0.3555885
## project_renewable.income_level30_50k  0.10629619 0.06589176   1.6132 0.1067024
## project_renewable.income_level50_       -0.09562888 0.07070349  -1.3525 0.1762045
## project_landfill.Q9_PC1                 -0.02450817 0.01485907  -1.6494 0.0990709 .
## project_landfill.Q10_PC1                -0.05112505 0.01128112  -4.5319 5.845e-06 ***
## project_landfill.age_group35_54         -0.10087717 0.07765844  -1.2990 0.1939490
## project_landfill.age_group55_           -0.05446167 0.09419129  -0.5782 0.5631271
## project_landfill.is_women                0.02706026 0.06674110   0.4055 0.6851459
## project_landfill.income_level30_50k      0.26482901 0.07640320   3.4662 0.0005279 ***
## project_landfill.income_level50_         0.04636287 0.08291217   0.5592 0.5760385
## project_manure.Q9_PC1                   -0.01176680 0.01262260  -0.9322 0.3512327
## project_manure.Q10_PC1                  -0.04302190 0.00993761  -4.3292 1.497e-05 ***
## project_manure.age_group35_54           0.12065450 0.06914325   1.7450 0.0809860 .
## project_manure.age_group55_             0.17119443 0.08402218   2.0375 0.0416009 *
## project_manure.is_women                  0.03563114 0.05907287   0.6032 0.5463938
## project_manure.income_level30_50k       -0.02125858 0.06755955  -0.3147 0.7530166
## project_manure.income_level50_           0.09375657 0.07330901   1.2789 0.2009242
## sd.I                                     2.49621781 0.06833439  36.5295 < 2.2e-16 ***
## sd.location_EU                           0.64669339 0.03774916  17.1313 < 2.2e-16 ***
## sd.location_UK                           0.78404329 0.03759664  20.8541 < 2.2e-16 ***
## sd.certificate_NGO                       0.50847753 0.04475517  11.3613 < 2.2e-16 ***
## sd.certificate_UK                        0.58992224 0.04031773  14.6318 < 2.2e-16 ***
## sd.project_renewable                     0.83103390 0.04323629  19.2207 < 2.2e-16 ***
## sd.project_landfill                      0.58388638 0.05149181  11.3394 < 2.2e-16 ***
## sd.project_manure                        0.79658685 0.04144529  19.2202 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16467
## Number of observations: 12760
## Number of iterations: 55
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

```
## Simulation based on 2000 draws
```

mixed logit + 1 PCA for Q9 and Q10 + reduced demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                    Estimate Std. Error  t-value  Pr(>|t|)
## I                                 -32.701006   2.846629 -11.4876 < 2.2e-16 ***
## location_EU                        -0.589959   1.120067  -0.5267 0.5983895
## location_UK                         2.756047   1.112303   2.4778 0.0132201 *
## certificate_NGO                     1.098163   1.134266   0.9682 0.3329594
## certificate_UK                      7.915423   1.246725   6.3490 2.168e-10 ***
## project_renewable                   5.493685   1.304535   4.2112 2.540e-05 ***
## project_landfill                   -9.751816   1.588807  -6.1378 8.366e-10 ***
## project_manure                     -7.006146   1.349482  -5.1917 2.083e-07 ***
## I.Q9_PC1                           -9.580911   0.606929 -15.7859 < 2.2e-16 ***
## I.Q10_PC1                          -0.259800   0.229736  -1.1309 0.2581145
## I.age_group35_54                   -6.602480   1.629848  -4.0510 5.100e-05 ***
## I.age_group55_                     -7.212852   1.960332  -3.6794 0.0002338 ***
## I.is_women                         -2.751735   1.379391  -1.9949 0.0460548 *
## I.income_level30_50k               -5.829325   1.590928  -3.6641 0.0002482 ***
## I.income_level50_                  -4.587815   1.715145  -2.6749 0.0074755 **
## location_EU.Q9_PC1                  0.599185   0.191912   3.1222 0.0017951 **
## location_EU.Q10_PC1                 0.132850   0.148751   0.8931 0.3718023
## location_EU.age_group35_54         -0.228671   1.036121  -0.2207 0.8253271
## location_EU.age_group55_            0.166708   1.262676   0.1320 0.8949628
## location_EU.is_women               -0.429195   0.887648  -0.4835 0.6287275
## location_EU.income_level30_50k      0.731214   1.019571   0.7172 0.4732639
## location_EU.income_level50_         0.653433   1.095696   0.5964 0.5509323
## location_UK.Q9_PC1                  0.438851   0.188389   2.3295 0.0198329 *
## location_UK.Q10_PC1                 0.861729   0.152680   5.6440 1.661e-08 ***
## location_UK.age_group35_54          3.856686   1.030285   3.7433 0.0001816 ***
## location_UK.age_group55_            6.584960   1.279964   5.1446 2.680e-07 ***
## location_UK.is_women                0.122770   0.864150   0.1421 0.8870242
## location_UK.income_level30_50k      1.025219   0.990071   1.0355 0.3004353
## location_UK.income_level50_         0.097717   1.072075   0.0911 0.9273750
## certificate_NGO.Q9_PC1             1.132612   0.196999   5.7493 8.960e-09 ***
## certificate_NGO.Q10_PC1            0.115803   0.150006   0.7720 0.4401193
## certificate_NGO.age_group35_54     1.450096   1.040645   1.3935 0.1634810
## certificate_NGO.age_group55_       0.612146   1.253809   0.4882 0.6253879
## certificate_NGO.is_women           1.456126   0.892454   1.6316 0.1027640
## certificate_NGO.income_level30_50k 3.389427   1.031784   3.2850 0.0010198 **
## certificate_NGO.income_level50_    -0.456771   1.103706  -0.4139 0.6789824
## certificate_UK.Q9_PC1              1.254092   0.207591   6.0412 1.530e-09 ***
## certificate_UK.Q10_PC1             0.063128   0.152638   0.4136 0.6791822
## certificate_UK.age_group35_54      2.044435   1.070200   1.9103 0.0560907 .
## certificate_UK.age_group55_        2.625969   1.308350   2.0071 0.0447407 *
## certificate_UK.is_women            2.070962   0.913841   2.2662 0.0234380 *
## certificate_UK.income_level30_50k  1.482512   1.048647   1.4137 0.1574389
## certificate_UK.income_level50_     -0.756836   1.124734  -0.6729 0.5010096
## project_renewable.Q9_PC1           0.218111   0.214392   1.0173 0.3089874
```

```
## project_renewable.Q10_PC1              0.011281    0.168643    0.0669 0.9466692
## project_renewable.age_group35_54      -1.741508    1.178165   -1.4782 0.1393670
## project_renewable.age_group55_        -3.061412    1.449122   -2.1126 0.0346352 *
## project_renewable.is_women             0.931981    1.009265    0.9234 0.3557855
## project_renewable.income_level30_50k   1.874411    1.164716    1.6093 0.1075444
## project_renewable.income_level50_     -1.686305    1.249897   -1.3492 0.1772871
## project_landfill.Q9_PC1               -0.432173    0.262757   -1.6448 0.1000187
## project_landfill.Q10_PC1              -0.901531    0.204343   -4.4119 1.025e-05 ***
## project_landfill.age_group35_54       -1.778852    1.372119   -1.2964 0.1948282
## project_landfill.age_group55_         -0.960369    1.661668   -0.5780 0.5632947
## project_landfill.is_women              0.477176    1.177079    0.4054 0.6851906
## project_landfill.income_level30_50k    4.669954    1.369273    3.4105 0.0006484 ***
## project_landfill.income_level50_       0.817556    1.462622    0.5590 0.5761850
## project_manure.Q9_PC1                 -0.207494    0.222764   -0.9315 0.3516206
## project_manure.Q10_PC1                -0.758642    0.179532   -4.2257 2.383e-05 ***
## project_manure.age_group35_54          2.127603    1.223894    1.7384 0.0821425 .
## project_manure.age_group55_            3.018816    1.487047    2.0301 0.0423489 *
## project_manure.is_women                0.628314    1.042124    0.6029 0.5465640
## project_manure.income_level30_50k     -0.374870    1.191432   -0.3146 0.7530361
## project_manure.income_level50_         1.653289    1.295099    1.2766 0.2017531
## sd.I                                  44.017921    2.479970   17.7494 < 2.2e-16 ***
## sd.location_EU                        11.403692    0.919635   12.4002 < 2.2e-16 ***
## sd.location_UK                        13.825699    0.987590   13.9994 < 2.2e-16 ***
## sd.certificate_NGO                     8.966415    0.937002    9.5693 < 2.2e-16 ***
## sd.certificate_UK                     10.402598    0.922425   11.2774 < 2.2e-16 ***
## sd.project_renewable                  14.654324    1.107674   13.2298 < 2.2e-16 ***
## sd.project_landfill                   10.296163    1.074603    9.5814 < 2.2e-16 ***
## sd.project_manure                     14.046890    1.051988   13.3527 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA for Q9 and Q10 + full demographic controls

mixed logit + 1 PCA for Q9 and Q10 + full demographic controls Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:04 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1d, panel = T, method = "bhhh",
##     iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 1h:5m:47s
##
## Coefficients:
##                                         Estimate Std. Error  z-value  Pr(>|z|)
```

```
## price                                      -0.0566237  0.0026141 -21.6612 < 2.2e-16 ***
## I                                          -1.2247405  0.1271318  -9.6336 < 2.2e-16 ***
## location_EU                                 0.0102299  0.0769165   0.1330 0.8941930
## location_UK                                 0.0985541  0.0764069   1.2899 0.1970998
## certificate_NGO                             0.0489001  0.0782930   0.6246 0.5322482
## certificate_UK                              0.4701338  0.0800615   5.8722 4.302e-09 ***
## project_renewable                           0.2843552  0.0894565   3.1787 0.0014794 **
## project_landfill                           -0.4131688  0.1036941  -3.9845 6.762e-05 ***
## project_manure                             -0.3668990  0.0913626  -4.0159 5.923e-05 ***
## I.Q9_PC1                                    -0.5736137  0.0226170 -25.3621 < 2.2e-16 ***
## I.Q10_PC1                                   -0.0156014  0.0134567  -1.1594 0.2463038
## I.age_group35_54                           -0.3742004  0.0929566  -4.0255 5.684e-05 ***
## I.age_group55_                             -0.7229504  0.1156342  -6.2520 4.051e-10 ***
## I.is_women                                 -0.1877885  0.0794848  -2.3626 0.0181486 *
## I.diet_typeFlexitarian                     -0.3194088  0.1046339  -3.0526 0.0022684 **
## I.diet_typeVegan_Vegetarian                -0.2711852  0.1433469  -1.8918 0.0585162 .
## I.education_levelDegree                    -0.3012588  0.0893237  -3.3727 0.0007445 ***
## I.education_levelPostgraduate              -0.5387837  0.1170099  -4.6046 4.133e-06 ***
## I.income_level30_50k                       -0.4185617  0.0903142  -4.6345 3.578e-06 ***
## I.income_level50_                          -0.3366987  0.0997320  -3.3760 0.0007354 ***
## I.where_liveRuralarea                      -0.4835347  0.1294981  -3.7339 0.0001885 ***
## I.where_liveTownorsuburb                   -0.2167205  0.0962679  -2.2512 0.0243714 *
## location_EU.Q9_PC1                          0.0340244  0.0107425   3.1673 0.0015388 **
## location_EU.Q10_PC1                         0.0103797  0.0087515   1.1861 0.2356023
## location_EU.age_group35_54                 -0.0144225  0.0599521  -0.2406 0.8098908
## location_EU.age_group55_                    0.0028065  0.0749630   0.0374 0.9701356
## location_EU.is_women                       -0.0209555  0.0508374  -0.4122 0.6801876
## location_EU.diet_typeFlexitarian           -0.0085257  0.0679540  -0.1255 0.9001569
## location_EU.diet_typeVegan_Vegetarian      -0.1025582  0.0928737  -1.1043 0.2694732
## location_EU.education_levelDegree          -0.0227934  0.0582167  -0.3915 0.6954085
## location_EU.education_levelPostgraduate     0.0820713  0.0746832   1.0989 0.2718008
## location_EU.income_level30_50k              0.0435430  0.0586246   0.7427 0.4576380
## location_EU.income_level50_                 0.0193457  0.0649242   0.2980 0.7657238
## location_EU.where_liveRuralarea             0.0333312  0.0832901   0.4002 0.6890227
## location_EU.where_liveTownorsuburb         -0.0760128  0.0607498  -1.2512 0.2108456
## location_UK.Q9_PC1                          0.0241469  0.0106977   2.2572 0.0239955 *
## location_UK.Q10_PC1                         0.0457495  0.0085640   5.3421 9.188e-08 ***
## location_UK.age_group35_54                  0.1981129  0.0583238   3.3968 0.0006818 ***
## location_UK.age_group55_                    0.3425058  0.0734219   4.6649 3.088e-06 ***
## location_UK.is_women                       -0.0020762  0.0496645  -0.0418 0.9666543
## location_UK.diet_typeFlexitarian            0.0345794  0.0659021   0.5247 0.5997858
## location_UK.diet_typeVegan_Vegetarian      -0.0940725  0.0859225  -1.0949 0.2735809
## location_UK.education_levelDegree           0.0369217  0.0564728   0.6538 0.5132432
## location_UK.education_levelPostgraduate     0.0838796  0.0699327   1.1994 0.2303597
## location_UK.income_level30_50k              0.0574214  0.0566931   1.0128 0.3111333
## location_UK.income_level50_                 0.0023058  0.0628304   0.0367 0.9707246
## location_UK.where_liveRuralarea             0.2191950  0.0815304   2.6885 0.0071773 **
## location_UK.where_liveTownorsuburb          0.0360182  0.0589698   0.6108 0.5413388
## certificate_NGO.Q9_PC1                      0.0635044  0.0107690   5.8970 3.702e-09 ***
## certificate_NGO.Q10_PC1                     0.0101038  0.0088290   1.1444 0.2524634
## certificate_NGO.age_group35_54             0.0831306  0.0598195   1.3897 0.1646229
## certificate_NGO.age_group55_               0.0268563  0.0742824   0.3615 0.7176932
## certificate_NGO.is_women                   0.0726678  0.0511604   1.4204 0.1554942
## certificate_NGO.diet_typeFlexitarian       0.0181558  0.0679523   0.2672 0.7893272
```

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## certificate_NGO.diet_typeVegan_Vegetarian              -0.0183506  0.0908294   -0.2020 0.8398907
## certificate_NGO.education_levelDegree                    0.1145790  0.0579482    1.9773 0.0480115 *
## certificate_NGO.education_levelPostgraduate              0.1557802  0.0722709    2.1555 0.0311224 *
## certificate_NGO.income_level30_50k                       0.1620008  0.0583697    2.7754 0.0055129 **
## certificate_NGO.income_level50_                         -0.0768286  0.0650880   -1.1804 0.2378489
## certificate_NGO.where_liveRuralarea                      0.1094060  0.0834846    1.3105 0.1900289
## certificate_NGO.where_liveTownorsuburb                  -0.0697078  0.0609811   -1.1431 0.2529955
## certificate_UK.Q9_PC1                                    0.0718374  0.0112289    6.3975 1.579e-10 ***
## certificate_UK.Q10_PC1                                   0.0032503  0.0089492    0.3632 0.7164598
## certificate_UK.age_group35_54                            0.1236780  0.0614280    2.0134 0.0440744 *
## certificate_UK.age_group55_                              0.1678913  0.0771342    2.1766 0.0295095 *
## certificate_UK.is_women                                  0.1314962  0.0521525    2.5214 0.0116896 *
## certificate_UK.diet_typeFlexitarian                     -0.1018839  0.0700579   -1.4543 0.1458685
## certificate_UK.diet_typeVegan_Vegetarian                -0.0267769  0.0913351   -0.2932 0.7693906
## certificate_UK.education_levelDegree                    -0.0264952  0.0598151   -0.4430 0.6578008
## certificate_UK.education_levelPostgraduate               0.0613718  0.0769241    0.7978 0.4249732
## certificate_UK.income_level30_50k                        0.0843173  0.0600178    1.4049 0.1600597
## certificate_UK.income_level50_                          -0.0432962  0.0663148   -0.6529 0.5138276
## certificate_UK.where_liveRuralarea                      -0.0615190  0.0859566   -0.7157 0.4741776
## certificate_UK.where_liveTownorsuburb                   -0.0213804  0.0620441   -0.3446 0.7303956
## project_renewable.Q9_PC1                                 0.0135092  0.0121542    1.1115 0.2663594
## project_renewable.Q10_PC1                               -0.0060565  0.0099399   -0.6093 0.5423148
## project_renewable.age_group35_54                        -0.0967026  0.0676152   -1.4302 0.1526622
## project_renewable.age_group55_                          -0.2054270  0.0848039   -2.4224 0.0154194 *
## project_renewable.is_women                               0.0692898  0.0579640    1.1954 0.2319331
## project_renewable.diet_typeFlexitarian                  -0.0045543  0.0768292   -0.0593 0.9527308
## project_renewable.diet_typeVegan_Vegetarian             -0.4032266  0.1026887   -3.9267 8.612e-05 ***
## project_renewable.education_levelDegree                 -0.0534611  0.0659999   -0.8100 0.4179297
## project_renewable.education_levelPostgraduate            0.0229627  0.0833796    0.2754 0.7830088
## project_renewable.income_level30_50k                     0.1170071  0.0666856    1.7546 0.0793267 .
## project_renewable.income_level50_                       -0.0993533  0.0736515   -1.3490 0.1773481
## project_renewable.where_liveRuralarea                    0.1457075  0.0938851    1.5520 0.1206677
## project_renewable.where_liveTownorsuburb                 0.0729605  0.0690149    1.0572 0.2904336
## project_landfill.Q9_PC1                                 -0.0256208  0.0149703   -1.7114 0.0870003 .
## project_landfill.Q10_PC1                                -0.0516641  0.0116959   -4.4173 9.995e-06 ***
## project_landfill.age_group35_54                         -0.0755053  0.0789208   -0.9567 0.3387075
## project_landfill.age_group55_                           -0.0286710  0.0987636   -0.2903 0.7715871
## project_landfill.is_women                                0.0569703  0.0675940    0.8428 0.3993231
## project_landfill.diet_typeFlexitarian                   -0.0810988  0.0892202   -0.9090 0.3633643
## project_landfill.diet_typeVegan_Vegetarian              -0.3024277  0.1175780   -2.5721 0.0101071 *
## project_landfill.education_levelDegree                  -0.1662384  0.0769196   -2.1612 0.0306801 *
## project_landfill.education_levelPostgraduate             -0.0012906  0.0953022   -0.0135 0.9891956
## project_landfill.income_level30_50k                      0.2844651  0.0771928    3.6851 0.0002286 ***
## project_landfill.income_level50_                         0.0680564  0.0856014    0.7950 0.4265908
## project_landfill.where_liveRuralarea                    -0.1655099  0.1098290   -1.5070 0.1318163
## project_landfill.where_liveTownorsuburb                 -0.1106792  0.0806814   -1.3718 0.1701240
## project_manure.Q9_PC1                                   -0.0103398  0.0126801   -0.8154 0.4148233
## project_manure.Q10_PC1                                  -0.0475966  0.0102723   -4.6335 3.596e-06 ***
## project_manure.age_group35_54                            0.1302223  0.0705464    1.8459 0.0649052 .
## project_manure.age_group55_                              0.1966047  0.0881222    2.2310 0.0256780 *
## project_manure.is_women                                  0.0596324  0.0597780    0.9976 0.3184907
## project_manure.diet_typeFlexitarian                     -0.0456658  0.0798894   -0.5716 0.5675842
## project_manure.diet_typeVegan_Vegetarian                -0.1152187  0.1067111   -1.0797 0.2802648
## project_manure.education_levelDegree                    -0.1045228  0.0681917   -1.5328 0.1253304
```

```
## project_manure.education_levelPostgraduate      -0.1955111  0.0870235   -2.2466 0.0246625 *
## project_manure.income_level30_50k                0.0032832  0.0684345    0.0480 0.9617359
## project_manure.income_level50_                    0.1598440  0.0764481    2.0909 0.0365386 *
## project_manure.where_liveRuralarea               -0.0695908  0.0983736   -0.7074 0.4793098
## project_manure.where_liveTownorsuburb             0.0248816  0.0712492    0.3492 0.7269249
## sd.I                                              2.4897329  0.0689341   36.1176 < 2.2e-16 ***
## sd.location_EU                                    0.6431590  0.0381444   16.8612 < 2.2e-16 ***
## sd.location_UK                                    0.7734970  0.0375527   20.5977 < 2.2e-16 ***
## sd.certificate_NGO                                0.5008684  0.0450206   11.1253 < 2.2e-16 ***
## sd.certificate_UK                                 0.5902377  0.0407592   14.4811 < 2.2e-16 ***
## sd.project_renewable                              0.8195204  0.0434820   18.8474 < 2.2e-16 ***
## sd.project_landfill                               0.5695149  0.0529734   10.7510 < 2.2e-16 ***
## sd.project_manure                                 0.7929437  0.0417713   18.9830 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16438
## Number of observations: 12760
## Number of iterations: 75
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + 1 PCA for Q9 and Q10 + full demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                     Estimate Std. Error   t-value   Pr(>|t|)
## I                                  -21.629456   2.723103   -7.9429 1.998e-15 ***
## location_EU                          0.180665   1.358153    0.1330 0.8941755
## location_UK                          1.740509   1.352457    1.2869 0.1981209
## certificate_NGO                      0.863597   1.383769    0.6241 0.5325683
## certificate_UK                       8.302769   1.492166    5.5642 2.633e-08 ***
## project_renewable                    5.021838   1.594546    3.1494 0.0016361 **
## project_landfill                    -7.296743   1.871245   -3.8994 9.643e-05 ***
## project_manure                      -6.479598   1.625820   -3.9854 6.736e-05 ***
## I.Q9_PC1                           -10.130271   0.637983  -15.8786 < 2.2e-16 ***
## I.Q10_PC1                           -0.275527   0.237885   -1.1582 0.2467669
## I.age_group35_54                    -6.608544   1.672425   -3.9515 7.767e-05 ***
## I.age_group55_                     -12.767622   2.127466   -6.0013 1.957e-09 ***
## I.is_women                          -3.316428   1.413936   -2.3455 0.0190001 *
## I.diet_typeFlexitarian              -5.640900   1.871636   -3.0139 0.0025792 **
## I.diet_typeVegan_Vegetarian         -4.789250   2.538970   -1.8863 0.0592551 .
## I.education_levelDegree             -5.320363   1.601560   -3.3220 0.0008938 ***
## I.education_levelPostgraduate       -9.515156   2.121901   -4.4843 7.317e-06 ***
## I.income_level30_50k                -7.391984   1.632225   -4.5288 5.933e-06 ***
## I.income_level50_                   -5.946247   1.782968   -3.3350 0.0008529 ***
## I.where_liveRuralarea               -8.539435   2.329182   -3.6663 0.0002461 ***
## I.where_liveTownorsuburb            -3.827380   1.712701   -2.2347 0.0254368 *
## location_EU.Q9_PC1                   0.600885   0.192451    3.1223 0.0017946 **
## location_EU.Q10_PC1                  0.183311   0.154873    1.1836 0.2365646
```

```
## location_EU.age_group35_54                  -0.254707   1.059034  -0.2405 0.8099356
## location_EU.age_group55_                      0.049564   1.323862   0.0374 0.9701352
## location_EU.is_women                          -0.370084   0.898121  -0.4121 0.6802921
## location_EU.diet_typeFlexitarian             -0.150568   1.199987  -0.1255 0.9001477
## location_EU.diet_typeVegan_Vegetarian        -1.811224   1.642737  -1.1026 0.2702163
## location_EU.education_levelDegree            -0.402541   1.028251  -0.3915 0.6954415
## location_EU.education_levelPostgraduate       1.449414   1.321590   1.0967 0.2727636
## location_EU.income_level30_50k                0.768988   1.036325   0.7420 0.4580669
## location_EU.income_level50_                   0.341653   1.146758   0.2979 0.7657571
## location_EU.where_liveRuralarea               0.588643   1.471598   0.4000 0.6891544
## location_EU.where_liveTownorsuburb           -1.342419   1.075281  -1.2484 0.2118717
## location_UK.Q9_PC1                            0.426444   0.189833   2.2464 0.0246775 *
## location_UK.Q10_PC1                           0.807957   0.156883   5.1501 2.604e-07 ***
## location_UK.age_group35_54                    3.498761   1.046205   3.3442 0.0008251 ***
## location_UK.age_group55_                      6.048804   1.333851   4.5348 5.765e-06 ***
## location_UK.is_women                         -0.036667   0.877090  -0.0418 0.9666541
## location_UK.diet_typeFlexitarian              0.610687   1.164362   0.5245 0.5999433
## location_UK.diet_typeVegan_Vegetarian        -1.661363   1.519883  -1.0931 0.2743561
## location_UK.education_levelDegree             0.652053   0.997995   0.6534 0.5135224
## location_UK.education_levelPostgraduate       1.481351   1.236646   1.1979 0.2309646
## location_UK.income_level30_50k                1.014087   1.002320   1.0117 0.3116621
## location_UK.income_level50_                   0.040722   1.109618   0.0367 0.9707247
## location_UK.where_liveRuralarea               3.871080   1.453324   2.6636 0.0077309 **
## location_UK.where_liveTownorsuburb            0.636097   1.041979   0.6105 0.5415506
## certificate_NGO.Q9_PC1                        1.121516   0.198195   5.6586 1.526e-08 ***
## certificate_NGO.Q10_PC1                       0.178437   0.156232   1.1421 0.2534002
## certificate_NGO.age_group35_54                1.468122   1.059592   1.3856 0.1658831
## certificate_NGO.age_group55_                  0.474294   1.312277   0.3614 0.7177792
## certificate_NGO.is_women                      1.283344   0.905551   1.4172 0.1564253
## certificate_NGO.diet_typeFlexitarian          0.320639   1.200409   0.2671 0.7893856
## certificate_NGO.diet_typeVegan_Vegetarian    -0.324079   1.603994  -0.2020 0.8398815
## certificate_NGO.education_levelDegree         2.023515   1.027832   1.9687 0.0489850 *
## certificate_NGO.education_levelPostgraduate   2.751148   1.284316   2.1421 0.0321846 *
## certificate_NGO.income_level30_50k            2.861005   1.041348   2.7474 0.0060069 **
## certificate_NGO.income_level50_              -1.356827   1.151955  -1.1778 0.2388572
## certificate_NGO.where_liveRuralarea           1.932159   1.476902   1.3083 0.1907880
## certificate_NGO.where_liveTownorsuburb       -1.231070   1.078949  -1.1410 0.2538742
## certificate_UK.Q9_PC1                         1.268679   0.208536   6.0837 1.174e-09 ***
## certificate_UK.Q10_PC1                        0.057402   0.158123   0.3630 0.7165896
## certificate_UK.age_group35_54                 2.184207   1.092192   1.9998 0.0455178 *
## certificate_UK.age_group55_                   2.965033   1.373349   2.1590 0.0308517 *
## certificate_UK.is_women                       2.322281   0.928050   2.5023 0.0123381 *
## certificate_UK.diet_typeFlexitarian          -1.799314   1.239866  -1.4512 0.1467196
## certificate_UK.diet_typeVegan_Vegetarian     -0.472892   1.612518  -0.2933 0.7693211
## certificate_UK.education_levelDegree          -0.467916   1.056692  -0.4428 0.6579013
## certificate_UK.education_levelPostgraduate    1.083853   1.359611   0.7972 0.4253474
## certificate_UK.income_level30_50k             1.489081   1.062944   1.4009 0.1612433
## certificate_UK.income_level50_               -0.764630   1.171855  -0.6525 0.5140814
## certificate_UK.where_liveRuralarea           -1.086452   1.519601  -0.7150 0.4746346
## certificate_UK.where_liveTownorsuburb        -0.377587   1.095965  -0.3445 0.7304520
## project_renewable.Q9_PC1                      0.238578   0.214928   1.1100 0.2669828
## project_renewable.Q10_PC1                    -0.106961   0.175548  -0.6093 0.5423276
## project_renewable.age_group35_54            -1.707810   1.197509  -1.4261 0.1538293
## project_renewable.age_group55_              -3.627930   1.512659  -2.3984 0.0164678 *
```

```
## project_renewable.is_women                      1.223689   1.024608   1.1943 0.2323607
## project_renewable.diet_typeFlexitarian         -0.080430   1.356794  -0.0593 0.9527293
## project_renewable.diet_typeVegan_Vegetarian    -7.121159   1.843872  -3.8621 0.0001124 ***
## project_renewable.education_levelDegree         -0.944147   1.166550  -0.8093 0.4183142
## project_renewable.education_levelPostgraduate    0.405532   1.472607   0.2754 0.7830213
## project_renewable.income_level30_50k            2.066396   1.181378   1.7491 0.0802667 .
## project_renewable.income_level50_              -1.754623   1.303775  -1.3458 0.1783665
## project_renewable.where_liveRuralarea           2.573258   1.663655   1.5468 0.1219235
## project_renewable.where_liveTownorsuburb        1.288515   1.220200   1.0560 0.2909744
## project_landfill.Q9_PC1                         -0.452474   0.265187  -1.7062 0.0879626 .
## project_landfill.Q10_PC1                        -0.912410   0.211827  -4.3073 1.652e-05 ***
## project_landfill.age_group35_54                -1.333456   1.395110  -0.9558 0.3391696
## project_landfill.age_group55_                  -0.506343   1.744286  -0.2903 0.7715970
## project_landfill.is_women                       1.006121   1.194740   0.8421 0.3997178
## project_landfill.diet_typeFlexitarian          -1.432240   1.577226  -0.9081 0.3638384
## project_landfill.diet_typeVegan_Vegetarian     -5.341005   2.090565  -2.5548 0.0106244 *
## project_landfill.education_levelDegree          -2.935843   1.367989  -2.1461 0.0318649 *
## project_landfill.education_levelPostgraduate    -0.022792   1.683087  -0.0135 0.9891956
## project_landfill.income_level30_50k             5.023779   1.388219   3.6189 0.0002959 ***
## project_landfill.income_level50_                1.201907   1.513202   0.7943 0.4270322
## project_landfill.where_liveRuralarea           -2.922977   1.947538  -1.5009 0.1333924
## project_landfill.where_liveTownorsuburb        -1.954644   1.429346  -1.3675 0.1714656
## project_manure.Q9_PC1                          -0.182605   0.224060  -0.8150 0.4150822
## project_manure.Q10_PC1                         -0.840577   0.186475  -4.5077 6.553e-06 ***
## project_manure.age_group35_54                   2.299783   1.251361   1.8378 0.0660881 .
## project_manure.age_group55_                     3.472126   1.564006   2.2200 0.0264173 *
## project_manure.is_women                         1.053134   1.057011   0.9963 0.3190887
## project_manure.diet_typeFlexitarian            -0.806478   1.411799  -0.5712 0.5678358
## project_manure.diet_typeVegan_Vegetarian       -2.034812   1.887619  -1.0780 0.2810434
## project_manure.education_levelDegree           -1.845919   1.209245  -1.5265 0.1268842
## project_manure.education_levelPostgraduate     -3.452812   1.547817  -2.2308 0.0256969 *
## project_manure.income_level30_50k               0.057982   1.208598   0.0480 0.9617363
## project_manure.income_level50_                  2.822916   1.357935   2.0788 0.0376330 *
## project_manure.where_liveRuralarea             -1.229004   1.738848  -0.7068 0.4796960
## project_manure.where_liveTownorsuburb           0.439420   1.258342   0.3492 0.7269353
## sd.I                                           43.969778   2.488055  17.6723 < 2.2e-16 ***
## sd.location_EU                                 11.358471   0.925625  12.2711 < 2.2e-16 ***
## sd.location_UK                                 13.660298   0.984000  13.8824 < 2.2e-16 ***
## sd.certificate_NGO                              8.845555   0.940397   9.4062 < 2.2e-16 ***
## sd.certificate_UK                              10.423857   0.932219  11.1818 < 2.2e-16 ***
## sd.project_renewable                           14.473091   1.107327  13.0703 < 2.2e-16 ***
## sd.project_landfill                            10.057884   1.094076   9.1930 < 2.2e-16 ***
## sd.project_manure                              14.003734   1.057311  13.2447 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA for Q9 and Q12 + reduced demographic controls

mixed logit + 1 PCA for Q9 and Q12 + reduced demographic controls coefficients

```
##
```

```
## Model estimated on: Thu Nov 14 08:27:10 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1rd, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:33m:52s
##
## Coefficients:
##                                   Estimate  Std. Error  z-value  Pr(>|z|)
## price                           -0.05673566  0.00260654 -21.7666 < 2.2e-16 ***
## I                               -2.01543440  0.10491768 -19.2097 < 2.2e-16 ***
## location_EU                     -0.04541380  0.06028477  -0.7533 0.4512569
## location_UK                      0.08124601  0.05919437   1.3725 0.1698987
## certificate_NGO                  0.07345315  0.06108669   1.2024 0.2291927
## certificate_UK                   0.45507473  0.06241979   7.2906 3.086e-13 ***
## project_renewable                0.26379130  0.06911566   3.8167 0.0001353 ***
## project_landfill                -0.53874669  0.08066363  -6.6789 2.407e-11 ***
## project_manure                  -0.35050858  0.07174507  -4.8855 1.032e-06 ***
## I.Q9_PC1                        -0.50868383  0.02205079 -23.0687 < 2.2e-16 ***
## I.Q12_PC1                       -0.31549587  0.02569346 -12.2792 < 2.2e-16 ***
## I.age_group35_54                -0.13719005  0.08859048  -1.5486 0.1214811
## I.age_group55_                  -0.32107941  0.10271163  -3.1260 0.0017718 **
## I.is_women                      -0.06238424  0.07719465  -0.8081 0.4190088
## I.income_level30_50k            -0.10420503  0.08859794  -1.1762 0.2395324
## I.income_level50_               -0.51774593  0.09713277  -5.3303 9.806e-08 ***
## location_EU.Q9_PC1               0.02991764  0.01113442   2.6870 0.0072108 **
## location_EU.Q12_PC1              0.01468819  0.01591236   0.9231 0.3559719
## location_EU.age_group35_54      -0.01356097  0.05765351  -0.2352 0.8140419
## location_EU.age_group55_         0.02444746  0.06615073   0.3696 0.7117014
## location_EU.is_women            -0.02319774  0.05013641  -0.4627 0.6435849
## location_EU.income_level30_50k   0.03955695  0.05795375   0.6826 0.4948845
## location_EU.income_level50_      0.05109989  0.06214793   0.8222 0.4109460
## location_UK.Q9_PC1               0.01145810  0.01110524   1.0318 0.3021781
## location_UK.Q12_PC1              0.06555815  0.01534264   4.2729 1.929e-05 ***
## location_UK.age_group35_54       0.26206031  0.05617942   4.6647 3.091e-06 ***
## location_UK.age_group55_         0.47904327  0.06493781   7.3770 1.619e-13 ***
## location_UK.is_women             0.02371578  0.04865546   0.4874 0.6259587
## location_UK.income_level30_50k   0.07418267  0.05592745   1.3264 0.1847043
## location_UK.income_level50_      0.03566259  0.06069454   0.5876 0.5568176
## certificate_NGO.Q9_PC1           0.05770779  0.01111076   5.1939 2.060e-07 ***
## certificate_NGO.Q12_PC1          0.03698395  0.01564654   2.3637 0.0180928 *
## certificate_NGO.age_group35_54   0.07408920  0.05778019   1.2823 0.1997516
## certificate_NGO.age_group55_     0.02153258  0.06598870   0.3263 0.7441921
## certificate_NGO.is_women         0.07457942  0.05018470   1.4861 0.1372530
## certificate_NGO.income_level30_50k  0.18824656  0.05775859   3.2592 0.0011173 **
## certificate_NGO.income_level50_ -0.01782996  0.06264834  -0.2846 0.7759476
## certificate_UK.Q9_PC1            0.06689710  0.01165624   5.7392 9.514e-09 ***
```

```
## certificate_UK.Q12_PC1                    0.01893617  0.01638295   1.1558 0.2477442
## certificate_UK.age_group35_54             0.10932900  0.05907980   1.8505 0.0642371 .
## certificate_UK.age_group55_               0.14343903  0.06776604   2.1167 0.0342870 *
## certificate_UK.is_women                   0.10810194  0.05126378   2.1087 0.0349671 *
## certificate_UK.income_level30_50k         0.08196288  0.05929294   1.3823 0.1668680
## certificate_UK.income_level50_           -0.03078882  0.06358768  -0.4842 0.6282477
## project_renewable.Q9_PC1                  0.02136634  0.01266750   1.6867 0.0916600 .
## project_renewable.Q12_PC1                -0.04483883  0.01803129  -2.4867 0.0128926 *
## project_renewable.age_group35_54         -0.06102492  0.06550063  -0.9317 0.3515075
## project_renewable.age_group55_           -0.12120705  0.07519677  -1.6119 0.1069913
## project_renewable.is_women                0.07992986  0.05721707   1.3970 0.1624261
## project_renewable.income_level30_50k      0.09675615  0.06595132   1.4671 0.1423531
## project_renewable.income_level50_        -0.11425153  0.07102833  -1.6085 0.1077181
## project_landfill.Q9_PC1                   0.00714424  0.01550220   0.4609 0.6449037
## project_landfill.Q12_PC1                 -0.15386576  0.02109802  -7.2929 3.033e-13 ***
## project_landfill.age_group35_54          -0.09301260  0.07624475  -1.2199 0.2224947
## project_landfill.age_group55_            -0.06726719  0.08725011  -0.7710 0.4407249
## project_landfill.is_women                 0.05129854  0.06613203   0.7757 0.4379268
## project_landfill.income_level30_50k       0.21778587  0.07621573   2.8575 0.0042700 **
## project_landfill.income_level50_         -0.01048697  0.08265972  -0.1269 0.8990440
## project_manure.Q9_PC1                     0.00031164  0.01306837   0.0238 0.9809749
## project_manure.Q12_PC1                   -0.06332236  0.01856822  -3.4103 0.0006490 ***
## project_manure.age_group35_54            0.07984206  0.06774870   1.1785 0.2385961
## project_manure.age_group55_              0.09763926  0.07800788   1.2517 0.2106942
## project_manure.is_women                  0.02795450  0.05887895   0.4748 0.6349444
## project_manure.income_level30_50k       -0.04225437  0.06775142  -0.6237 0.5328459
## project_manure.income_level50_           0.07568114  0.07330694   1.0324 0.3018908
## sd.I                                     2.46254013  0.06787977  36.2780 < 2.2e-16 ***
## sd.location_EU                           0.64080215  0.03820850  16.7712 < 2.2e-16 ***
## sd.location_UK                           0.79175828  0.03737082  21.1865 < 2.2e-16 ***
## sd.certificate_NGO                       0.49925843  0.04495954  11.1046 < 2.2e-16 ***
## sd.certificate_UK                        0.58680622  0.04038699  14.5296 < 2.2e-16 ***
## sd.project_renewable                     0.82063382  0.04321074  18.9914 < 2.2e-16 ***
## sd.project_landfill                      0.56380908  0.05275980  10.6863 < 2.2e-16 ***
## sd.project_manure                        0.79290245  0.04150263  19.1049 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16434
## Number of observations: 12760
## Number of iterations: 49
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + 1 PCA for Q9 and Q12 + reduced demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                        Estimate  Std. Error  t-value  Pr(>|t|)
## I                                    -35.5232385   2.9241654 -12.1482 < 2.2e-16 ***
```

```
## location_EU                              -0.8004454  1.0646685  -0.7518 0.4521558
## location_UK                               1.4320096  1.0460307   1.3690 0.1710012
## certificate_NGO                           1.2946557  1.0790766   1.1998 0.2302244
## certificate_UK                            8.0209647  1.1901686   6.7394 1.591e-11 ***
## project_renewable                         4.6494796  1.2318434   3.7744 0.0001604 ***
## project_landfill                         -9.4957331  1.5078721  -6.2974 3.026e-10 ***
## project_manure                           -6.1779236  1.2798389  -4.8271 1.385e-06 ***
## I.Q9_PC1                                 -8.9658572  0.5855006 -15.3131 < 2.2e-16 ***
## I.Q12_PC1                                -5.5608037  0.5279819 -10.5322 < 2.2e-16 ***
## I.age_group35_54                         -2.4180569  1.5651577  -1.5449 0.1223635
## I.age_group55_                           -5.6592168  1.8262048  -3.0989 0.0019424 **
## I.is_women                               -1.0995596  1.3619432  -0.8073 0.4194671
## I.income_level30_50k                     -1.8366760  1.5633300  -1.1748 0.2400553
## I.income_level50_                        -9.1255822  1.7676098  -5.1627 2.435e-07 ***
## location_EU.Q9_PC1                        0.5273163  0.1983115   2.6590 0.0078366 **
## location_EU.Q12_PC1                       0.2588881  0.2808122   0.9219 0.3565672
## location_EU.age_group35_54              -0.2390202  1.0163978  -0.2352 0.8140814
## location_EU.age_group55_                 0.4309011  1.1660683   0.3695 0.7117302
## location_EU.is_women                     -0.4088740  0.8840452  -0.4625 0.6437203
## location_EU.income_level30_50k           0.6972149  1.0222588   0.6820 0.4952177
## location_EU.income_level50_              0.9006662  1.0966571   0.8213 0.4114849
## location_UK.Q9_PC1                        0.2019558  0.1958249   1.0313 0.3023963
## location_UK.Q12_PC1                       1.1555017  0.2768893   4.1732 3.004e-05 ***
## location_UK.age_group35_54               4.6189699  1.0179230   4.5376 5.689e-06 ***
## location_UK.age_group55_                 8.4434246  1.2231024   6.9033 5.081e-12 ***
## location_UK.is_women                      0.4180048  0.8580029   0.4872 0.6261283
## location_UK.income_level30_50k           1.3075140  0.9873724   1.3242 0.1854247
## location_UK.income_level50_              0.6285746  1.0702234   0.5873 0.5569819
## certificate_NGO.Q9_PC1                    1.0171344  0.2021202   5.0323 4.846e-07 ***
## certificate_NGO.Q12_PC1                   0.6518643  0.2776204   2.3480 0.0188724 *
## certificate_NGO.age_group35_54           1.3058666  1.0210558   1.2789 0.2009191
## certificate_NGO.age_group55_             0.3795246  1.1634662   0.3262 0.7442718
## certificate_NGO.is_women                  1.3145070  0.8870540   1.4819 0.1383724
## certificate_NGO.income_level30_50k       3.3179585  1.0315985   3.2163 0.0012984 **
## certificate_NGO.income_level50_         -0.3142638  1.1044369  -0.2845 0.7759915
## certificate_UK.Q9_PC1                     1.1791014  0.2140426   5.5087 3.614e-08 ***
## certificate_UK.Q12_PC1                    0.3337613  0.2892120   1.1540 0.2484851
## certificate_UK.age_group35_54            1.9269891  1.0477130   1.8392 0.0658808 .
## certificate_UK.age_group55_              2.5281989  1.2046548   2.0987 0.0358441 *
## certificate_UK.is_women                   1.9053615  0.9085414   2.0972 0.0359789 *
## certificate_UK.income_level30_50k        1.4446449  1.0477979   1.3787 0.1679738
## certificate_UK.income_level50_          -0.5426714  1.1210645  -0.4841 0.6283376
## project_renewable.Q9_PC1                  0.3765945  0.2240486   1.6809 0.0927900 .
## project_renewable.Q12_PC1               -0.7903112  0.3206755  -2.4645 0.0137197 *
## project_renewable.age_group35_54        -1.0756008  1.1556197  -0.9308 0.3519794
## project_renewable.age_group55_          -2.1363469  1.3307895  -1.6053 0.1084227
## project_renewable.is_women                1.4088116  1.0103577   1.3944 0.1632062
## project_renewable.income_level30_50k     1.7053851  1.1643411   1.4647 0.1430087
## project_renewable.income_level50_       -2.0137517  1.2562740  -1.6030 0.1089444
## project_landfill.Q9_PC1                   0.1259216  0.2733810   0.4606 0.6450796
## project_landfill.Q12_PC1                 -2.7119763  0.3965793  -6.8384 8.007e-12 ***
## project_landfill.age_group35_54         -1.6394028  1.3461134  -1.2179 0.2232701
## project_landfill.age_group55_           -1.1856245  1.5390499  -0.7704 0.4410856
## project_landfill.is_women                 0.9041676  1.1663900   0.7752 0.4382306
```

```
## project_landfill.income_level30_50k     3.8386064    1.3582162    2.8262 0.0047102 **
## project_landfill.income_level50_        -0.1848391    1.4569462   -0.1269 0.8990453
## project_manure.Q9_PC1                     0.0054928    0.2303400    0.0238 0.9809751
## project_manure.Q12_PC1                   -1.1160946    0.3320138   -3.3616 0.0007749 ***
## project_manure.age_group35_54            1.4072641    1.1961479    1.1765 0.2393965
## project_manure.age_group55_              1.7209504    1.3761477    1.2506 0.2110964
## project_manure.is_women                  0.4927147    1.0380359    0.4747 0.6350289
## project_manure.income_level30_50k       -0.7447586    1.1945688   -0.6235 0.5329863
## project_manure.income_level50_           1.3339255    1.2936954    1.0311 0.3024953
## sd.I                                     43.4037447    2.4462182   17.7432 < 2.2e-16 ***
## sd.location_EU                           11.2945217    0.9217552   12.2533 < 2.2e-16 ***
## sd.location_UK                           13.9552140    0.9880503   14.1240 < 2.2e-16 ***
## sd.certificate_NGO                        8.7997289    0.9352800    9.4087 < 2.2e-16 ***
## sd.certificate_UK                        10.3428110    0.9215748   11.2230 < 2.2e-16 ***
## sd.project_renewable                     14.4641627    1.0984148   13.1682 < 2.2e-16 ***
## sd.project_landfill                       9.9374727    1.0836583    9.1703 < 2.2e-16 ***
## sd.project_manure                        13.9753806    1.0469538   13.3486 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA for Q9 and Q12 + full demographic controls

mixed logit + 1 PCA for Q9 and Q12 + full demographic controls coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:10 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1d, panel = T, method = "bhhh",
##     iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:52m:10s
##
## Coefficients:
##                                  Estimate  Std. Error  z-value  Pr(>|z|)
## price                          -0.05689530  0.00261827 -21.7301 < 2.2e-16 ***
## I                              -1.68656173  0.12589552 -13.3965 < 2.2e-16 ***
## location_EU                    -0.00780422  0.07426516  -0.1051 0.9163077
## location_UK                     0.04492484  0.07341952   0.6119 0.5406090
## certificate_NGO                 0.05699614  0.07544078   0.7555 0.4499440
## certificate_UK                  0.49577207  0.07716440   6.4249 1.320e-10 ***
## project_renewable               0.24100621  0.08604265   2.8010 0.0050943 **
## project_landfill               -0.41910582  0.09993009  -4.1940 2.741e-05 ***
## project_manure                 -0.29913467  0.08817430  -3.3925 0.0006925 ***
## I.Q9_PC1                        -0.50193173  0.02221946 -22.5897 < 2.2e-16 ***
## I.Q12_PC1                       -0.33285792  0.02643152 -12.5932 < 2.2e-16 ***
```

```
## I.age_group35_54                              -0.06397399 0.09103760  -0.7027 0.4822299
## I.age_group55_                                 -0.24992031 0.10954889  -2.2814 0.0225272 *
## I.is_women                                      0.08043337 0.07841745   1.0257 0.3050295
## I.diet_typeFlexitarian                         -0.33520640 0.10418161  -3.2175 0.0012930 **
## I.diet_typeVegan_Vegetarian                    -0.10618326 0.14410111  -0.7369 0.4612036
## I.education_levelDegree                        -0.46622772 0.08982996  -5.1901 2.102e-07 ***
## I.education_levelPostgraduate                  -0.69689895 0.11726287  -5.9430 2.798e-09 ***
## I.income_level30_50k                           -0.13335841 0.08994672  -1.4826 0.1381707
## I.income_level50_                              -0.28521244 0.09987323  -2.8557 0.0042936 **
## I.where_liveRuralarea                          -0.32604433 0.12852025  -2.5369 0.0111836 *
## I.where_liveTownorsuburb                       -0.13547755 0.09547621  -1.4190 0.1559088
## location_EU.Q9_PC1                              0.02758476 0.01121577   2.4595 0.0139146 *
## location_EU.Q12_PC1                             0.02268267 0.01642044   1.3814 0.1671659
## location_EU.age_group35_54                     -0.00773052 0.05922700  -0.1305 0.8961522
## location_EU.age_group55_                        0.01434249 0.07123467   0.2013 0.8404316
## location_EU.is_women                           -0.02542456 0.05063947  -0.5021 0.6156182
## location_EU.diet_typeFlexitarian               -0.01509649 0.06787730  -0.2224 0.8239959
## location_EU.diet_typeVegan_Vegetarian          -0.12997344 0.09373803  -1.3866 0.1655759
## location_EU.education_levelDegree              -0.01591058 0.05826869  -0.2731 0.7848106
## location_EU.education_levelPostgraduate         0.08717482 0.07491720   1.1636 0.2445799
## location_EU.income_level30_50k                  0.04475853 0.05903794   0.7581 0.4483722
## location_EU.income_level50_                     0.03458357 0.06526687   0.5299 0.5961955
## location_EU.where_liveRuralarea                 0.04280837 0.08273286   0.5174 0.6048568
## location_EU.where_liveTownorsuburb             -0.06966241 0.06008474  -1.1594 0.2462921
## location_UK.Q9_PC1                              0.00757741 0.01120594   0.6762 0.4989160
## location_UK.Q12_PC1                             0.07178368 0.01575962   4.5549 5.241e-06 ***
## location_UK.age_group35_54                      0.21912656 0.05758979   3.8050 0.0001418 ***
## location_UK.age_group55_                        0.40197168 0.06982909   5.7565 8.587e-09 ***
## location_UK.is_women                            0.01140348 0.04929494   0.2313 0.8170572
## location_UK.diet_typeFlexitarian               -0.02152390 0.06544867  -0.3289 0.7422563
## location_UK.diet_typeVegan_Vegetarian          -0.21185029 0.08698175  -2.4356 0.0148683 *
## location_UK.education_levelDegree               0.03939679 0.05656250   0.6965 0.4861046
## location_UK.education_levelPostgraduate         0.08665711 0.06989406   1.2398 0.2150364
## location_UK.income_level30_50k                  0.07022793 0.05676346   1.2372 0.2160117
## location_UK.income_level50_                     0.02546243 0.06289674   0.4048 0.6856032
## location_UK.where_liveRuralarea                 0.25483214 0.08090296   3.1498 0.0016335 **
## location_UK.where_liveTownorsuburb              0.06657282 0.05829985   1.1419 0.2534941
## certificate_NGO.Q9_PC1                          0.05704714 0.01121432   5.0870 3.638e-07 ***
## certificate_NGO.Q12_PC1                         0.04080596 0.01610379   2.5339 0.0112790 *
## certificate_NGO.age_group35_54                  0.07155951 0.05931077   1.2065 0.2276178
## certificate_NGO.age_group55_                    0.01947622 0.07091306   0.2746 0.7835857
## certificate_NGO.is_women                        0.06974367 0.05086497   1.3712 0.1703272
## certificate_NGO.diet_typeFlexitarian           -0.00209888 0.06784096  -0.0309 0.9753187
## certificate_NGO.diet_typeVegan_Vegetarian      -0.06549215 0.09169631  -0.7142 0.4750857
## certificate_NGO.education_levelDegree           0.11660150 0.05827910   2.0007 0.0454201 *
## certificate_NGO.education_levelPostgraduate     0.16775167 0.07225635   2.3216 0.0202535 *
## certificate_NGO.income_level30_50k              0.16390511 0.05873663   2.7905 0.0052625 **
## certificate_NGO.income_level50_                -0.06921159 0.06542693  -1.0578 0.2901258
## certificate_NGO.where_liveRuralarea             0.11003201 0.08289307   1.3274 0.1843774
## certificate_NGO.where_liveTownorsuburb         -0.06625709 0.06029360  -1.0989 0.2718084
## certificate_UK.Q9_PC1                           0.06655422 0.01174716   5.6656 1.465e-08 ***
## certificate_UK.Q12_PC1                          0.02270320 0.01683691   1.3484 0.1775240
## certificate_UK.age_group35_54                   0.11555471 0.06048098   1.9106 0.0560566 .
## certificate_UK.age_group55_                     0.15740920 0.07306671   2.1543 0.0312149 *
```

```
## certificate_UK.is_women                      0.12365987  0.05187470   2.3838 0.0171341 *
## certificate_UK.diet_typeFlexitarian         -0.10260915  0.06957567  -1.4748 0.1402704
## certificate_UK.diet_typeVegan_Vegetarian    -0.05926200  0.09256672  -0.6402 0.5220371
## certificate_UK.education_levelDegree         -0.02526053  0.05979072  -0.4225 0.6726729
## certificate_UK.education_levelPostgraduate    0.06288791  0.07721804   0.8144 0.4154044
## certificate_UK.income_level30_50k            0.07997237  0.06021140   1.3282 0.1841143
## certificate_UK.income_level50_              -0.03563818  0.06647783  -0.5361 0.5918956
## certificate_UK.where_liveRuralarea          -0.07438457  0.08518905  -0.8732 0.3825701
## certificate_UK.where_liveTownorsuburb       -0.03362072  0.06129531  -0.5485 0.5833459
## project_renewable.Q9_PC1                      0.02104921  0.01275821   1.6499 0.0989724 .
## project_renewable.Q12_PC1                    -0.03572588  0.01849523  -1.9316 0.0534056 .
## project_renewable.age_group35_54            -0.09097803  0.06706127  -1.3566 0.1748955
## project_renewable.age_group55_              -0.18759888  0.08056295  -2.3286 0.0198803 *
## project_renewable.is_women                    0.08131591  0.05794929   1.4032 0.1605497
## project_renewable.diet_typeFlexitarian        0.01372721  0.07664661   0.1791 0.8578612
## project_renewable.diet_typeVegan_Vegetarian  -0.34541455  0.10377244  -3.3286 0.0008729 ***
## project_renewable.education_levelDegree      -0.03745741  0.06639496  -0.5642 0.5726449
## project_renewable.education_levelPostgraduate 0.01553165  0.08372713   0.1855 0.8528344
## project_renewable.income_level30_50k          0.11310159  0.06707251   1.6863 0.0917460 .
## project_renewable.income_level50_           -0.09890658  0.07414931  -1.3339 0.1822419
## project_renewable.where_liveRuralarea         0.16008397  0.09325010   1.7167 0.0860310 .
## project_renewable.where_liveTownorsuburb      0.08589332  0.06802633   1.2626 0.2067156
## project_landfill.Q9_PC1                       0.00571454  0.01566365   0.3648 0.7152399
## project_landfill.Q12_PC1                     -0.14753251  0.02162484  -6.8224 8.956e-12 ***
## project_landfill.age_group35_54             -0.07422745  0.07792091  -0.9526 0.3407928
## project_landfill.age_group55_               -0.04649447  0.09390038  -0.4951 0.6204965
## project_landfill.is_women                     0.06687955  0.06689884   0.9997 0.3174501
## project_landfill.diet_typeFlexitarian         0.00462230  0.08845785   0.0523 0.9583261
## project_landfill.diet_typeVegan_Vegetarian   -0.10983327  0.11897250  -0.9232 0.3559124
## project_landfill.education_levelDegree       -0.15403012  0.07699537  -2.0005 0.0454451 *
## project_landfill.education_levelPostgraduate  0.01866073  0.09521007   0.1960 0.8446139
## project_landfill.income_level30_50k           0.23941841  0.07727910   3.0981 0.0019477 **
## project_landfill.income_level50_              0.00691170  0.08554567   0.0808 0.9356046
## project_landfill.where_liveRuralarea         -0.17492406  0.10902520  -1.6044 0.1086178
## project_landfill.where_liveTownorsuburb      -0.11891564  0.07960063  -1.4939 0.1352009
## project_manure.Q9_PC1                         0.00034483  0.01318600   0.0262 0.9791369
## project_manure.Q12_PC1                       -0.06535291  0.01911347  -3.4192 0.0006280 ***
## project_manure.age_group35_54                0.08459170  0.06959830   1.2154 0.2242030
## project_manure.age_group55_                  0.10431079  0.08388012   1.2436 0.2136579
## project_manure.is_women                      0.03685837  0.05953740   0.6191 0.5358642
## project_manure.diet_typeFlexitarian          0.02248704  0.07958180   0.2826 0.7775102
## project_manure.diet_typeVegan_Vegetarian    -0.00790965  0.10768944  -0.0734 0.9414491
## project_manure.education_levelDegree        -0.09112800  0.06839446  -1.3324 0.1827325
## project_manure.education_levelPostgraduate  -0.19494452  0.08711550  -2.2378 0.0252360 *
## project_manure.income_level30_50k           -0.02687295  0.06888111  -0.3901 0.6964366
## project_manure.income_level50_               0.12843677  0.07666852   1.6752 0.0938907 .
## project_manure.where_liveRuralarea          -0.10570444  0.09778380  -1.0810 0.2796964
## project_manure.where_liveTownorsuburb       -0.00704397  0.07057655  -0.0998 0.9204982
## sd.I                                          2.50236182  0.06960728  35.9497 < 2.2e-16 ***
## sd.location_EU                                0.64852308  0.03855572  16.8204 < 2.2e-16 ***
## sd.location_UK                                0.78725350  0.03768200  20.8920 < 2.2e-16 ***
## sd.certificate_NGO                            0.50244945  0.04502677  11.1589 < 2.2e-16 ***
## sd.certificate_UK                             0.58953993  0.04062927  14.5102 < 2.2e-16 ***
## sd.project_renewable                          0.82232494  0.04365424  18.8372 < 2.2e-16 ***
```

```
## sd.project_landfill                              0.56500928  0.05359392  10.5424 < 2.2e-16 ***
## sd.project_manure                               0.79821265  0.04187302  19.0627 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16401
## Number of observations: 12760
## Number of iterations: 59
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + 1 PCA for Q9 and Q12 + full demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                            Estimate  Std. Error  t-value   Pr(>|t|)
## I                                       -29.6432533   2.9575077 -10.0231 < 2.2e-16 ***
## location_EU                              -0.1371680   1.3055329  -0.1051 0.9163229
## location_UK                               0.7896055   1.2911963   0.6115 0.5408487
## certificate_NGO                           1.0017724   1.3271104   0.7549 0.4503376
## certificate_UK                            8.7137618   1.4411704   6.0463 1.482e-09 ***
## project_renewable                         4.2359601   1.5202199   2.7864 0.0053295 **
## project_landfill                         -7.3662646   1.7994795  -4.0936 4.248e-05 ***
## project_manure                           -5.2576343   1.5552598  -3.3806 0.0007234 ***
## I.Q9_PC1                                 -8.8220248   0.5823983 -15.1478 < 2.2e-16 ***
## I.Q12_PC1                                -5.8503590   0.5465045 -10.7051 < 2.2e-16 ***
## I.age_group35_54                         -1.1244162   1.6006811  -0.7025 0.4823917
## I.age_group55_                           -4.3926356   1.9330154  -2.2724 0.0230608 *
## I.is_women                                1.4137085   1.3799375   1.0245 0.3056120
## I.diet_typeFlexitarian                   -5.8916363   1.8580808  -3.1708 0.0015201 **
## I.diet_typeVegan_Vegetarian              -1.8662923   2.5332856  -0.7367 0.4612998
## I.education_levelDegree                  -8.1944859   1.6323634  -5.0200 5.167e-07 ***
## I.education_levelPostgraduate           -12.2487969   2.1499646  -5.6972 1.218e-08 ***
## I.income_level30_50k                     -2.3439267   1.5838989  -1.4798 0.1389143
## I.income_level50_                        -5.0129352   1.7711443  -2.8303 0.0046499 **
## I.where_liveRuralarea                    -5.7306023   2.2780337  -2.5156 0.0118833 *
## I.where_liveTownorsuburb                 -2.3811730   1.6829239  -1.4149 0.1570971
## location_EU.Q9_PC1                        0.4848337   0.1988420   2.4383 0.0147571 *
## location_EU.Q12_PC1                       0.3986739   0.2894020   1.3776 0.1683335
## location_EU.age_group35_54              -0.1358728   1.0411025  -0.1305 0.8961641
## location_EU.age_group55_                  0.2520857   1.2520202   0.2013 0.8404303
## location_EU.is_women                     -0.4468658   0.8904961  -0.5018 0.6157964
## location_EU.diet_typeFlexitarian         -0.2653380   1.1928565  -0.2224 0.8239720
## location_EU.diet_typeVegan_Vegetarian    -2.2844320   1.6513387  -1.3834 0.1665478
## location_EU.education_levelDegree        -0.2796467   1.0241791  -0.2730 0.7848188
## location_EU.education_levelPostgraduate   1.5321973   1.3198533   1.1609 0.2456888
## location_EU.income_level30_50k            0.7866824   1.0386449   0.7574 0.4488029
## location_EU.income_level50_               0.6078459   1.1476289   0.5297 0.5963521
## location_EU.where_liveRuralarea           0.7524061   1.4550869   0.5171 0.6050956
## location_EU.where_liveTownorsuburb       -1.2243965   1.0580659  -1.1572 0.2471896
```

```
## location_UK.Q9_PC1                             0.1331817  0.1969453   0.6762 0.4988901
## location_UK.Q12_PC1                            1.2616803  0.2846254   4.4328 9.303e-06 ***
## location_UK.age_group35_54                     3.8514002  1.0310641   3.7354 0.0001874 ***
## location_UK.age_group55_                       7.0651125  1.2794390   5.5220 3.351e-08 ***
## location_UK.is_women                           0.2004292  0.8665262   0.2313 0.8170803
## location_UK.diet_typeFlexitarian              -0.3783072  1.1504956  -0.3288 0.7422910
## location_UK.diet_typeVegan_Vegetarian         -3.7235113  1.5406150  -2.4169 0.0156533 *
## location_UK.education_levelDegree              0.6924437  0.9949021   0.6960 0.4864340
## location_UK.education_levelPostgraduate        1.5230978  1.2303621   1.2379 0.2157433
## location_UK.income_level30_50k                 1.2343363  0.9991412   1.2354 0.2166827
## location_UK.income_level50_                    0.4475313  1.1056832   0.4048 0.6856573
## location_UK.where_liveRuralarea                4.4789666  1.4402039   3.1100 0.0018712 **
## location_UK.where_liveTownorsuburb             1.1700935  1.0264113   1.1400 0.2542926
## certificate_NGO.Q9_PC1                         1.0026687  0.2032842   4.9323 8.125e-07 ***
## certificate_NGO.Q12_PC1                        0.7172114  0.2852193   2.5146 0.0119169 *
## certificate_NGO.age_group35_54                 1.2577403  1.0448542   1.2037 0.2286873
## certificate_NGO.age_group55_                   0.3423169  1.2466885   0.2746 0.7836382
## certificate_NGO.is_women                       1.2258248  0.8961048   1.3679 0.1713283
## certificate_NGO.diet_typeFlexitarian          -0.0368903  1.1923622  -0.0309 0.9753183
## certificate_NGO.diet_typeVegan_Vegetarian     -1.1510995  1.6120810  -0.7140 0.4751989
## certificate_NGO.education_levelDegree          2.0494048  1.0287680   1.9921 0.0463605 *
## certificate_NGO.education_levelPostgraduate    2.9484277  1.2794949   2.3044 0.0212020 *
## certificate_NGO.income_level30_50k             2.8808200  1.0425833   2.7632 0.0057245 **
## certificate_NGO.income_level50_               -1.2164729  1.1519833  -1.0560 0.2909767
## certificate_NGO.where_liveRuralarea            1.9339386  1.4598164   1.3248 0.1852435
## certificate_NGO.where_liveTownorsuburb        -1.1645443  1.0612850  -1.0973 0.2725118
## certificate_UK.Q9_PC1                          1.1697665  0.2148872   5.4436 5.221e-08 ***
## certificate_UK.Q12_PC1                         0.3990347  0.2964894   1.3459 0.1783461
## certificate_UK.age_group35_54                  2.0310063  1.0699056   1.8983 0.0576560 .
## certificate_UK.age_group55_                    2.7666469  1.2956996   2.1353 0.0327403 *
## certificate_UK.is_women                        2.1734637  0.9183800   2.3666 0.0179510 *
## certificate_UK.diet_typeFlexitarian           -1.8034733  1.2254366  -1.4717 0.1411023
## certificate_UK.diet_typeVegan_Vegetarian      -1.0415975  1.6263900  -0.6404 0.5218897
## certificate_UK.education_levelDegree          -0.4439827  1.0512119  -0.4224 0.6727672
## certificate_UK.education_levelPostgraduate     1.1053270  1.3583690   0.8137 0.4158075
## certificate_UK.income_level30_50k              1.4056059  1.0607806   1.3251 0.1851487
## certificate_UK.income_level50_                -0.6263817  1.1688016  -0.5359 0.5920153
## certificate_UK.where_liveRuralarea            -1.3073939  1.4994428  -0.8719 0.3832521
## certificate_UK.where_liveTownorsuburb         -0.5909227  1.0777697  -0.5483 0.5834977
## project_renewable.Q9_PC1                       0.3699640  0.2249934   1.6443 0.1001074
## project_renewable.Q12_PC1                     -0.6279232  0.3270212  -1.9201 0.0548415 .
## project_renewable.age_group35_54             -1.5990430  1.1813861  -1.3535 0.1758860
## project_renewable.age_group55_               -3.2972651  1.4272805  -2.3102 0.0208786 *
## project_renewable.is_women                     1.4292203  1.0202517   1.4009 0.1612587
## project_renewable.diet_typeFlexitarian         0.2412714  1.3473465   0.1791 0.8578815
## project_renewable.diet_typeVegan_Vegetarian   -6.0710562  1.8441559  -3.2921 0.0009946 ***
## project_renewable.education_levelDegree       -0.6583569  1.1673589  -0.5640 0.5727737
## project_renewable.education_levelPostgraduate  0.2729866  1.4715903   0.1855 0.8528334
## project_renewable.income_level30_50k           1.9878899  1.1816284   1.6823 0.0925047 .
## project_renewable.income_level50_             -1.7383963  1.3062833  -1.3308 0.1832562
## project_renewable.where_liveRuralarea          2.8136591  1.6458641   1.7095 0.0873522 .
## project_renewable.where_liveTownorsuburb       1.5096734  1.1980765   1.2601 0.2076401
## project_landfill.Q9_PC1                        0.1004395  0.2754160   0.3647 0.7153481
## project_landfill.Q12_PC1                      -2.5930528  0.4027215  -6.4388 1.204e-10 ***
```

```
## project_landfill.age_group35_54              -1.3046324  1.3706938  -0.9518 0.3411962
## project_landfill.age_group55_                 -0.8171936  1.6507332  -0.4950 0.6205656
## project_landfill.is_women                       1.1754847  1.1772597   0.9985 0.3180407
## project_landfill.diet_typeFlexitarian           0.0812422  1.5547729   0.0523 0.9583268
## project_landfill.diet_typeVegan_Vegetarian     -1.9304455  2.0922206  -0.9227 0.3561752
## project_landfill.education_levelDegree          -2.7072557  1.3609795  -1.9892 0.0466795 *
## project_landfill.education_levelPostgraduate     0.3279836  1.6734530   0.1960 0.8446163
## project_landfill.income_level30_50k             4.2080527  1.3758476   3.0585 0.0022244 **
## project_landfill.income_level50_                 0.1214810  1.5035927   0.0808 0.9356059
## project_landfill.where_liveRuralarea           -3.0744906  1.9246184  -1.5975 0.1101644
## project_landfill.where_liveTownorsuburb        -2.0900785  1.4038776  -1.4888 0.1365428
## project_manure.Q9_PC1                            0.0060607  0.2317618   0.0262 0.9791371
## project_manure.Q12_PC1                          -1.1486522  0.3408457  -3.3700 0.0007517 ***
## project_manure.age_group35_54                    1.4867960  1.2255600   1.2132 0.2250700
## project_manure.age_group55_                      1.8333816  1.4757648   1.2423 0.2141162
## project_manure.is_women                          0.6478280  1.0469381   0.6188 0.5360590
## project_manure.diet_typeFlexitarian              0.3952355  1.3987407   0.2826 0.7775101
## project_manure.diet_typeVegan_Vegetarian        -0.1390211  1.8928128  -0.0734 0.9414505
## project_manure.education_levelDegree            -1.6016790  1.2056607  -1.3285 0.1840243
## project_manure.education_levelPostgraduate      -3.4263732  1.5418160  -2.2223 0.0262632 *
## project_manure.income_level30_50k               -0.4723228  1.2107664  -0.3901 0.6964609
## project_manure.income_level50_                   2.2574234  1.3525487   1.6690 0.0951145 .
## project_manure.where_liveRuralarea              -1.8578765  1.7215525  -1.0792 0.2805045
## project_manure.where_liveTownorsuburb           -0.1238059  1.2404986  -0.0998 0.9205005
## sd.I                                            43.9818741  2.4893975  17.6677 < 2.2e-16 ***
## sd.location_EU                                  11.3985356  0.9289059  12.2709 < 2.2e-16 ***
## sd.location_UK                                  13.8368817  0.9875745  14.0110 < 2.2e-16 ***
## sd.certificate_NGO                               8.8311243  0.9365914   9.4290 < 2.2e-16 ***
## sd.certificate_UK                               10.3618392  0.9249811  11.2022 < 2.2e-16 ***
## sd.project_renewable                            14.4533023  1.1040259  13.0915 < 2.2e-16 ***
## sd.project_landfill                              9.9306850  1.0958842   9.0618 < 2.2e-16 ***
## sd.project_manure                               14.0295012  1.0534448  13.3177 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption + framing effect + 2 PCA for Q9 and Q10

We included the first two coponents for Q9 and Q10. Q9 was about respondents' attitude towards carbon offsetting, and Q10 was about respondents' attitude towards climate change.

mixed logit + co2 consumption + framing effect + PCA Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:16 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_efp2, panel = T,
##     method = "bhhh", iterlim = 5000)
##
```

```
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:26m:37s
##
## Coefficients:
##                                          Estimate  Std. Error  z-value   Pr(>|z|)
## price                                  -0.05667082  0.00261584 -21.6645  < 2.2e-16 ***
## I                                      -2.54195367  0.11152391 -22.7929  < 2.2e-16 ***
## location_EU                             0.06220601  0.06401652   0.9717  0.3311908
## location_UK                             0.48756696  0.06210222   7.8510  4.219e-15 ***
## certificate_NGO                         0.29862710  0.06307720   4.7343  2.198e-06 ***
## certificate_UK                          0.67618071  0.06702094  10.0891  < 2.2e-16 ***
## project_renewable                       0.28681561  0.07213247   3.9762  7.002e-05 ***
## project_landfill                       -0.57630330  0.08424534  -6.8408  7.877e-12 ***
## project_manure                         -0.39304057  0.07503009  -5.2384  1.619e-07 ***
## I.co2_value                             0.00796516  0.03287708   0.2423  0.8085703
## I.framing_effectconsequence             0.14946037  0.12158745   1.2292  0.2189812
## I.framing_effectMetOffice               0.34892287  0.10262653   3.3999  0.0006740 ***
## I.framing_effectUN                      0.15349392  0.11977163   1.2816  0.1999988
## I.Q9_PC1                               -0.55221841  0.02195515 -25.1521  < 2.2e-16 ***
## I.Q9_PC2                               -0.00090329  0.02310186  -0.0391  0.9688103
## I.Q10_PC1                              -0.04856156  0.01264388  -3.8407  0.0001227 ***
## I.Q10_PC2                               0.24445797  0.04336469   5.6373  1.728e-08 ***
## location_EU.co2_value                  -0.00304581  0.02028208  -0.1502  0.8806287
## location_EU.framing_effectconsequence  -0.09294231  0.07891203  -1.1778  0.2388778
## location_EU.framing_effectMetOffice    -0.13040087  0.06763762  -1.9279  0.0538633 .
## location_EU.framing_effectUN           -0.08897079  0.07884544  -1.1284  0.2591425
## location_EU.Q9_PC1                      0.03515742  0.01087544   3.2327  0.0012261 **
## location_EU.Q9_PC2                      0.01543764  0.01430696   1.0790  0.2805741
## location_EU.Q10_PC1                     0.01077395  0.00798563   1.3492  0.1772834
## location_EU.Q10_PC2                     0.00455036  0.02783543   0.1635  0.8701455
## location_UK.co2_value                  -0.04121520  0.01940229  -2.1242  0.0336497 *
## location_UK.framing_effectconsequence  -0.12409495  0.07702587  -1.6111  0.1071620
## location_UK.framing_effectMetOffice    -0.03780020  0.06544894  -0.5776  0.5635663
## location_UK.framing_effectUN           -0.01098916  0.07579184  -0.1450  0.8847177
## location_UK.Q9_PC1                      0.01851328  0.01068550   1.7326  0.0831737 .
## location_UK.Q9_PC2                     -0.01455729  0.01351819  -1.0769  0.2815397
## location_UK.Q10_PC1                     0.06340947  0.00785432   8.0732  6.661e-16 ***
## location_UK.Q10_PC2                    -0.01304734  0.02761681  -0.4724  0.6366113
## certificate_NGO.co2_value              -0.05497859  0.02009001  -2.7366  0.0062075 **
## certificate_NGO.framing_effectconsequence -0.01556153 0.07851297 -0.1982  0.8428860
## certificate_NGO.framing_effectMetOffice 0.00277672  0.06678379   0.0416  0.9668353
## certificate_NGO.framing_effectUN       -0.02952985  0.07773536  -0.3799  0.7040370
## certificate_NGO.Q9_PC1                  0.05864897  0.01081360   5.4236  5.840e-08 ***
## certificate_NGO.Q9_PC2                 -0.02435831  0.01400264  -1.7396  0.0819378 .
## certificate_NGO.Q10_PC1                 0.00357552  0.00801030   0.4464  0.6553335
## certificate_NGO.Q10_PC2                -0.05646685  0.02851565  -1.9802  0.0476804 *
## certificate_UK.co2_value               -0.03348884  0.02066031  -1.6209  0.1050334
## certificate_UK.framing_effectconsequence -0.06068877 0.08132526 -0.7462  0.4555179
## certificate_UK.framing_effectMetOffice  0.03718624  0.06956699   0.5345  0.5929690
## certificate_UK.framing_effectUN        -0.02921768  0.08102166  -0.3606  0.7183868
```

```
## certificate_UK.Q9_PC1                         0.06959412  0.01129080   6.1638 7.102e-10 ***
## certificate_UK.Q9_PC2                        -0.01689314  0.01462571  -1.1550 0.2480780
## certificate_UK.Q10_PC1                        0.00785234  0.00816700   0.9615 0.3363153
## certificate_UK.Q10_PC2                       -0.03180617  0.02884918  -1.1025 0.2702452
## project_renewable.co2_value                   0.00047111  0.02241514   0.0210 0.9832318
## project_renewable.framing_effectconsequence  0.03918281  0.09029280   0.4340 0.6643227
## project_renewable.framing_effectMetOffice    -0.11850707  0.07604050  -1.5585 0.1191211
## project_renewable.framing_effectUN            0.06708996  0.08863347   0.7569 0.4490875
## project_renewable.Q9_PC1                      0.01022072  0.01229600   0.8312 0.4058475
## project_renewable.Q9_PC2                     -0.00197053  0.01603162  -0.1229 0.9021745
## project_renewable.Q10_PC1                    -0.00728790  0.00904615  -0.8056 0.4204532
## project_renewable.Q10_PC2                    -0.05871247  0.03250179  -1.8064 0.0708500 .
## project_landfill.co2_value                    0.04181240  0.02637137   1.5855 0.1128477
## project_landfill.framing_effectconsequence   0.07080758  0.10477183   0.6758 0.4991508
## project_landfill.framing_effectMetOffice     -0.03940131  0.08923403  -0.4416 0.6588147
## project_landfill.framing_effectUN            0.04720232  0.10266576   0.4598 0.6456835
## project_landfill.Q9_PC1                      -0.01937022  0.01497205  -1.2938 0.1957488
## project_landfill.Q9_PC2                      -0.00322632  0.01817135  -0.1776 0.8590763
## project_landfill.Q10_PC1                     -0.05039839  0.01063476  -4.7390 2.148e-06 ***
## project_landfill.Q10_PC2                      0.07980282  0.03708027   2.1522 0.0313845 *
## project_manure.co2_value                      0.01611407  0.02375075   0.6785 0.4974766
## project_manure.framing_effectconsequence     0.10533805  0.09262294   1.1373 0.2554220
## project_manure.framing_effectMetOffice       0.15081699  0.07925047   1.9030 0.0570350 .
## project_manure.framing_effectUN              0.10991515  0.09215663   1.1927 0.2329871
## project_manure.Q9_PC1                        -0.00622159  0.01272017  -0.4891 0.6247620
## project_manure.Q9_PC2                        -0.02491527  0.01691071  -1.4733 0.1406586
## project_manure.Q10_PC1                       -0.03382577  0.00943104  -3.5866 0.0003350 ***
## project_manure.Q10_PC2                        0.07079770  0.03293108   2.1499 0.0315651 *
## sd.I                                          2.52032385  0.06918155  36.4306 < 2.2e-16 ***
## sd.location_EU                                0.63715491  0.03802188  16.7576 < 2.2e-16 ***
## sd.location_UK                                0.79183081  0.03730800  21.2242 < 2.2e-16 ***
## sd.certificate_NGO                            0.50566802  0.04443533  11.3799 < 2.2e-16 ***
## sd.certificate_UK                             0.59657045  0.03986041  14.9665 < 2.2e-16 ***
## sd.project_renewable                          0.82425032  0.04319021  19.0842 < 2.2e-16 ***
## sd.project_landfill                           0.58173134  0.05129517  11.3409 < 2.2e-16 ***
## sd.project_manure                             0.80499197  0.04151432  19.3907 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16476
## Number of observations: 12760
## Number of iterations: 37
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + co2 consumption + framing effect + PCA Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                              Estimate  Std. Error  t-value  Pr(>|t|)
## I                                          -44.8547149   3.3420953 -13.4211 < 2.2e-16 ***
```

```
## location_EU                                    1.0976725  1.1290341   0.9722 0.3309398
## location_UK                                    8.6034915  1.1818144   7.2799 3.342e-13 ***
## certificate_NGO                                5.2695034  1.1489202   4.5865 4.508e-06 ***
## certificate_UK                                11.9317252  1.3627534   8.7556 < 2.2e-16 ***
## project_renewable                              5.0610805  1.2858817   3.9359 8.289e-05 ***
## project_landfill                             -10.1693121  1.5772221  -6.4476 1.136e-10 ***
## project_manure                                -6.9355012  1.3456408  -5.1541 2.549e-07 ***
## I.co2_value                                    0.1405513  0.5800484   0.2423 0.8085403
## I.framing_effectconsequence                    2.6373425  2.1476324   1.2280 0.2194382
## I.framing_effectMetOffice                      6.1570106  1.8322669   3.3603 0.0007785 ***
## I.framing_effectUN                             2.7085175  2.1153483   1.2804 0.2004002
## I.Q9_PC1                                       -9.7443157  0.6162574 -15.8121 < 2.2e-16 ***
## I.Q9_PC2                                       -0.0159393  0.4076486  -0.0391 0.9688102
## I.Q10_PC1                                      -0.8569058  0.2265670  -3.7821 0.0001555 ***
## I.Q10_PC2                                       4.3136476  0.7930879   5.4391 5.356e-08 ***
## location_EU.co2_value                          -0.0537456  0.3578803  -0.1502 0.8806245
## location_EU.framing_effectconsequence          -1.6400381  1.3957207  -1.1750 0.2399757
## location_EU.framing_effectMetOffice            -2.3010230  1.1996751  -1.9180 0.0551061 .
## location_EU.framing_effectUN                   -1.5699575  1.3932693  -1.1268 0.2598205
## location_EU.Q9_PC1                             0.6203796  0.1949964   3.1815 0.0014652 **
## location_EU.Q9_PC2                             0.2724090  0.2527986   1.0776 0.2812243
## location_EU.Q10_PC1                            0.1901145  0.1412626   1.3458 0.1783594
## location_EU.Q10_PC2                            0.0802946  0.4911544   0.1635 0.8701395
## location_UK.co2_value                          -0.7272737  0.3443022  -2.1123 0.0346597 *
## location_UK.framing_effectconsequence          -2.1897503  1.3632290  -1.6063 0.1082087
## location_UK.framing_effectMetOffice            -0.6670134  1.1554488  -0.5773 0.5637527
## location_UK.framing_effectUN                   -0.1939121  1.3374793  -0.1450 0.8847241
## location_UK.Q9_PC1                             0.3266810  0.1890806   1.7277 0.0840358 .
## location_UK.Q9_PC2                             -0.2568746  0.2387595  -1.0759 0.2819847
## location_UK.Q10_PC1                            1.1189086  0.1502711   7.4459 9.637e-14 ***
## location_UK.Q10_PC2                            -0.2302303  0.4872460  -0.4725 0.6365603
## certificate_NGO.co2_value                      -0.9701392  0.3583171  -2.7075 0.0067795 **
## certificate_NGO.framing_effectconsequence      -0.2745950  1.3854838  -0.1982 0.8428930
## certificate_NGO.framing_effectMetOffice        0.0489973  1.1784405   0.0416 0.9668350
## certificate_NGO.framing_effectUN               -0.5210768  1.3718101  -0.3798 0.7040596
## certificate_NGO.Q9_PC1                         1.0349060  0.1973219   5.2448 1.565e-07 ***
## certificate_NGO.Q9_PC2                         -0.4298209  0.2478483  -1.7342 0.0828808 .
## certificate_NGO.Q10_PC1                        0.0630928  0.1414065   0.4462 0.6554670
## certificate_NGO.Q10_PC2                        -0.9964008  0.5053656  -1.9716 0.0486503 *
## certificate_UK.co2_value                       -0.5909361  0.3663353  -1.6131 0.1067224
## certificate_UK.framing_effectconsequence       -1.0708997  1.4359579  -0.7458 0.4558041
## certificate_UK.framing_effectMetOffice         0.6561795  1.2280986   0.5343 0.5931304
## certificate_UK.framing_effectUN                -0.5155683  1.4297901  -0.3606 0.7184058
## certificate_UK.Q9_PC1                          1.2280413  0.2084828   5.8904 3.853e-09 ***
## certificate_UK.Q9_PC2                          -0.2980923  0.2582027  -1.1545 0.2482995
## certificate_UK.Q10_PC1                         0.1385605  0.1444780   0.9590 0.3375375
## certificate_UK.Q10_PC2                         -0.5612442  0.5098388  -1.1008 0.2709721
## project_renewable.co2_value                    0.0083131  0.3955310   0.0210 0.9832317
## project_renewable.framing_effectconsequence    0.6914107  1.5938048   0.4338 0.6644254
## project_renewable.framing_effectMetOffice      -2.0911478  1.3452024  -1.5545 0.1200598
## project_renewable.framing_effectUN             1.1838537  1.5657441   0.7561 0.4495913
## project_renewable.Q9_PC1                       0.1803524  0.2171326   0.8306 0.4061941
## project_renewable.Q9_PC2                       -0.0347714  0.2828475  -0.1229 0.9021598
## project_renewable.Q10_PC1                      -0.1286005  0.1596822  -0.8054 0.4206160
```

```
## project_renewable.Q10_PC2                 -1.0360265  0.5765370  -1.7970 0.0723385 .
## project_landfill.co2_value                  0.7378117  0.4661574   1.5828 0.1134779
## project_landfill.framing_effectconsequence  1.2494539  1.8501228   0.6753 0.4994625
## project_landfill.framing_effectMetOffice   -0.6952662  1.5749539  -0.4415 0.6588860
## project_landfill.framing_effectUN           0.8329211  1.8119653   0.4597 0.6457472
## project_landfill.Q9_PC1                     -0.3418024  0.2647059  -1.2913 0.1966159
## project_landfill.Q9_PC2                     -0.0569310  0.3206429  -0.1776 0.8590744
## project_landfill.Q10_PC1                    -0.8893181  0.1933666  -4.5991 4.243e-06 ***
## project_landfill.Q10_PC2                     1.4081817  0.6571191   2.1430 0.0321161 *
## project_manure.co2_value                     0.2843450  0.4192343   0.6782 0.4976142
## project_manure.framing_effectconsequence     1.8587705  1.6378729   1.1349 0.2564304
## project_manure.framing_effectMetOffice       2.6612810  1.4046877   1.8946 0.0581492 .
## project_manure.framing_effectUN              1.9395369  1.6283852   1.1911 0.2336222
## project_manure.Q9_PC1                       -0.1097848  0.2245012  -0.4890 0.6248300
## project_manure.Q9_PC2                       -0.4396491  0.2994675  -1.4681 0.1420763
## project_manure.Q10_PC1                      -0.5968816  0.1696380  -3.5186 0.0004339 ***
## project_manure.Q10_PC2                       1.2492796  0.5833523   2.1416 0.0322295 *
## sd.I                                        44.4730402  2.5117804  17.7058 < 2.2e-16 ***
## sd.location_EU                              11.2430853  0.9199617  12.2213 < 2.2e-16 ***
## sd.location_UK                              13.9724598  0.9895599  14.1199 < 2.2e-16 ***
## sd.certificate_NGO                           8.9228987  0.9323816   9.5700 < 2.2e-16 ***
## sd.certificate_UK                           10.5269415  0.9212403  11.4269 < 2.2e-16 ***
## sd.project_renewable                        14.5445267  1.1044817  13.1686 < 2.2e-16 ***
## sd.project_landfill                         10.2650941  1.0716792   9.5785 < 2.2e-16 ***
## sd.project_manure                           14.2046985  1.0593999  13.4082 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption + framing effect + 2 PCA for Q9 and Q12

mixed logit + co2 consumption + framing effect + PCA Coefficients

```
##
## Model estimated on: Thu Nov 14 08:27:17 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_efp2, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:38m:25s
##
## Coefficients:
##                                     Estimate  Std. Error  z-value  Pr(>|z|)
## price                            -0.05683683  0.00261303 -21.7513 < 2.2e-16 ***
## I                                -2.44262848  0.11136573 -21.9334 < 2.2e-16 ***
```

```
## location_EU                                      0.05952083  0.06434329   0.9251 0.3549393
## location_UK                                      0.46771731  0.06224173   7.5145 5.707e-14 ***
## certificate_NGO                                  0.29113384  0.06352816   4.5828 4.589e-06 ***
## certificate_UK                                   0.67650726  0.06731748  10.0495 < 2.2e-16 ***
## project_renewable                                0.31313809  0.07292588   4.2939 1.755e-05 ***
## project_landfill                                -0.51477455  0.08444816  -6.0957 1.089e-09 ***
## project_manure                                  -0.39122055  0.07535492  -5.1917 2.084e-07 ***
## I.co2_value                                     -0.04752812  0.03331656  -1.4266 0.1537064
## I.framing_effectconsequence                      0.12138508  0.12250459   0.9909 0.3217532
## I.framing_effectMetOffice                        0.37739854  0.10327415   3.6543 0.0002578 ***
## I.framing_effectUN                               0.13591957  0.11985333   1.1340 0.2567739
## I.Q9_PC1                                        -0.50899122  0.02183825 -23.3073 < 2.2e-16 ***
## I.Q9_PC2                                        -0.06761140  0.02323852  -2.9095 0.0036206 **
## I.Q12_PC1                                       -0.32033704  0.02660101 -12.0423 < 2.2e-16 ***
## I.Q12_PC2                                        0.16774690  0.03824708   4.3859 1.155e-05 ***
## location_EU.co2_value                            0.00052377  0.02068569   0.0253 0.9797993
## location_EU.framing_effectconsequence           -0.09710141  0.07896607  -1.2297 0.2188245
## location_EU.framing_effectMetOffice             -0.13801416  0.06773470  -2.0376 0.0415930 *
## location_EU.framing_effectUN                    -0.09665390  0.07871167  -1.2279 0.2194662
## location_EU.Q9_PC1                               0.03042713  0.01107894   2.7464 0.0060254 **
## location_EU.Q9_PC2                               0.01330399  0.01432826   0.9285 0.3531408
## location_EU.Q12_PC1                              0.01585300  0.01645865   0.9632 0.3354463
## location_EU.Q12_PC2                             -0.00400317  0.02416713  -0.1656 0.8684360
## location_UK.co2_value                           -0.04006644  0.01980593  -2.0230 0.0430781 *
## location_UK.framing_effectconsequence           -0.09595557  0.07710693  -1.2444 0.2133347
## location_UK.framing_effectMetOffice             -0.02918438  0.06545231  -0.4459 0.6556783
## location_UK.framing_effectUN                    -0.01832226  0.07577034  -0.2418 0.8089250
## location_UK.Q9_PC1                               0.00300213  0.01097943   0.2734 0.7845208
## location_UK.Q9_PC2                              -0.02162234  0.01370720  -1.5774 0.1146933
## location_UK.Q12_PC1                              0.07504432  0.01596578   4.7003 2.597e-06 ***
## location_UK.Q12_PC2                             -0.02009271  0.02360459  -0.8512 0.3946469
## certificate_NGO.co2_value                       -0.05298617  0.02054919  -2.5785 0.0099229 **
## certificate_NGO.framing_effectconsequence       -0.00706915  0.07900892  -0.0895 0.9287062
## certificate_NGO.framing_effectMetOffice          0.00303570  0.06711837   0.0452 0.9639247
## certificate_NGO.framing_effectUN                -0.02849378  0.07788567  -0.3658 0.7144836
## certificate_NGO.Q9_PC1                           0.05816503  0.01106371   5.2573 1.462e-07 ***
## certificate_NGO.Q9_PC2                          -0.02131592  0.01416834  -1.5045 0.1324588
## certificate_NGO.Q12_PC1                          0.02530821  0.01617905   1.5643 0.1177571
## certificate_NGO.Q12_PC2                          0.03438544  0.02448922   1.4041 0.1602875
## certificate_UK.co2_value                        -0.03594044  0.02102634  -1.7093 0.0873943 .
## certificate_UK.framing_effectconsequence        -0.05322945  0.08124812  -0.6551 0.5123732
## certificate_UK.framing_effectMetOffice           0.03146025  0.06954557   0.4524 0.6510033
## certificate_UK.framing_effectUN                 -0.03065257  0.08095708  -0.3786 0.7049645
## certificate_UK.Q9_PC1                            0.06312770  0.01155585   5.4628 4.686e-08 ***
## certificate_UK.Q9_PC2                           -0.01784470  0.01473980  -1.2106 0.2260305
## certificate_UK.Q12_PC1                           0.01717385  0.01704926   1.0073 0.3137868
## certificate_UK.Q12_PC2                           0.05146914  0.02486391   2.0700 0.0384491 *
## project_renewable.co2_value                     -0.02075060  0.02292921  -0.9050 0.3654732
## project_renewable.framing_effectconsequence      0.03975209  0.09078594   0.4379 0.6614833
## project_renewable.framing_effectMetOffice       -0.13708724  0.07663944  -1.7887 0.0736584 .
## project_renewable.framing_effectUN               0.07994601  0.08895881   0.8987 0.3688201
## project_renewable.Q9_PC1                         0.02126948  0.01263497   1.6834 0.0923012 .
## project_renewable.Q9_PC2                        -0.01536736  0.01611916  -0.9534 0.3404079
## project_renewable.Q12_PC1                       -0.05780942  0.01861583  -3.1054 0.0019003 **
```

```
## project_renewable.Q12_PC2                      0.03336508  0.02795445    1.1936 0.2326534
## project_landfill.co2_value                      0.01348755  0.02691106    0.5012 0.6162375
## project_landfill.framing_effectconsequence      0.03456050  0.10487582    0.3295 0.7417496
## project_landfill.framing_effectMetOffice       -0.06338902  0.08931488   -0.7097 0.4778746
## project_landfill.framing_effectUN               0.03977079  0.10259582    0.3876 0.6982785
## project_landfill.Q9_PC1                          0.00710397  0.01543914    0.4601 0.6454249
## project_landfill.Q9_PC2                         -0.03024756  0.01851010   -1.6341 0.1022356
## project_landfill.Q12_PC1                        -0.16709441  0.02200451   -7.5936 3.109e-14 ***
## project_landfill.Q12_PC2                         0.07968887  0.03218503    2.4760 0.0132878 *
## project_manure.co2_value                         0.01519779  0.02428369    0.6258 0.5314176
## project_manure.framing_effectconsequence        0.08801180  0.09277638    0.9486 0.3428014
## project_manure.framing_effectMetOffice          0.15380313  0.07930933    1.9393 0.0524670 .
## project_manure.framing_effectUN                 0.10528757  0.09210507    1.1431 0.2529868
## project_manure.Q9_PC1                            0.00105396  0.01296317    0.0813 0.9352002
## project_manure.Q9_PC2                           -0.02719648  0.01701234   -1.5986 0.1099022
## project_manure.Q12_PC1                          -0.06579356  0.01930373   -3.4083 0.0006536 ***
## project_manure.Q12_PC2                           0.02745557  0.02828865    0.9706 0.3317721
## sd.I                                             2.49559955  0.06881290   36.2665 < 2.2e-16 ***
## sd.location_EU                                   0.63836731  0.03848895   16.5857 < 2.2e-16 ***
## sd.location_UK                                   0.81620839  0.03756514   21.7278 < 2.2e-16 ***
## sd.certificate_NGO                               0.50442039  0.04432960   11.3789 < 2.2e-16 ***
## sd.certificate_UK                                0.58826296  0.03997045   14.7174 < 2.2e-16 ***
## sd.project_renewable                             0.82820648  0.04331662   19.1198 < 2.2e-16 ***
## sd.project_landfill                              0.56582534  0.05280222   10.7159 < 2.2e-16 ***
## sd.project_manure                                0.80026339  0.04129507   19.3792 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16451
## Number of observations: 12760
## Number of iterations: 54
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + co2 consumption + framing effect + PCA Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                      Estimate  Std. Error  t-value  Pr(>|t|)
## I                                 -42.9761536   3.2543168 -13.2059 < 2.2e-16 ***
## location_EU                         1.0472228   1.1314908   0.9255 0.3546930
## location_UK                         8.2291233   1.1721682   7.0204 2.212e-12 ***
## certificate_NGO                     5.1222741   1.1515983   4.4480 8.669e-06 ***
## certificate_UK                     11.9026205   1.3636250   8.7287 < 2.2e-16 ***
## project_renewable                   5.5094219   1.3006987   4.2357 2.278e-05 ***
## project_landfill                   -9.0570590   1.5571485  -5.8164 6.011e-09 ***
## project_manure                     -6.8832222   1.3465757  -5.1116 3.194e-07 ***
## I.co2_value                        -0.8362205   0.5884415  -1.4211 0.1552945
## I.framing_effectconsequence         2.1356763   2.1563895   0.9904 0.3219813
## I.framing_effectMetOffice           6.6400346   1.8417817   3.6052 0.0003119 ***
## I.framing_effectUN                  2.3913994   2.1096719   1.1335 0.2569872
```

```
## I.Q9_PC1                                   -8.9553058  0.5837144 -15.3419 < 2.2e-16 ***
## I.Q9_PC2                                   -1.1895702  0.4130395  -2.8800 0.0039763 **
## I.Q12_PC1                                  -5.6360818  0.5431173 -10.3773 < 2.2e-16 ***
## I.Q12_PC2                                   2.9513766  0.6873816   4.2937 1.758e-05 ***
## location_EU.co2_value                       0.0092154  0.3639526   0.0253 0.9797995
## location_EU.framing_effectconsequence      -1.7084240  1.3929706  -1.2265 0.2200253
## location_EU.framing_effectMetOffice        -2.4282522  1.1990497  -2.0251 0.0428523 *
## location_EU.framing_effectUN               -1.7005504  1.3873213  -1.2258 0.2202816
## location_EU.Q9_PC1                          0.5353418  0.1971946   2.7148 0.0066318 **
## location_EU.Q9_PC2                          0.2340734  0.2523711   0.9275 0.3536687
## location_EU.Q12_PC1                         0.2789212  0.2899546   0.9619 0.3360758
## location_EU.Q12_PC2                        -0.0704327  0.4252587  -0.1656 0.8684534
## location_UK.co2_value                      -0.7049380  0.3501716  -2.0131 0.0441019 *
## location_UK.framing_effectconsequence      -1.6882638  1.3588917  -1.2424 0.2140953
## location_UK.framing_effectMetOffice        -0.5134766  1.1519121  -0.4458 0.6557705
## location_UK.framing_effectUN               -0.3223660  1.3332741  -0.2418 0.8089466
## location_UK.Q9_PC1                          0.0528202  0.1931472   0.2735 0.7844910
## location_UK.Q9_PC2                         -0.3804283  0.2417869  -1.5734 0.1156255
## location_UK.Q12_PC1                         1.3203465  0.2894696   4.5613 5.085e-06 ***
## location_UK.Q12_PC2                        -0.3535157  0.4158750  -0.8501 0.3952957
## certificate_NGO.co2_value                  -0.9322506  0.3649745  -2.5543 0.0106405 *
## certificate_NGO.framing_effectconsequence  -0.1243762  1.3901276  -0.0895 0.9287076
## certificate_NGO.framing_effectMetOffice     0.0534109  1.1808785   0.0452 0.9639242
## certificate_NGO.framing_effectUN           -0.5013260  1.3704763  -0.3658 0.7145112
## certificate_NGO.Q9_PC1                      1.0233686  0.2008724   5.0946 3.494e-07 ***
## certificate_NGO.Q9_PC2                     -0.3750372  0.2499411  -1.5005 0.1334844
## certificate_NGO.Q12_PC1                     0.4452783  0.2855356   1.5594 0.1188900
## certificate_NGO.Q12_PC2                     0.6049852  0.4318371   1.4010 0.1612269
## certificate_UK.co2_value                   -0.6323442  0.3719208  -1.7002 0.0890910 .
## certificate_UK.framing_effectconsequence   -0.9365309  1.4303274  -0.6548 0.5126179
## certificate_UK.framing_effectMetOffice      0.5535187  1.2238500   0.4523 0.6510697
## certificate_UK.framing_effectUN            -0.5393082  1.4245475  -0.3786 0.7049982
## certificate_UK.Q9_PC1                       1.1106828  0.2107385   5.2704 1.361e-07 ***
## certificate_UK.Q9_PC2                      -0.3139637  0.2595818  -1.2095 0.2264715
## certificate_UK.Q12_PC1                      0.3021606  0.3004405   1.0057 0.3145477
## certificate_UK.Q12_PC2                      0.9055596  0.4390838   2.0624 0.0391712 *
## project_renewable.co2_value                -0.3650907  0.4039495  -0.9038 0.3661000
## project_renewable.framing_effectconsequence 0.6994073  1.5977626   0.4377 0.6615736
## project_renewable.framing_effectMetOffice  -2.4119436  1.3538424  -1.7816 0.0748220 .
## project_renewable.framing_effectUN          1.4065880  1.5672461   0.8975 0.3694574
## project_renewable.Q9_PC1                    0.3742200  0.2230918   1.6774 0.0934592 .
## project_renewable.Q9_PC2                   -0.2703767  0.2836825  -0.9531 0.3405413
## project_renewable.Q12_PC1                  -1.0171120  0.3319312  -3.0642 0.0021823 **
## project_renewable.Q12_PC2                   0.5870326  0.4923569   1.1923 0.2331472
## project_landfill.co2_value                  0.2373030  0.4734347   0.5012 0.6162043
## project_landfill.framing_effectconsequence  0.6080652  1.8455524   0.3295 0.7417959
## project_landfill.framing_effectMetOffice   -1.1152806  1.5724295  -0.7093 0.4781555
## project_landfill.framing_effectUN           0.6997362  1.8052612   0.3876 0.6983051
## project_landfill.Q9_PC1                     0.1249888  0.2717694   0.4599 0.6455825
## project_landfill.Q9_PC2                    -0.5321823  0.3265904  -1.6295 0.1032051
## project_landfill.Q12_PC1                   -2.9398966  0.4153725  -7.0777 1.465e-12 ***
## project_landfill.Q12_PC2                    1.4020639  0.5710929   2.4551 0.0140863 *
## project_manure.co2_value                    0.2673933  0.4273668   0.6257 0.5315272
## project_manure.framing_effectconsequence    1.5484994  1.6348278   0.9472 0.3435398
```

```
## project_manure.framing_effectMetOffice       2.7060468  1.4019125    1.9303 0.0535754 .
## project_manure.framing_effectUN              1.8524532  1.6223683    1.1418 0.2535287
## project_manure.Q9_PC1                         0.0185436  0.2280894    0.0813 0.9352037
## project_manure.Q9_PC2                        -0.4785011  0.3004605   -1.5926 0.1112591
## project_manure.Q12_PC1                       -1.1575866  0.3452343   -3.3530 0.0007993 ***
## project_manure.Q12_PC2                        0.4830594  0.4984550    0.9691 0.3324887
## sd.I                                         43.9081387  2.4790192   17.7119 < 2.2e-16 ***
## sd.location_EU                               11.2315777  0.9227847   12.1714 < 2.2e-16 ***
## sd.location_UK                               14.3605537  1.0041840   14.3007 < 2.2e-16 ***
## sd.certificate_NGO                            8.8748856  0.9278623    9.5649 < 2.2e-16 ***
## sd.certificate_UK                            10.3500306  0.9160009   11.2991 < 2.2e-16 ***
## sd.project_renewable                         14.5716506  1.1036328   13.2034 < 2.2e-16 ***
## sd.project_landfill                           9.9552580  1.0838775    9.1849 < 2.2e-16 ***
## sd.project_manure                            14.0800138  1.0467840   13.4507 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- Higher meeting consumption, i.e., higher co2 value consistently reduce the WTP.

- The framing effects is either non-significant or seems to mitigate the preference premium relative to the base line for both endosement and carbon offset approaches.

Latent Class Models, Marginal Utiltiy Without Interaction Terms

This specification allows marginal utility paramters varies by class and treating the co2 consumption, framing effect, and PCAs of as demographics.

Latent Class Treating co2 consumption + framing effect + PCA as demographics, 2 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Nov 14 08:27:18 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:7s
##
## Coefficients:
##                          Estimate Std. Error  z-value  Pr(>|z|)
## class.1.I               -0.3412401  0.0444907  -7.6699 1.732e-14 ***
## class.1.price           -0.0392215  0.0021731 -18.0486 < 2.2e-16 ***
## class.1.location_EU     -0.0674888  0.0210293  -3.2093  0.001331 **
```

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```
## class.1.location_UK         0.1332018  0.0202700   6.5714 4.985e-11 ***
## class.1.certificate_NGO     0.0346578  0.0211352   1.6398  0.101045
## class.1.certificate_UK      0.3286375  0.0214574  15.3158 < 2.2e-16 ***
## class.1.project_renewable   0.1725005  0.0239655   7.1979 6.115e-13 ***
## class.1.project_landfill   -0.2166329  0.0279751  -7.7438 9.548e-15 ***
## class.1.project_manure     -0.1158708  0.0247819  -4.6756 2.931e-06 ***
## class.2.I                  -3.4833513  0.0947536 -36.7622 < 2.2e-16 ***
## class.2.price              -0.0361526  0.0040437  -8.9406 < 2.2e-16 ***
## class.2.location_EU         0.0698498  0.0382584   1.8257  0.067890 .
## class.2.location_UK         0.4050697  0.0368772  10.9843 < 2.2e-16 ***
## class.2.certificate_NGO     0.3069834  0.0368541   8.3297 < 2.2e-16 ***
## class.2.certificate_UK      0.5321108  0.0414124  12.8491 < 2.2e-16 ***
## class.2.project_renewable   0.1321055  0.0441377   2.9930  0.002762 **
## class.2.project_landfill   -0.5899856  0.0512568 -11.5104 < 2.2e-16 ***
## class.2.project_manure     -0.3172132  0.0462331  -6.8612 6.830e-12 ***
## (class)2                   -0.1611202  0.0180500  -8.9263 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -17728
## Number of observations: 12760
## Number of iterations: 17
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

The class membership probabilities are:

```
##    Class_1   Class_2
## 0.5401931 0.4598069
```

The effects of demographics are:

```
## $Class_2
##                                   coef         se           z      p_val
## (Intercept)                -0.1407921997 0.31589666 -0.44569068 0.6558207
## co2_value                  -0.0623752915 0.05378257 -1.15976779 0.2461434
## framing_effectconsequence   0.0840640753 0.17911719  0.46932445 0.6388377
## framing_effectMetOffice     0.0287070789 0.15532606  0.18481817 0.8533717
## framing_effectUN            0.2105488275 0.17883677  1.17732404 0.2390662
## Q9_PC1                     -0.0001625444 0.02298600 -0.00707145 0.9943578
## Q9_PC2                     -0.0256566982 0.03307478 -0.77571794 0.4379155
## Q10_PC1                     0.0266656630 0.02316180  1.15127775 0.2496180
## Q10_PC2                    -0.0105586504 0.06929843 -0.15236493 0.8788991
## age_group35_54             -0.0667037470 0.14928205 -0.44683032 0.6549976
## age_group55_                0.1117951345 0.17248587  0.64814084 0.5168939
## is_women                   -0.1098353477 0.12076774 -0.90947585 0.3630990
## diet_typeFlexitarian       -0.1838796676 0.16726698 -1.09931839 0.2716292
## diet_typeVegan_Vegetarian  -0.0967938153 0.22444877 -0.43125125 0.6662857
## education_levelDegree      -0.0295270392 0.13308994 -0.22185778 0.8244246
## education_levelPostgraduate -0.0122299321 0.17107668 -0.07148801 0.9430094
## hh_size                     0.0523495182 0.06372408  0.82150293 0.4113599
## income_level30_50k          0.0318212543 0.13563758  0.23460500 0.8145153
## income_level50_             0.1213756088 0.15493996  0.78337191 0.4334087
```

```
## n_children              -0.0327183357 0.09034438 -0.36215133 0.7172389
## is_shopper               -0.0086403258 0.14449072 -0.05979848 0.9523161
## where_liveRuralarea      -0.1644415529 0.19343297 -0.85012163 0.3952575
## where_liveTownorsuburb   -0.0250084159 0.14994304 -0.16678610 0.8675384
```

Latent Class Treating co2 consumption + framing effect + PCA as demographics, 3 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Nov 14 08:27:18 PM 2024
##
## Call:
## gmnl(formula = f2, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##         1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:7s
##
## Coefficients:
##                          Estimate Std. Error  z-value  Pr(>|z|)
## class.1.I                -0.4745246  0.0471349 -10.0674 < 2.2e-16 ***
## class.1.price            -0.0292255  0.0022267 -13.1249 < 2.2e-16 ***
## class.1.location_EU      -0.0160290  0.0215339  -0.7444 0.4566576
## class.1.location_UK       0.1652015  0.0207310   7.9688 1.554e-15 ***
## class.1.certificate_NGO   0.0831284  0.0215511   3.8573 0.0001147 ***
## class.1.certificate_UK    0.3615126  0.0222526  16.2459 < 2.2e-16 ***
## class.1.project_renewable 0.2162835  0.0249448   8.6705 < 2.2e-16 ***
## class.1.project_landfill -0.2422197  0.0288237  -8.4035 < 2.2e-16 ***
## class.1.project_manure   -0.1329240  0.0257051  -5.1711 2.327e-07 ***
## class.2.I                 0.4650589  0.2682802   1.7335 0.0830101 .
## class.2.price            -0.2428531  0.0126570 -19.1872 < 2.2e-16 ***
## class.2.location_EU      -1.0364971  0.1197874  -8.6528 < 2.2e-16 ***
## class.2.location_UK       0.3849672  0.1132237   3.4001 0.0006737 ***
## class.2.certificate_NGO  -0.2754939  0.1083798  -2.5419 0.0110242 *
## class.2.certificate_UK    0.6164478  0.1292306   4.7701 1.841e-06 ***
## class.2.project_renewable -0.5736398  0.1286163  -4.4601 8.193e-06 ***
## class.2.project_landfill -0.4348426  0.1711899  -2.5401 0.0110815 *
## class.2.project_manure    0.0152187  0.1361393   0.1118 0.9109915
## class.3.I                -3.8803868  0.1083355 -35.8182 < 2.2e-16 ***
## class.3.price            -0.0374090  0.0042698  -8.7614 < 2.2e-16 ***
## class.3.location_EU       0.0668430  0.0403760   1.6555 0.0978202 .
## class.3.location_UK       0.4087315  0.0387818  10.5393 < 2.2e-16 ***
## class.3.certificate_NGO   0.3206281  0.0387231   8.2800 2.220e-16 ***
## class.3.certificate_UK    0.5416737  0.0437614  12.3779 < 2.2e-16 ***
## class.3.project_renewable 0.1305824  0.0463554   2.8170 0.0048477 **
## class.3.project_landfill -0.6003817  0.0546129 -10.9934 < 2.2e-16 ***
## class.3.project_manure   -0.3435792  0.0489108  -7.0246 2.147e-12 ***
```

```
## (class)2                    -1.6289501  0.0320951 -50.7539 < 2.2e-16 ***
## (class)3                    -0.0863485  0.0189983  -4.5451 5.492e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16649
## Number of observations: 12760
## Number of iterations: 16
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3
## 0.47316897 0.09280518 0.43402585
```

The effects of demographics are:

```
## $Class_2
##                                    coef         se           z       p_val
## (Intercept)                -1.1994974906 0.57155303 -2.098663507 0.03584657
## co2_value                  -0.0883204469 0.09874776 -0.894404591 0.37110546
## framing_effectconsequence  -0.1744690768 0.33219624 -0.525198829 0.59944498
## framing_effectMetOffice     0.1190709582 0.27256538  0.436852824 0.66221809
## framing_effectUN            0.1350052336 0.32158283  0.419814809 0.67462075
## Q9_PC1                     -0.0950444292 0.03752552 -2.532794285 0.01131573
## Q9_PC2                     -0.0018296254 0.06102497 -0.029981586 0.97608174
## Q10_PC1                     0.0456504652 0.04285888  1.065134330 0.28681515
## Q10_PC2                    -0.0528919454 0.12848842 -0.411647561 0.68059777
## age_group35_54             -0.2158104566 0.27069472 -0.797246636 0.42530781
## age_group55_               -0.1613233202 0.30463577 -0.529561314 0.59641612
## is_women                   -0.1835708892 0.21680686 -0.846702396 0.39716102
## diet_typeFlexitarian       -0.1080532292 0.29523593 -0.365989432 0.71437296
## diet_typeVegan_Vegetarian  -0.6914507545 0.47471367 -1.456563816 0.14523682
## education_levelDegree       0.1437456937 0.23668076  0.607339998 0.54362530
## education_levelPostgraduate 0.1238467654 0.31027708  0.399148936 0.68978347
## hh_size                    -0.0647289125 0.11874879 -0.545091143 0.58569083
## income_level30_50k         -0.2784380790 0.24722522 -1.126252724 0.26005856
## income_level50_            -0.0619998067 0.27845503 -0.222656446 0.82380290
## n_children                 -0.0007756627 0.17043035 -0.004551201 0.99636868
## is_shopper                 -0.1855368257 0.25492639 -0.727805493 0.46673266
## where_liveRuralarea         0.1614389505 0.36512941  0.442141732 0.65838665
## where_liveTownorsuburb      0.4059983231 0.28737539  1.412780413 0.15772030
##
## $Class_3
##                                  coef         se           z       p_val
## (Intercept)                -0.02658375 0.33179907 -0.08012002 0.93614180
## co2_value                  -0.08871837 0.05637360 -1.57375747 0.11554353
## framing_effectconsequence   0.05856722 0.18763597  0.31213217 0.75494008
## framing_effectMetOffice     0.07791305 0.16340467  0.47681042 0.63349712
## framing_effectUN            0.28058883 0.18808598  1.49181154 0.13574856
## Q9_PC1                     -0.02073648 0.02507561 -0.82695815 0.40826078
## Q9_PC2                     -0.02208815 0.03495258 -0.63194625 0.52742200
```

```
## Q10_PC1                        0.02834657 0.02420831  1.17094386 0.24162135
## Q10_PC2                       -0.01700728 0.07246506 -0.23469625 0.81444450
## age_group35_54                -0.10521805 0.15649901 -0.67232407 0.50137741
## age_group55_                   0.14586831 0.18180159  0.80234892 0.42235115
## is_women                      -0.13201405 0.12691805 -1.04015184 0.29826936
## diet_typeFlexitarian          -0.29792482 0.17602948 -1.69247115 0.09055618
## diet_typeVegan_Vegetarian     -0.29679588 0.23314328 -1.27301925 0.20301121
## education_levelDegree          0.05719835 0.14001619  0.40851242 0.68289752
## education_levelPostgraduate    0.03400627 0.17961172  0.18933211 0.84983253
## hh_size                        0.03963119 0.06671727  0.59401704 0.55250071
## income_level30_50k             0.01114186 0.14234173  0.07827544 0.93760895
## income_level50_                0.13470304 0.16300237  0.82638700 0.40858459
## n_children                    -0.02425034 0.09439848 -0.25689332 0.79726113
## is_shopper                    -0.05884562 0.15244562 -0.38601057 0.69948884
## where_liveRuralarea           -0.10406143 0.20202593 -0.51508947 0.60649050
## where_liveTownorsuburb         0.06373342 0.15651376  0.40720650 0.68385633
```

We can't do an LC esimtation with more than 3 classes due to lack of variation and the hessian matrix would be singular.

Latent Class Models, Marginal Utiltiy With Interaction Terms

This specification interacts the marginal utility parameters with the co2 consumption, framing effect, and PCAs. This specification would be similar to the mixed logit model with the exception that the marginal utility parameters are allowed to vary by class, but without being random parameters.

Latent Class interact with co2 consumption + framing effect + PCA, 2 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Nov 14 08:27:19 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:1m:29s
##
## Coefficients:
##                                        Estimate  Std. Error  z-value  Pr(>|z|)
## class.1.I                            -0.34444834  0.04465853  -7.7129 1.221e-14 ***
## class.1.price                        -0.03480341  0.00428775  -8.1169 4.441e-16 ***
## class.1.location_EU                   0.02612167  0.05200069   0.5023 0.6154332
## class.1.location_UK                   0.28004120  0.05300178   5.2836 1.267e-07 ***
## class.1.certificate_NGO               0.02421002  0.05397572   0.4485 0.6537669
```

```
## class.1.certificate_UK                                      0.26383806  0.05699769   4.6289 3.676e-06 ***
## class.1.project_renewable                                   0.21618254  0.05873168   3.6809 0.0002325 ***
## class.1.project_landfill                                   -0.31146105  0.06984478  -4.4593 8.222e-06 ***
## class.1.project_manure                                     -0.27432365  0.06505697  -4.2167 2.479e-05 ***
## class.1.price:co2_value                                    -0.00118238  0.00117883  -1.0030 0.3158573
## class.1.price:framing_effectconsequence                    -0.01110029  0.00497544  -2.2310 0.0256799 *
## class.1.price:framing_effectMetOffice                       0.00013758  0.00418395   0.0329 0.9737675
## class.1.price:framing_effectUN                             -0.00360270  0.00492740  -0.7312 0.4646829
## class.1.location_EU:co2_value                               0.00519319  0.01502441   0.3456 0.7296058
## class.1.location_EU:framing_effectconsequence             -0.12101755  0.06532170  -1.8526 0.0639341 .
## class.1.location_EU:framing_effectMetOffice               -0.14499036  0.05475179  -2.6481 0.0080936 **
## class.1.location_EU:framing_effectUN                      -0.08368630  0.06486678  -1.2901 0.1970070
## class.1.location_UK:co2_value                             -0.06152076  0.01538081  -3.9998 6.339e-05 ***
## class.1.location_UK:framing_effectconsequence             -0.16165232  0.06728477  -2.4025 0.0162830 *
## class.1.location_UK:framing_effectMetOffice               -0.01442206  0.05611382  -0.2570 0.7971676
## class.1.location_UK:framing_effectUN                      -0.03514117  0.06516192  -0.5393 0.5896868
## class.1.certificate_NGO:co2_value                         -0.02687459  0.01607775  -1.6715 0.0946151 .
## class.1.certificate_NGO:framing_effectconsequence          0.01922058  0.06938931   0.2770 0.7817830
## class.1.certificate_NGO:framing_effectMetOffice            0.08480764  0.05703878   1.4868 0.1370566
## class.1.certificate_NGO:framing_effectUN                   0.08119141  0.06727280   1.2069 0.2274715
## class.1.certificate_UK:co2_value                          -0.01253344  0.01639282  -0.7646 0.4445284
## class.1.certificate_UK:framing_effectconsequence           0.08814691  0.07180163   1.2276 0.2195803
## class.1.certificate_UK:framing_effectMetOffice             0.09729107  0.06012113   1.6183 0.1056085
## class.1.certificate_UK:framing_effectUN                    0.15401325  0.07108767   2.1665 0.0302711 *
## class.1.project_renewable:co2_value                       -0.01975792  0.01698424  -1.1633 0.2447039
## class.1.project_renewable:framing_effectconsequence        0.08206402  0.07445929   1.1021 0.2704040
## class.1.project_renewable:framing_effectMetOffice         -0.06764584  0.06105159  -1.1080 0.2678570
## class.1.project_renewable:framing_effectUN                 0.01889592  0.07202891   0.2623 0.7930609
## class.1.project_landfill:co2_value                         0.02645724  0.02043211   1.2949 0.1953597
## class.1.project_landfill:framing_effectconsequence         0.13853136  0.08784221   1.5770 0.1147845
## class.1.project_landfill:framing_effectMetOffice           0.02416044  0.07381056   0.3273 0.7434181
## class.1.project_landfill:framing_effectUN                  0.06365703  0.08591901   0.7409 0.4587566
## class.1.project_manure:co2_value                           0.01231719  0.01911689   0.6443 0.5193751
## class.1.project_manure:framing_effectconsequence           0.19157458  0.08244454   2.3237 0.0201428 *
## class.1.project_manure:framing_effectMetOffice             0.14105372  0.06891893   2.0467 0.0406913 *
## class.1.project_manure:framing_effectUN                    0.20137745  0.08087882   2.4899 0.0127791 *
## class.2.I                                                 -3.51097936  0.09574295 -36.6709 < 2.2e-16 ***
## class.2.price                                             -0.01862446  0.00869673  -2.1415 0.0322298 *
## class.2.location_EU                                        0.12893971  0.10025780   1.2861 0.1984146
## class.2.location_UK                                        0.39384184  0.09500483   4.1455 3.391e-05 ***
## class.2.certificate_NGO                                    0.49355358  0.09510959   5.1893 2.111e-07 ***
## class.2.certificate_UK                                     0.70810644  0.10988008   6.4444 1.161e-10 ***
## class.2.project_renewable                                  0.12487839  0.10781826   1.1582 0.2467700
## class.2.project_landfill                                  -0.60118947  0.13401768  -4.4859 7.261e-06 ***
## class.2.project_manure                                    -0.36443608  0.12109770  -3.0094 0.0026173 **
## class.2.price:co2_value                                   -0.00744175  0.00276301  -2.6933 0.0070738 **
## class.2.price:framing_effectconsequence                   -0.00689547  0.00983838  -0.7009 0.4833814
## class.2.price:framing_effectMetOffice                     -0.00248212  0.00882688  -0.2812 0.7785571
## class.2.price:framing_effectUN                            -0.01938214  0.00951650  -2.0367 0.0416813 *
## class.2.location_EU:co2_value                             -0.03902193  0.03419225  -1.1413 0.2537657
## class.2.location_EU:framing_effectconsequence              0.00658105  0.11330094   0.0581 0.9536812
## class.2.location_EU:framing_effectMetOffice                0.03632315  0.10305699   0.3525 0.7244956
## class.2.location_EU:framing_effectUN                      -0.07832540  0.11234401  -0.6972 0.4856823
## class.2.location_UK:co2_value                              0.00105147  0.03417404   0.0308 0.9754544
```

```
## class.2.location_UK:framing_effectconsequence      0.08002041 0.11128620  0.7191 0.4721097
## class.2.location_UK:framing_effectMetOffice       -0.03303828 0.09934509 -0.3326 0.7394659
## class.2.location_UK:framing_effectUN               0.02523403 0.11336272  0.2226 0.8238503
## class.2.certificate_NGO:co2_value                 -0.08788468 0.03354764 -2.6197 0.0088008 **
## class.2.certificate_NGO:framing_effectconsequence  0.02147935 0.10961174  0.1960 0.8446427
## class.2.certificate_NGO:framing_effectMetOffice   -0.10791400 0.09925200 -1.0873 0.2769162
## class.2.certificate_NGO:framing_effectUN          -0.11398248 0.11259154 -1.0124 0.3113689
## class.2.certificate_UK:co2_value                  -0.05001066 0.03913932 -1.2778 0.2013340
## class.2.certificate_UK:framing_effectconsequence  -0.14405942 0.12596082 -1.1437 0.2527546
## class.2.certificate_UK:framing_effectMetOffice    -0.07019183 0.11402350 -0.6156 0.5381646
## class.2.certificate_UK:framing_effectUN           -0.21564560 0.12647060 -1.7051 0.0881749 .
## class.2.project_renewable:co2_value                0.01438950 0.03751145  0.3836 0.7012727
## class.2.project_renewable:framing_effectconsequence 0.00847322 0.12279573  0.0690 0.9449876
## class.2.project_renewable:framing_effectMetOffice -0.10019856 0.11088217 -0.9036 0.3661816
## class.2.project_renewable:framing_effectUN         0.11937438 0.12515622  0.9538 0.3401834
## class.2.project_landfill:co2_value                 0.07368949 0.04548708  1.6200 0.1052303
## class.2.project_landfill:framing_effectconsequence -0.11995387 0.14902724 -0.8049 0.4208702
## class.2.project_landfill:framing_effectMetOffice  -0.17889877 0.13460242 -1.3291 0.1838182
## class.2.project_landfill:framing_effectUN         -0.05890704 0.15047583 -0.3915 0.6954486
## class.2.project_manure:co2_value                   0.04612135 0.04220569  1.0928 0.2744923
## class.2.project_manure:framing_effectconsequence  -0.05331936 0.13951895 -0.3822 0.7023385
## class.2.project_manure:framing_effectMetOffice     0.03465735 0.12676456  0.2734 0.7845462
## class.2.project_manure:framing_effectUN           -0.09170416 0.13897237 -0.6599 0.5093351
## (class)2                                          -0.16251577 0.01804042 -9.0084 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -17660
## Number of observations: 12760
## Number of iterations: 15
## Exit of MLE: successive function values within relative tolerance limit (reltol)


##      AIC      BIC
## 35485.49 36104.18
```

The class membership probabilities are:

```
##   Class_1   Class_2
## 0.5405398 0.4594602
```

The effects of demographics are:

```
## $Class_2
##                               coef         se          z    p_val
## (Intercept)             -0.27706383 0.26928171 -1.02889955 0.3035269
## age_group35_54           0.01687408 0.14393905  0.11723074 0.9066772
## age_group55_             0.21461920 0.16138350  1.32987078 0.1835609
## is_women                -0.05672937 0.11697192 -0.48498275 0.6276886
## diet_typeFlexitarian    -0.17437595 0.15894831 -1.09706072 0.2726148
## diet_typeVegan_Vegetarian -0.01878985 0.20874883 -0.09001175 0.9282779
## education_levelDegree   -0.03686092 0.13211409 -0.27900827 0.7802385
## education_levelPostgraduate -0.01573016 0.16999594 -0.09253254 0.9262749
```

```
## hh_size                       0.04971871 0.06331892  0.78521101 0.4323299
## income_level30_50k            0.03911787 0.13487259  0.29003572 0.7717889
## income_level50_               0.13410448 0.15350885  0.87359447 0.3823391
## n_children                   -0.05309249 0.08930491 -0.59450803 0.5521724
## is_shopper                   -0.03132222 0.14260838 -0.21963798 0.8261531
## where_liveRuralarea          -0.11939830 0.19058367 -0.62648756 0.5309952
## where_liveTownorsuburb        0.03137536 0.14660774  0.21400888 0.8305401
```

Latent Class interact with co2 consumption + framing effect + PCA, 3 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Nov 14 08:27:19 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:1m:37s
##
## Coefficients:
##                                                  Estimate  Std. Error  z-value  Pr(>|z|)
## class.1.I                                       9.4246e-01  3.0266e-01   3.1140  0.001846 **
## class.1.price                                  -1.2806e-01  2.7608e-02  -4.6387 3.507e-06 ***
## class.1.location_EU                            -2.4175e-01  2.9770e-01  -0.8121  0.416755
## class.1.location_UK                            -1.4595e-01  3.0339e-01  -0.4811  0.630474
## class.1.certificate_NGO                        -5.2612e-01  2.9135e-01  -1.8058  0.070949 .
## class.1.certificate_UK                          2.1375e-01  3.2835e-01   0.6510  0.515052
## class.1.project_renewable                      -1.5500e-01  3.1028e-01  -0.4996  0.617388
## class.1.project_landfill                       -5.8410e-01  4.5701e-01  -1.2781  0.201215
## class.1.project_manure                         -4.6515e-01  3.6559e-01  -1.2723  0.203253
## class.1.price:co2_value                        -6.4195e-02  1.1018e-02  -5.8266 5.656e-09 ***
## class.1.price:framing_effectconsequence        -4.1486e-01  1.0495e-01  -3.9528 7.724e-05 ***
## class.1.price:framing_effectMetOffice           3.5668e-03  2.9495e-02   0.1209  0.903749
## class.1.price:framing_effectUN                  7.5184e-02  3.1682e-02   2.3731  0.017641 *
## class.1.location_EU:co2_value                  -5.1618e-01  1.2591e-01  -4.0995 4.141e-05 ***
## class.1.location_EU:framing_effectconsequence  -1.4785e+00  5.7819e-01  -2.5572  0.010553 *
## class.1.location_EU:framing_effectMetOffice    -1.7969e-02  3.1090e-01  -0.0578  0.953911
## class.1.location_EU:framing_effectUN            6.5970e-01  3.7485e-01   1.7599  0.078426 .
## class.1.location_UK:co2_value                   1.2103e-01  1.3127e-01   0.9220  0.356542
## class.1.location_UK:framing_effectconsequence   1.4041e+00  6.5843e-01   2.1324  0.032971 *
## class.1.location_UK:framing_effectMetOffice     5.9197e-01  3.1197e-01   1.8975  0.057760 .
## class.1.location_UK:framing_effectUN            5.2634e-01  3.3509e-01   1.5707  0.116242
## class.1.certificate_NGO:co2_value               1.1433e-01  1.0273e-01   1.1129  0.265733
## class.1.certificate_NGO:framing_effectconsequence  7.2350e-01  4.6665e-01   1.5504  0.121038
## class.1.certificate_NGO:framing_effectMetOffice 1.6847e-01  3.0499e-01   0.5524  0.580688
## class.1.certificate_NGO:framing_effectUN        2.4260e-01  3.3107e-01   0.7328  0.463687
```

```
## class.1.certificate_UK:co2_value                            1.5870e-01  1.4649e-01   1.0834  0.278644
## class.1.certificate_UK:framing_effectconsequence            2.6371e+00  9.9760e-01   2.6434  0.008208 **
## class.1.certificate_UK:framing_effectMetOffice              9.3959e-02  3.3512e-01   0.2804  0.779189
## class.1.certificate_UK:framing_effectUN                     2.6252e-02  3.8768e-01   0.0677  0.946013
## class.1.project_renewable:co2_value                        -3.6505e-01  1.3133e-01  -2.7797  0.005441 **
## class.1.project_renewable:framing_effectconsequence        -2.3363e+00  7.9826e-01  -2.9267  0.003426 **
## class.1.project_renewable:framing_effectMetOffice          -2.3689e-02  3.3737e-01  -0.0702  0.944021
## class.1.project_renewable:framing_effectUN                  8.2095e-01  3.4592e-01   2.3732  0.017633 *
## class.1.project_landfill:co2_value                         -7.7735e-02  2.1836e-01  -0.3560  0.721846
## class.1.project_landfill:framing_effectconsequence         -4.6354e-01  6.5379e-01  -0.7090  0.478322
## class.1.project_landfill:framing_effectMetOffice            2.2359e-01  4.6146e-01   0.4845  0.628018
## class.1.project_landfill:framing_effectUN                   4.4343e-01  4.7500e-01   0.9335  0.350553
## class.1.project_manure:co2_value                            1.8140e-01  1.2946e-01   1.4013  0.161134
## class.1.project_manure:framing_effectconsequence           -5.6272e-01  6.1190e-01  -0.9196  0.357769
## class.1.project_manure:framing_effectMetOffice              2.3315e-01  3.8354e-01   0.6079  0.543257
## class.1.project_manure:framing_effectUN                     1.2914e-01  4.2719e-01   0.3023  0.762430
## class.2.I                                                  -4.9159e-01  4.7498e-02 -10.3497  < 2.2e-16 ***
## class.2.price                                              -2.6927e-02  4.6463e-03  -5.7954  6.817e-09 ***
## class.2.location_EU                                         6.8386e-02  5.3860e-02   1.2697  0.204187
## class.2.location_UK                                         3.4737e-01  5.4544e-02   6.3686  1.908e-10 ***
## class.2.certificate_NGO                                     6.0734e-02  5.5372e-02   1.0968  0.272716
## class.2.certificate_UK                                      2.8855e-01  5.9639e-02   4.8382  1.310e-06 ***
## class.2.project_renewable                                   2.8167e-01  6.2050e-02   4.5394  5.642e-06 ***
## class.2.project_landfill                                   -3.2662e-01  7.2499e-02  -4.5051  6.634e-06 ***
## class.2.project_manure                                     -2.9661e-01  6.7826e-02  -4.3731  1.225e-05 ***
## class.2.price:co2_value                                    -4.2102e-05  1.2866e-03  -0.0327  0.973896
## class.2.price:framing_effectconsequence                    -7.5795e-03  5.3534e-03  -1.4158  0.156826
## class.2.price:framing_effectMetOffice                      -2.3168e-03  4.5017e-03  -0.5147  0.606794
## class.2.price:framing_effectUN                             -3.9420e-03  5.2792e-03  -0.7467  0.455246
## class.2.location_EU:co2_value                               1.5244e-02  1.5549e-02   0.9804  0.326892
## class.2.location_EU:framing_effectconsequence              -1.0652e-01  6.7123e-02  -1.5870  0.112518
## class.2.location_EU:framing_effectMetOffice                -1.6806e-01  5.6072e-02  -2.9973  0.002724 **
## class.2.location_EU:framing_effectUN                       -1.0104e-01  6.5958e-02  -1.5320  0.125535
## class.2.location_UK:co2_value                              -7.2556e-02  1.5699e-02  -4.6217  3.806e-06 ***
## class.2.location_UK:framing_effectconsequence              -1.7722e-01  6.8571e-02  -2.5845  0.009753 **
## class.2.location_UK:framing_effectMetOffice                -5.0987e-02  5.7364e-02  -0.8888  0.374092
## class.2.location_UK:framing_effectUN                       -6.5545e-02  6.6602e-02  -0.9841  0.325050
## class.2.certificate_NGO:co2_value                          -3.8290e-02  1.6393e-02  -2.3358  0.019503 *
## class.2.certificate_NGO:framing_effectconsequence           5.2684e-02  7.0825e-02   0.7439  0.456962
## class.2.certificate_NGO:framing_effectMetOffice             1.1083e-01  5.8297e-02   1.9012  0.057280 .
## class.2.certificate_NGO:framing_effectUN                    1.1444e-01  6.8687e-02   1.6661  0.095703 .
## class.2.certificate_UK:co2_value                           -1.8145e-02  1.7014e-02  -1.0665  0.286205
## class.2.certificate_UK:framing_effectconsequence            9.0454e-02  7.4295e-02   1.2175  0.223415
## class.2.certificate_UK:framing_effectMetOffice              1.1649e-01  6.2208e-02   1.8725  0.061132 .
## class.2.certificate_UK:framing_effectUN                     1.8892e-01  7.3257e-02   2.5789  0.009912 **
## class.2.project_renewable:co2_value                        -2.9870e-02  1.7588e-02  -1.6983  0.089446 .
## class.2.project_renewable:framing_effectconsequence         6.9914e-02  7.7210e-02   0.9055  0.365200
## class.2.project_renewable:framing_effectMetOffice          -7.8536e-02  6.3681e-02  -1.2333  0.217476
## class.2.project_renewable:framing_effectUN                  1.4431e-02  7.5161e-02   0.1920  0.847742
## class.2.project_landfill:co2_value                          2.4840e-02  2.1069e-02   1.1790  0.238398
## class.2.project_landfill:framing_effectconsequence          1.1003e-01  9.0539e-02   1.2153  0.224267
## class.2.project_landfill:framing_effectMetOffice            2.2018e-02  7.5803e-02   0.2905  0.771459
## class.2.project_landfill:framing_effectUN                   5.2984e-02  8.8231e-02   0.6005  0.548159
## class.2.project_manure:co2_value                            3.4390e-03  1.9824e-02   0.1735  0.862277
```

```
## class.2.project_manure:framing_effectconsequence           1.9544e-01  8.5460e-02   2.2869  0.022204 *
## class.2.project_manure:framing_effectMetOffice             1.5758e-01  7.1241e-02   2.2119  0.026976 *
## class.2.project_manure:framing_effectUN                    2.5416e-01  8.3192e-02   3.0551  0.002250 **
## class.3.I                                                  -3.8842e+00  1.0851e-01 -35.7948 < 2.2e-16 ***
## class.3.price                                              -2.2838e-02  9.3090e-03  -2.4533  0.014155 *
## class.3.location_EU                                         1.0964e-01  1.0398e-01   1.0544  0.291697
## class.3.location_UK                                         4.0228e-01  9.8569e-02   4.0812 4.481e-05 ***
## class.3.certificate_NGO                                     5.4044e-01  9.8463e-02   5.4888 4.047e-08 ***
## class.3.certificate_UK                                      7.4559e-01  1.1418e-01   6.5300 6.576e-11 ***
## class.3.project_renewable                                   1.0558e-01  1.1194e-01   0.9432  0.345579
## class.3.project_landfill                                   -6.2394e-01  1.3935e-01  -4.4774 7.555e-06 ***
## class.3.project_manure                                     -3.6422e-01  1.2603e-01  -2.8898  0.003854 **
## class.3.price:co2_value                                    -7.3738e-03  3.0899e-03  -2.3864  0.017014 *
## class.3.price:framing_effectconsequence                    -7.1791e-03  1.0723e-02  -0.6695  0.503185
## class.3.price:framing_effectMetOffice                       5.2119e-04  9.6674e-03   0.0539  0.957005
## class.3.price:framing_effectUN                             -1.1849e-02  1.0628e-02  -1.1148  0.264916
## class.3.location_EU:co2_value                              -3.6130e-02  3.6627e-02  -0.9864  0.323921
## class.3.location_EU:framing_effectconsequence               1.1301e-02  1.1936e-01   0.0947  0.924571
## class.3.location_EU:framing_effectMetOffice                 4.6343e-02  1.0843e-01   0.4274  0.669092
## class.3.location_EU:framing_effectUN                       -5.0398e-02  1.2002e-01  -0.4199  0.674550
## class.3.location_UK:co2_value                               1.2403e-02  3.6049e-02   0.3441  0.730801
## class.3.location_UK:framing_effectconsequence               4.6445e-02  1.1725e-01   0.3961  0.692025
## class.3.location_UK:framing_effectMetOffice                -5.3508e-02  1.0416e-01  -0.5137  0.607460
## class.3.location_UK:framing_effectUN                        1.0064e-02  1.2013e-01   0.0838  0.933234
## class.3.certificate_NGO:co2_value                          -8.1317e-02  3.5599e-02  -2.2843  0.022356 *
## class.3.certificate_NGO:framing_effectconsequence          -4.1883e-02  1.1523e-01  -0.3635  0.716252
## class.3.certificate_NGO:framing_effectMetOffice            -1.6773e-01  1.0415e-01  -1.6105  0.107286
## class.3.certificate_NGO:framing_effectUN                   -1.5476e-01  1.1946e-01  -1.2954  0.195167
## class.3.certificate_UK:co2_value                           -4.7332e-02  4.1912e-02  -1.1293  0.258763
## class.3.certificate_UK:framing_effectconsequence           -1.9442e-01  1.3232e-01  -1.4693  0.141760
## class.3.certificate_UK:framing_effectMetOffice             -1.0071e-01  1.1990e-01  -0.8400  0.400912
## class.3.certificate_UK:framing_effectUN                    -2.6999e-01  1.3483e-01  -2.0025  0.045233 *
## class.3.project_renewable:co2_value                         2.9007e-02  4.0387e-02   0.7182  0.472612
## class.3.project_renewable:framing_effectconsequence        -8.5450e-03  1.2904e-01  -0.0662  0.947204
## class.3.project_renewable:framing_effectMetOffice          -1.1759e-01  1.1710e-01  -1.0042  0.315305
## class.3.project_renewable:framing_effectUN                  1.3785e-01  1.3311e-01   1.0356  0.300375
## class.3.project_landfill:co2_value                          9.0391e-02  4.9439e-02   1.8283  0.067500 .
## class.3.project_landfill:framing_effectconsequence         -1.2499e-01  1.5964e-01  -0.7829  0.433667
## class.3.project_landfill:framing_effectMetOffice           -2.2470e-01  1.4255e-01  -1.5763  0.114953
## class.3.project_landfill:framing_effectUN                  -2.8256e-02  1.6306e-01  -0.1733  0.862426
## class.3.project_manure:co2_value                            5.1839e-02  4.4595e-02   1.1624  0.245055
## class.3.project_manure:framing_effectconsequence           -7.1217e-02  1.4704e-01  -0.4843  0.628148
## class.3.project_manure:framing_effectMetOffice              1.4519e-05  1.3354e-01   0.0001  0.999913
## class.3.project_manure:framing_effectUN                    -1.6684e-01  1.4920e-01  -1.1182  0.263475
## (class)2                                                    1.6297e+00  3.2013e-02  50.9085 < 2.2e-16 ***
## (class)3                                                    1.5476e+00  3.2200e-02  48.0636 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16556
## Number of observations: 12760
## Number of iterations: 25
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

```
##       AIC      BIC
## 33362.41 34294.16
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3
## 0.09256792 0.47232955 0.43510253
```

The effects of demographics are:

```
## $Class_2
##                                  coef        se           z       p_val
## (Intercept)                1.42033718 0.4901568  2.89771992 0.003758861
## age_group35_54             0.11413038 0.2583437  0.44177730 0.658650369
## age_group55_              -0.02728599 0.2845539 -0.09589043 0.923607597
## is_women                   0.13761868 0.2099346  0.65553128 0.512125752
## diet_typeFlexitarian       0.14294429 0.2815017  0.50779199 0.611599229
## diet_typeVegan_Vegetarian  0.36951400 0.4095747  0.90218940 0.366956263
## education_levelDegree     -0.23355034 0.2348208 -0.99458983 0.319935797
## education_levelPostgraduate -0.21926346 0.3041742 -0.72084831 0.471002847
## hh_size                    0.05996884 0.1182586  0.50709904 0.612085325
## income_level30_50k         0.42410286 0.2503298  1.69417639 0.090231769
## income_level50_            0.10943850 0.2717746  0.40268110 0.687182841
## n_children                -0.02812311 0.1659385 -0.16947910 0.865419813
## is_shopper                 0.29530823 0.2494918  1.18363886 0.236556050
## where_liveRuralarea       -0.27292285 0.3581150 -0.76210960 0.445994593
## where_liveTownorsuburb    -0.49091146 0.2804028 -1.75073649 0.079991311
##
## $Class_3
##                                 coef        se          z      p_val
## (Intercept)                1.23982900 0.4936895  2.5113539 0.01202691
## age_group35_54             0.10524975 0.2614839  0.4025095 0.68730910
## age_group55_               0.23870679 0.2856290  0.8357232 0.40331066
## is_women                   0.04658651 0.2110631  0.2207232 0.82530800
## diet_typeFlexitarian      -0.11556784 0.2870557 -0.4025973 0.68724452
## diet_typeVegan_Vegetarian  0.20181526 0.4150824  0.4862052 0.62682165
## education_levelDegree     -0.17302596 0.2359466 -0.7333267 0.46335921
## education_levelPostgraduate -0.17146327 0.3059652 -0.5604012 0.57520580
## hh_size                    0.10242903 0.1187729  0.8623939 0.38847079
## income_level30_50k         0.41480235 0.2519150  1.6465965 0.09964102
## income_level50_            0.23050778 0.2723096  0.8464916 0.39727854
## n_children                -0.06707639 0.1671427 -0.4013122 0.68819030
## is_shopper                 0.20504090 0.2491996  0.8227979 0.41062294
## where_liveRuralarea       -0.33795452 0.3621879 -0.9330917 0.35077261
## where_liveTownorsuburb    -0.38035762 0.2832444 -1.3428601 0.17931729
```

Latent Class interact with co2 consumption + framing effect + PCA, 4 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Nov 14 08:27:19 PM 2024
```

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```
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:2m:19s
##
## Coefficients:
##                                                       Estimate  Std. Error  z-value   Pr(>|z|)
## class.1.I                                            0.93491282  0.29950199   3.1216 0.0017990 **
## class.1.price                                       -0.13301316  0.02812733  -4.7290 2.257e-06 ***
## class.1.location_EU                                 -0.26789962  0.30160634  -0.8882 0.3744102
## class.1.location_UK                                 -0.13757511  0.30802181  -0.4466 0.6551344
## class.1.certificate_NGO                             -0.52626124  0.29546792  -1.7811 0.0748943 .
## class.1.certificate_UK                               0.22597339  0.33375718   0.6771 0.4983683
## class.1.project_renewable                           -0.18084439  0.31575655  -0.5727 0.5668251
## class.1.project_landfill                            -0.60072841  0.46240724  -1.2991 0.1938984
## class.1.project_manure                              -0.47129605  0.37074828  -1.2712 0.2036567
## class.1.price:co2_value                             -0.06197079  0.01103819  -5.6142 1.975e-08 ***
## class.1.price:framing_effectconsequence             -0.41421570  0.10503356  -3.9437 8.025e-05 ***
## class.1.price:framing_effectMetOffice                0.00820898  0.02978220   0.2756 0.7828294
## class.1.price:framing_effectUN                       0.07759499  0.03200208   2.4247 0.0153216 *
## class.1.location_EU:co2_value                       -0.50197199  0.12607206  -3.9816 6.844e-05 ***
## class.1.location_EU:framing_effectconsequence       -1.46765008  0.58029861  -2.5291 0.0114346 *
## class.1.location_EU:framing_effectMetOffice         -0.00245198  0.31285898  -0.0078 0.9937468
## class.1.location_EU:framing_effectUN                 0.67170779  0.37626769   1.7852 0.0742312 .
## class.1.location_UK:co2_value                        0.11179022  0.13104250   0.8531 0.3936129
## class.1.location_UK:framing_effectconsequence        1.41364758  0.65989897   2.1422 0.0321759 *
## class.1.location_UK:framing_effectMetOffice          0.58078003  0.31414304   1.8488 0.0644902 .
## class.1.location_UK:framing_effectUN                 0.53462603  0.33626351   1.5899 0.1118569
## class.1.certificate_NGO:co2_value                    0.11076307  0.10279841   1.0775 0.2812666
## class.1.certificate_NGO:framing_effectconsequence    0.73096268  0.46881158   1.5592 0.1189533
## class.1.certificate_NGO:framing_effectMetOffice      0.16831937  0.30808470   0.5463 0.5848314
## class.1.certificate_NGO:framing_effectUN             0.25631533  0.33237047   0.7712 0.4406041
## class.1.certificate_UK:co2_value                     0.15549474  0.14620484   1.0635 0.2875370
## class.1.certificate_UK:framing_effectconsequence     2.64095067  0.99853229   2.6448 0.0081731 **
## class.1.certificate_UK:framing_effectMetOffice       0.08767646  0.33704333   0.2601 0.7947603
## class.1.certificate_UK:framing_effectUN              0.01474483  0.38819659   0.0380 0.9697013
## class.1.project_renewable:co2_value                 -0.34748220  0.13167445  -2.6389 0.0083163 **
## class.1.project_renewable:framing_effectconsequence -2.34183888  0.80008053  -2.9270 0.0034224 **
## class.1.project_renewable:framing_effectMetOffice    0.00048447  0.34042585   0.0014 0.9988645
## class.1.project_renewable:framing_effectUN           0.84817405  0.34909027   2.4297 0.0151126 *
## class.1.project_landfill:co2_value                  -0.06490451  0.21742185  -0.2985 0.7653072
## class.1.project_landfill:framing_effectconsequence  -0.47033812  0.65649764  -0.7164 0.4737226
## class.1.project_landfill:framing_effectMetOffice     0.24578345  0.46252383   0.5314 0.5951442
## class.1.project_landfill:framing_effectUN            0.42166512  0.47540490   0.8870 0.3751004
## class.1.project_manure:co2_value                     0.18562217  0.12930848   1.4355 0.1511450
## class.1.project_manure:framing_effectconsequence    -0.57002009  0.61457709  -0.9275 0.3536671
## class.1.project_manure:framing_effectMetOffice       0.24229893  0.38725424   0.6257 0.5315220
```

```
## class.1.project_manure:framing_effectUN                         0.12770044  0.42925533    0.2975 0.7660902
## class.2.I                                                       -2.44343672  0.13502879  -18.0957 < 2.2e-16 ***
## class.2.price                                                   -0.17001480  0.01631934  -10.4180 < 2.2e-16 ***
## class.2.location_EU                                              0.00411192  0.14786648    0.0278 0.9778150
## class.2.location_UK                                             -0.76101005  0.13647254   -5.5763 2.457e-08 ***
## class.2.certificate_NGO                                          0.44521879  0.18953590    2.3490 0.0188242 *
## class.2.certificate_UK                                           0.99754422  0.20017246    4.9834 6.247e-07 ***
## class.2.project_renewable                                        0.95981443  0.20366037    4.7128 2.443e-06 ***
## class.2.project_landfill                                        -0.07199254  0.18403067   -0.3912 0.6956504
## class.2.project_manure                                          -0.61913265  0.18630902   -3.3231 0.0008901 ***
## class.2.price:co2_value                                          0.00681815  0.00323897    2.1050 0.0352885 *
## class.2.price:framing_effectconsequence                        -0.03203964  0.02106695   -1.5208 0.1282978
## class.2.price:framing_effectMetOffice                           0.07374143  0.01520333    4.8503 1.232e-06 ***
## class.2.price:framing_effectUN                                  0.02124769  0.01784582    1.1906 0.2338005
## class.2.location_EU:co2_value                                  -0.10385518  0.03828943   -2.7124 0.0066803 **
## class.2.location_EU:framing_effectconsequence                   0.15060570  0.19773340    0.7617 0.4462627
## class.2.location_EU:framing_effectMetOffice                    -0.65948526  0.15142058   -4.3553 1.329e-05 ***
## class.2.location_EU:framing_effectUN                           -0.74511870  0.18599427   -4.0061 6.172e-05 ***
## class.2.location_UK:co2_value                                  -0.11926238  0.03731753   -3.1959 0.0013940 **
## class.2.location_UK:framing_effectconsequence                   0.91980992  0.17151947    5.3627 8.198e-08 ***
## class.2.location_UK:framing_effectMetOffice                     0.01148416  0.14155518    0.0811 0.9353397
## class.2.location_UK:framing_effectUN                            0.13648422  0.16501821    0.8271 0.4081884
## class.2.certificate_NGO:co2_value                              -0.12523153  0.04881946   -2.5652 0.0103117 *
## class.2.certificate_NGO:framing_effectconsequence               0.46393518  0.24029764    1.9307 0.0535240 .
## class.2.certificate_NGO:framing_effectMetOffice                -0.87216367  0.19800859   -4.4047 1.059e-05 ***
## class.2.certificate_NGO:framing_effectUN                       -0.39394530  0.24325191   -1.6195 0.1053408
## class.2.certificate_UK:co2_value                               -0.05101603  0.03893106   -1.3104 0.1900539
## class.2.certificate_UK:framing_effectconsequence                0.61884645  0.28707070    2.1557 0.0311049 *
## class.2.certificate_UK:framing_effectMetOffice                 -0.61669362  0.19859699   -3.1053 0.0019012 **
## class.2.certificate_UK:framing_effectUN                        -0.32899817  0.22976397   -1.4319 0.1521735
## class.2.project_renewable:co2_value                             0.06398402  0.04531591    1.4120 0.1579632
## class.2.project_renewable:framing_effectconsequence           -0.18128845  0.27915812   -0.6494 0.5160725
## class.2.project_renewable:framing_effectMetOffice             -1.09244643  0.20668077   -5.2857 1.252e-07 ***
## class.2.project_renewable:framing_effectUN                    -0.40674477  0.25436883   -1.5990 0.1098127
## class.2.project_landfill:co2_value                             0.03034245  0.04502547    0.6739 0.5003779
## class.2.project_landfill:framing_effectconsequence            -0.38777745  0.23151451   -1.6750 0.0939422 .
## class.2.project_landfill:framing_effectMetOffice              -0.56757497  0.18973484   -2.9914 0.0027769 **
## class.2.project_landfill:framing_effectUN                      0.31108269  0.23708786    1.3121 0.1894868
## class.2.project_manure:co2_value                              -0.12415808  0.05116767   -2.4265 0.0152455 *
## class.2.project_manure:framing_effectconsequence               0.39251102  0.22111336    1.7752 0.0758719 .
## class.2.project_manure:framing_effectMetOffice                -0.28734360  0.19610194   -1.4653 0.1428454
## class.2.project_manure:framing_effectUN                        0.40761864  0.22876390    1.7818 0.0747768 .
## class.3.I                                                       0.03489706  0.05956543    0.5859 0.5579689
## class.3.price                                                   0.00337758  0.00568987    0.5936 0.5527715
## class.3.location_EU                                             0.11711902  0.06576252    1.7809 0.0749224 .
## class.3.location_UK                                             0.63999952  0.06852087    9.3402 < 2.2e-16 ***
## class.3.certificate_NGO                                         0.06467655  0.07008464    0.9228 0.3560933
## class.3.certificate_UK                                          0.25603530  0.07275109    3.5193 0.0004326 ***
## class.3.project_renewable                                       0.25531176  0.07785290    3.2794 0.0010402 **
## class.3.project_landfill                                       -0.34558864  0.08948905   -3.8618 0.0001126 ***
## class.3.project_manure                                         -0.21932096  0.08503452   -2.5792 0.0099030 **
## class.3.price:co2_value                                        -0.00128335  0.00156926   -0.8178 0.4134665
## class.3.price:framing_effectconsequence                        0.00103962  0.00660980    0.1573 0.8750208
## class.3.price:framing_effectMetOffice                         -0.01523893  0.00554028   -2.7506 0.0059492 **
```

```
## class.3.price:framing_effectUN                              -0.00587870  0.00635099  -0.9256 0.3546357
## class.3.location_EU:co2_value                                 0.05744765  0.02037925   2.8189 0.0048184 **
## class.3.location_EU:framing_effectconsequence               -0.11702320  0.08374969  -1.3973 0.1623242
## class.3.location_EU:framing_effectMetOffice                 -0.05006687  0.06862186  -0.7296 0.4656315
## class.3.location_EU:framing_effectUN                          0.02117966  0.08032398   0.2637 0.7920281
## class.3.location_UK:co2_value                                -0.07380883  0.02023556  -3.6475 0.0002648 ***
## class.3.location_UK:framing_effectconsequence               -0.46288496  0.08665611  -5.3416 9.211e-08 ***
## class.3.location_UK:framing_effectMetOffice                  0.01304941  0.07334704   0.1779 0.8587911
## class.3.location_UK:framing_effectUN                         -0.13071717  0.08294268  -1.5760 0.1150272
## class.3.certificate_NGO:co2_value                           -0.04253414  0.02163486  -1.9660 0.0492986 *
## class.3.certificate_NGO:framing_effectconsequence           -0.07261584  0.09004715  -0.8064 0.4200006
## class.3.certificate_NGO:framing_effectMetOffice              0.27754591  0.07478347   3.7113 0.0002062 ***
## class.3.certificate_NGO:framing_effectUN                     0.18687931  0.08613028   2.1697 0.0300274 *
## class.3.certificate_UK:co2_value                            -0.01970934  0.02202853  -0.8947 0.3709374
## class.3.certificate_UK:framing_effectconsequence            -0.12913475  0.09217252  -1.4010 0.1612107
## class.3.certificate_UK:framing_effectMetOffice               0.17894306  0.07653210   2.3381 0.0193798 *
## class.3.certificate_UK:framing_effectUN                      0.24614985  0.08936606   2.7544 0.0058800 **
## class.3.project_renewable:co2_value                         -0.07470769  0.02235010  -3.3426 0.0008299 ***
## class.3.project_renewable:framing_effectconsequence          0.05549296  0.09762365   0.5684 0.5697378
## class.3.project_renewable:framing_effectMetOffice            0.06547472  0.08009311   0.8175 0.4136527
## class.3.project_renewable:framing_effectUN                   0.09094448  0.09196528   0.9889 0.3227120
## class.3.project_landfill:co2_value                           0.01029564  0.02663912   0.3865 0.6991369
## class.3.project_landfill:framing_effectconsequence           0.24488636  0.11394096   2.1492 0.0316155 *
## class.3.project_landfill:framing_effectMetOffice             0.10546358  0.09452303   1.1157 0.2645314
## class.3.project_landfill:framing_effectUN                   -0.03763644  0.10808894  -0.3482 0.7276909
## class.3.project_manure:co2_value                             0.05233896  0.02578545   2.0298 0.0423782 *
## class.3.project_manure:framing_effectconsequence             0.14339547  0.10803896   1.3273 0.1844237
## class.3.project_manure:framing_effectMetOffice               0.29754609  0.09074768   3.2788 0.0010424 **
## class.3.project_manure:framing_effectUN                      0.24790486  0.10380416   2.3882 0.0169312 *
## class.4.I                                                   -3.86197929  0.10750149 -35.9249 < 2.2e-16 ***
## class.4.price                                               -0.02268608  0.00926321  -2.4491 0.0143233 *
## class.4.location_EU                                          0.10705932  0.10349180   1.0345 0.3009158
## class.4.location_UK                                          0.39607308  0.09833092   4.0280 5.626e-05 ***
## class.4.certificate_NGO                                      0.53933524  0.09822232   5.4910 3.997e-08 ***
## class.4.certificate_UK                                       0.73211690  0.11390229   6.4276 1.296e-10 ***
## class.4.project_renewable                                    0.10265946  0.11168833   0.9192 0.3580118
## class.4.project_landfill                                    -0.63063714  0.13882817  -4.5426 5.557e-06 ***
## class.4.project_manure                                      -0.37683191  0.12547149  -3.0033 0.0026705 **
## class.4.price:co2_value                                     -0.00764752  0.00306660  -2.4938 0.0126379 *
## class.4.price:framing_effectconsequence                     -0.00712198  0.01062107  -0.6706 0.5025059
## class.4.price:framing_effectMetOffice                        0.00115340  0.00957836   0.1204 0.9041524
## class.4.price:framing_effectUN                              -0.01383465  0.01043882  -1.3253 0.1850692
## class.4.location_EU:co2_value                               -0.03677785  0.03636723  -1.0113 0.3118772
## class.4.location_EU:framing_effectconsequence                0.01511458  0.11875803   0.1273 0.8987250
## class.4.location_EU:framing_effectMetOffice                  0.04798024  0.10788603   0.4447 0.6565143
## class.4.location_EU:framing_effectUN                        -0.05617214  0.11885485  -0.4726 0.6364906
## class.4.location_UK:co2_value                                0.01134849  0.03599215   0.3153 0.7525305
## class.4.location_UK:framing_effectconsequence                0.05674605  0.11687227   0.4855 0.6272940
## class.4.location_UK:framing_effectMetOffice                 -0.05057450  0.10374814  -0.4875 0.6259226
## class.4.location_UK:framing_effectUN                         0.01428942  0.11924078   0.1198 0.9046126
## class.4.certificate_NGO:co2_value                           -0.08167483  0.03547650  -2.3022 0.0213226 *
## class.4.certificate_NGO:framing_effectconsequence           -0.03326725  0.11496389  -0.2894 0.7722972
## class.4.certificate_NGO:framing_effectMetOffice             -0.16516494  0.10389199  -1.5898 0.1118854
## class.4.certificate_NGO:framing_effectUN                    -0.15858245  0.11874001  -1.3355 0.1816985
```

```
## class.4.certificate_UK:co2_value                        -0.04599070  0.04183172  -1.0994 0.2715841
## class.4.certificate_UK:framing_effectconsequence        -0.18368780  0.13167757  -1.3950 0.1630213
## class.4.certificate_UK:framing_effectMetOffice          -0.09021296  0.11929826  -0.7562 0.4495312
## class.4.certificate_UK:framing_effectUN                 -0.25885996  0.13360316  -1.9375 0.0526808 .
## class.4.project_renewable:co2_value                      0.02761830  0.04034589   0.6845 0.4936353
## class.4.project_renewable:framing_effectconsequence     -0.00136319  0.12845506  -0.0106 0.9915329
## class.4.project_renewable:framing_effectMetOffice       -0.11048382  0.11646802  -0.9486 0.3428142
## class.4.project_renewable:framing_effectUN               0.14002259  0.13203958   1.0605 0.2889357
## class.4.project_landfill:co2_value                       0.09072550  0.04911887   1.8471 0.0647385 .
## class.4.project_landfill:framing_effectconsequence      -0.12342370  0.15860970  -0.7782 0.4364748
## class.4.project_landfill:framing_effectMetOffice        -0.21850955  0.14170483  -1.5420 0.1230724
## class.4.project_landfill:framing_effectUN               -0.02583993  0.16129189  -0.1602 0.8727188
## class.4.project_manure:co2_value                         0.05187437  0.04431592   1.1706 0.2417763
## class.4.project_manure:framing_effectconsequence        -0.06362698  0.14619326  -0.4352 0.6633990
## class.4.project_manure:framing_effectMetOffice           0.00969077  0.13279813   0.0730 0.9418271
## class.4.project_manure:framing_effectUN                 -0.14273028  0.14764287  -0.9667 0.3336808
## (class)2                                                 0.40326138  0.03892915  10.3589 < 2.2e-16 ***
## (class)3                                                 1.27127005  0.03335901  38.1087 < 2.2e-16 ***
## (class)4                                                 1.55010850  0.03213413  48.2387 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16296
## Number of observations: 12760
## Number of iterations: 113
## Exit of MLE: successive function values within relative tolerance limit (reltol)


##       AIC       BIC
## 32926.45 34171.28
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3    Class_4
## 0.09281554 0.13891684 0.33092249 0.43734512
```

The effects of demographics are:

```
## $Class_2
##                                 coef         se           z       p_val
## (Intercept)               0.18961199 0.5777249   0.32820465 0.74275693
## age_group35_54            0.08982129 0.3011930   0.29821834 0.76553653
## age_group55_             -0.20755904 0.3381053  -0.61388867 0.53928890
## is_women                  0.11357565 0.2476398   0.45863238 0.64649818
## diet_typeFlexitarian     -0.08472921 0.3366959  -0.25164907 0.80131233
## diet_typeVegan_Vegetarian 0.25879796 0.4663583   0.55493379 0.57893995
## education_levelDegree    -0.13561100 0.2780009  -0.48780778 0.62568600
## education_levelPostgraduate 0.02813733 0.3541981  0.07943954 0.93668302
## hh_size                   0.03493024 0.1387731   0.25170762 0.80126707
## income_level30_50k        0.25311800 0.2911211   0.86945950 0.38459585
## income_level50_          -0.18657428 0.3283436  -0.56822872 0.56987967
## n_children               -0.05636437 0.1955410  -0.28824834 0.77315665
## is_shopper                0.52282270 0.3073336   1.70115673 0.08891356
```

```
## where_liveRuralarea           -0.02684468 0.4094247 -0.06556684 0.94772269
## where_liveTownorsuburb         -0.46631408 0.3234287 -1.44178318 0.14936355
##
## $Class_3
##                                       coef        se          z      p_val
## (Intercept)                      1.01254944 0.5053865  2.00351520 0.04512202
## age_group35_54                   0.13347585 0.2667834  0.50031539 0.61685302
## age_group55_                     0.06326645 0.2945461  0.21479302 0.82992870
## is_women                         0.13753404 0.2170218  0.63373361 0.52625469
## diet_typeFlexitarian             0.22370593 0.2888025  0.77459845 0.43857697
## diet_typeVegan_Vegetarian        0.37556575 0.4178818  0.89873677 0.36879289
## education_levelDegree           -0.27207858 0.2426838 -1.12112387 0.26223514
## education_levelPostgraduate     -0.31432279 0.3164033 -0.99342450 0.32050313
## hh_size                          0.07955556 0.1220602  0.65177296 0.51454765
## income_level30_50k               0.48765094 0.2578450  1.89125596 0.05859018
## income_level50_                  0.23072792 0.2810215  0.82103306 0.41162744
## n_children                      -0.01210209 0.1709181 -0.07080635 0.94355188
## is_shopper                       0.20907560 0.2575477  0.81179357 0.41691009
## where_liveRuralarea             -0.36117513 0.3696592 -0.97704894 0.32854493
## where_liveTownorsuburb          -0.49192081 0.2876992 -1.70984397 0.08729473
##
## $Class_4
##                                       coef        se          z      p_val
## (Intercept)                      1.22662184 0.4926588  2.4897998 0.01278151
## age_group35_54                   0.11683214 0.2608767  0.4478443 0.65426556
## age_group55_                     0.24822526 0.2850002  0.8709653 0.38377308
## is_women                         0.04018989 0.2107522  0.1906974 0.84876271
## diet_typeFlexitarian            -0.11841969 0.2862535 -0.4136882 0.67910245
## diet_typeVegan_Vegetarian        0.19630185 0.4116360  0.4768822 0.63344604
## education_levelDegree           -0.17665350 0.2354536 -0.7502689 0.45309279
## education_levelPostgraduate     -0.16190327 0.3061758 -0.5287918 0.59694990
## hh_size                          0.10758422 0.1188829  0.9049596 0.36548681
## income_level30_50k               0.40740149 0.2512431  1.6215433 0.10490118
## income_level50_                  0.23352192 0.2723584  0.8574066 0.39122019
## n_children                      -0.07196474 0.1673134 -0.4301193 0.66710886
## is_shopper                       0.20576885 0.2489528  0.8265377 0.40849914
## where_liveRuralarea             -0.33366663 0.3616905 -0.9225198 0.35625752
## where_liveTownorsuburb          -0.37794358 0.2822510 -1.3390335 0.18055976
```

Based on BIC, the optimal number of classes is 3. Also, we could not estiamte a model with more than 4 classes due to lack of variation, i.e., singular hessian matrix.