

Consumer WTP for Carbon Offsets

Basic Logit Model

Basic Logit Model Coefficients

```
##
## Model estimated on: Thu Sep 19 10:23:44 PM 2024
##
## Call:
## gmn1(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:8s
##
## 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmm1(formula = f, data = dt, model = "mix1", 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:9m:16s
##
## Coefficients:
##              Estimate Std. Error z-value Pr(>|z|)
## I            -1.4857544  0.0473657 -31.3677 < 2.2e-16 ***
## price         -0.0545757  0.0026568 -20.5420 < 2.2e-16 ***
## location_EU     0.0284154  0.0264183   1.0756   0.2821
## location_UK     0.3646805  0.0256519  14.2165 < 2.2e-16 ***
## certificate_NGO  0.1994266  0.0252803   7.8886 3.109e-15 ***
## certificate_UK   0.6780877  0.0294640  23.0141 < 2.2e-16 ***
## project_renewable 0.3256955  0.0301148  10.8151 < 2.2e-16 ***
## project_landfill -0.3924930  0.0319928 -12.2682 < 2.2e-16 ***
## project_manure   -0.1786808  0.0286841  -6.2293 4.686e-10 ***
## sd.location_EU   0.9962610  0.0365881  27.2291 < 2.2e-16 ***
## sd.location_UK   1.0581997  0.0354755  29.8291 < 2.2e-16 ***
## sd.certificate_NGO 0.9540021  0.0373045  25.5734 < 2.2e-16 ***
## sd.certificate_UK 0.9802209  0.0376732  26.0191 < 2.2e-16 ***
## sd.project_renewable 1.0999047  0.0417274  26.3593 < 2.2e-16 ***
## sd.project_landfill 0.8566907  0.0454703  18.8407 < 2.2e-16 ***
## sd.project_manure 1.0135622  0.0398894  25.4093 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -19140
## Number of observations: 12760
```

```
## Number of iterations: 15
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

Mixed Logit Model Willingness to Pay

```
##
## Willingness-to-pay respect to: price
##
##               Estimate Std. Error t-value Pr(>|t|)
## I            -27.22371    2.09822 -12.9747 < 2.2e-16 ***
## location_EU      0.52066    0.48327   1.0774   0.2813
## location_UK      6.68210    0.61056  10.9441 < 2.2e-16 ***
## certificate_NGO   3.65413    0.51049   7.1581 8.180e-13 ***
## certificate_UK   12.42471    0.90650  13.7062 < 2.2e-16 ***
## project_renewable 5.96777    0.61968   9.6304 < 2.2e-16 ***
## project_landfill -7.19171    0.69916 -10.2862 < 2.2e-16 ***
## project_manure   -3.27400    0.51388  -6.3711 1.877e-10 ***
## sd.location_EU   18.25465    1.18157  15.4495 < 2.2e-16 ***
## sd.location_UK   19.38956    1.20583  16.0798 < 2.2e-16 ***
## sd.certificate_NGO 17.48033    1.13580  15.3903 < 2.2e-16 ***
## sd.certificate_UK 17.96074    1.18609  15.1428 < 2.2e-16 ***
## sd.project_renewable 20.15373    1.32680  15.1898 < 2.2e-16 ***
## sd.project_landfill 15.69728    1.18394  13.2585 < 2.2e-16 ***
## sd.project_manure 18.57166    1.22403  15.1726 < 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmn1(formula = f, data = dt, model = "mixl", ranp = randpar,
##       R = 2000, haltons = NA, mvar = mvarlist_1, 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:11m:32s
##
## Coefficients:
##
##               Estimate Std. Error z-value Pr(>|z|)
## I            -1.48342075  0.04742020 -31.2825 < 2.2e-16 ***
## price        -0.05444378  0.00265716 -20.4895 < 2.2e-16 ***
```

```

## location_EU          0.27096125  0.06440584   4.2071 2.587e-05 ***
## location_UK          0.62597031  0.06206529  10.0857 < 2.2e-16 ***
## certificate_NGO      0.40590326  0.06104415   6.6493 2.944e-11 ***
## certificate_UK       0.86540767  0.06655847  13.0022 < 2.2e-16 ***
## project_renewable    0.51720395  0.06988312   7.4010 1.352e-13 ***
## project_landfill     -0.32652869  0.07763382  -4.2060 2.599e-05 ***
## project_manure       -0.13760197  0.06931582  -1.9851  0.047128 *
## location_EU.co2_value -0.05817123  0.01969407  -2.9537  0.003139 **
## location_EU.framing_effectconsequence -0.17380139  0.07793679  -2.2300  0.025745 *
## location_EU.framing_effectMetOffice -0.21679907  0.06686230  -3.2425  0.001185 **
## location_EU.framing_effectUN -0.15509103  0.07689329  -2.0170  0.043699 *
## location_UK.co2_value -0.10914014  0.01843639  -5.9198 3.223e-09 ***
## location_UK.framing_effectconsequence -0.17258197  0.07561872  -2.2823  0.022474 *
## location_UK.framing_effectMetOffice -0.12210422  0.06457887  -1.8908  0.058654 .
## location_UK.framing_effectUN -0.05700486  0.07439191  -0.7663  0.443511
## certificate_NGO.co2_value -0.11562304  0.01893290  -6.1070 1.015e-09 ***
## certificate_NGO.framing_effectconsequence  0.00415171  0.07510762   0.0553  0.955918
## certificate_NGO.framing_effectMetOffice -0.05292553  0.06421762  -0.8242  0.409849
## certificate_NGO.framing_effectUN  0.00038918  0.07418675   0.0052  0.995814
## certificate_UK.co2_value -0.09727752  0.01963019  -4.9555 7.214e-07 ***
## certificate_UK.framing_effectconsequence -0.07977620  0.07821613  -1.0199  0.307754
## certificate_UK.framing_effectMetOffice -0.05209319  0.06696968  -0.7779  0.436650
## certificate_UK.framing_effectUN -0.01142996  0.07829506  -0.1460  0.883933
## project_renewable.co2_value -0.06674746  0.02076018  -3.2152  0.001304 **
## project_renewable.framing_effectconsequence -0.01402175  0.08483109  -0.1653  0.868716
## project_renewable.framing_effectMetOffice -0.21627556  0.07128935  -3.0338  0.002415 **
## project_renewable.framing_effectUN -0.00893805  0.08297689  -0.1077  0.914220
## project_landfill.co2_value -0.00260460  0.02330356  -0.1118  0.911007
## project_landfill.framing_effectconsequence  0.03516618  0.09436451   0.3727  0.709399
## project_landfill.framing_effectMetOffice -0.16360535  0.08097141  -2.0205  0.043328 *
## project_landfill.framing_effectUN -0.00592276  0.09249619  -0.0640  0.948944
## project_manure.co2_value -0.04095976  0.02118996  -1.9330  0.053239 .
## project_manure.framing_effectconsequence  0.04300060  0.08360151   0.5144  0.607006
## project_manure.framing_effectMetOffice  0.01363501  0.07229196   0.1886  0.850398
## project_manure.framing_effectUN  0.07275393  0.08338167   0.8725  0.382913
## sd.location_EU       0.98687155  0.03666827  26.9135 < 2.2e-16 ***
## sd.location_UK       1.04526477  0.03550663  29.4386 < 2.2e-16 ***
## sd.certificate_NGO   0.93948230  0.03720766  25.2497 < 2.2e-16 ***
## sd.certificate_UK    0.97555051  0.03778346  25.8195 < 2.2e-16 ***
## sd.project_renewable 1.08731461  0.04182832  25.9947 < 2.2e-16 ***
## sd.project_landfill  0.85454267  0.04557075  18.7520 < 2.2e-16 ***
## sd.project_manure    1.01391111  0.04004516  25.3192 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -19100
## Number of observations: 12760
## Number of iterations: 16
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws

```

mixed logit + co2 consumption + framing effect Willingness to Pay

```
##
## Willigness-to-pay respect to: price
##
##
```

	Estimate	Std. Error	t-value	Pr(> t)	
## I	-27.2468375	2.1055407	-12.9405	< 2.2e-16	***
## location_EU	4.9769002	1.2021757	4.1399	3.474e-05	***
## location_UK	11.4975547	1.3032321	8.8223	< 2.2e-16	***
## certificate_NGO	7.4554574	1.1944882	6.2415	4.333e-10	***
## certificate_UK	15.8954377	1.5257533	10.4181	< 2.2e-16	***
## project_renewable	9.4997808	1.3622350	6.9737	3.088e-12	***
## project_landfill	-5.9975393	1.4651182	-4.0936	4.248e-05	***
## project_manure	-2.5274141	1.2691064	-1.9915	0.046427	*
## location_EU.co2_value	-1.0684642	0.3650763	-2.9267	0.003426	**
## location_EU.framing_effectconsequence	-3.1923095	1.4407479	-2.2157	0.026710	*
## location_EU.framing_effectMetOffice	-3.9820725	1.2456188	-3.1969	0.001389	**
## location_EU.framing_effectUN	-2.8486457	1.4183072	-2.0085	0.044592	*
## location_UK.co2_value	-2.0046393	0.3538303	-5.6655	1.466e-08	***
## location_UK.framing_effectconsequence	-3.1699118	1.3959835	-2.2707	0.023163	*
## location_UK.framing_effectMetOffice	-2.2427580	1.1913958	-1.8825	0.059773	.
## location_UK.framing_effectUN	-1.0470410	1.3669483	-0.7660	0.443694	
## certificate_NGO.co2_value	-2.1237145	0.3652698	-5.8141	6.096e-09	***
## certificate_NGO.framing_effectconsequence	0.0762568	1.3795647	0.0553	0.955919	
## certificate_NGO.framing_effectMetOffice	-0.9721135	1.1806135	-0.8234	0.410282	
## certificate_NGO.framing_effectUN	0.0071483	1.3626348	0.0052	0.995814	
## certificate_UK.co2_value	-1.7867519	0.3732646	-4.7868	1.694e-06	***
## certificate_UK.framing_effectconsequence	-1.4652952	1.4384814	-1.0186	0.308374	
## certificate_UK.framing_effectMetOffice	-0.9568253	1.2308983	-0.7773	0.436959	
## certificate_UK.framing_effectUN	-0.2099407	1.4380709	-0.1460	0.883931	
## project_renewable.co2_value	-1.2259887	0.3863975	-3.1729	0.001509	**
## project_renewable.framing_effectconsequence	-0.2575454	1.5581309	-0.1653	0.868715	
## project_renewable.framing_effectMetOffice	-3.9724569	1.3239246	-3.0005	0.002695	**
## project_renewable.framing_effectUN	-0.1641703	1.5240839	-0.1077	0.914220	
## project_landfill.co2_value	-0.0478402	0.4280280	-0.1118	0.911007	
## project_landfill.framing_effectconsequence	0.6459173	1.7340536	0.3725	0.709528	
## project_landfill.framing_effectMetOffice	-3.0050331	1.4932958	-2.0123	0.044183	*
## project_landfill.framing_effectUN	-0.1087867	1.6989163	-0.0640	0.948944	
## project_manure.co2_value	-0.7523313	0.3908042	-1.9251	0.054219	.
## project_manure.framing_effectconsequence	0.7898166	1.5368335	0.5139	0.607305	
## project_manure.framing_effectMetOffice	0.2504421	1.3279712	0.1886	0.850414	
## project_manure.framing_effectUN	1.3363131	1.5334790	0.8714	0.383522	
## sd.location_EU	18.1264342	1.1790382	15.3739	< 2.2e-16	***
## sd.location_UK	19.1989760	1.2019257	15.9735	< 2.2e-16	***
## sd.certificate_NGO	17.2560089	1.1276482	15.3027	< 2.2e-16	***
## sd.certificate_UK	17.9184944	1.1883939	15.0779	< 2.2e-16	***
## sd.project_renewable	19.9713295	1.3250501	15.0721	< 2.2e-16	***
## sd.project_landfill	15.6958741	1.1885285	13.2061	< 2.2e-16	***
## sd.project_manure	18.6230853	1.2307462	15.1315	< 2.2e-16	***
## ---					
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					

mixed logit + co2 consumption + framing effect + PCA

We included the first two components 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmm1(formula = f, data = dt, model = "mixl", ranp = randpar,
##       R = 2000, haltons = NA, mvar = mvarlist_2, 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:12m:41s
##
## Coefficients:
##
##              Estimate Std. Error z-value Pr(>|z|)
## I             -1.47026893  0.04710388 -31.2133 < 2.2e-16 ***
## price          -0.05330761  0.00262404 -20.3151 < 2.2e-16 ***
## location_EU      0.18282667  0.06308018   2.8983 0.0037517 **
## location_UK      0.51058058  0.06046379   8.4444 < 2.2e-16 ***
## certificate_NGO   0.34060404  0.05977900   5.6977 1.214e-08 ***
## certificate_UK    0.78764548  0.06486768  12.1423 < 2.2e-16 ***
## project_renewable 0.44341837  0.06801322   6.5196 7.050e-11 ***
## project_landfill -0.31562954  0.07654430  -4.1235 3.732e-05 ***
## project_manure    -0.15798678  0.06842806  -2.3088 0.0209546 *
## location_EU.co2_value -0.02796770  0.01963489  -1.4244 0.1543342
## location_EU.framing_effectconsequence -0.15510579  0.07683989  -2.0186 0.0435332 *
## location_EU.framing_effectMetOffice -0.18505632  0.06553088  -2.8240 0.0047435 **
## location_EU.framing_effectUN -0.15126992  0.07558761  -2.0013 0.0453651 *
## location_EU.Q9_PC1  0.14335968  0.01161698  12.3405 < 2.2e-16 ***
## location_EU.Q9_PC2  0.01077460  0.01330820   0.8096 0.4181578
## location_EU.Q10_PC1 0.01744954  0.00803994   2.1704 0.0299798 *
## location_EU.Q10_PC2 -0.02402029  0.02754465  -0.8720 0.3831814
## location_UK.co2_value -0.06851555  0.01833944  -3.7360 0.0001870 ***
## location_UK.framing_effectconsequence -0.18084067  0.07393196  -2.4460 0.0144434 *
## location_UK.framing_effectMetOffice -0.06763793  0.06300574  -1.0735 0.2830378
## location_UK.framing_effectUN -0.07001446  0.07294355  -0.9598 0.3371335
## location_UK.Q9_PC1  0.12095150  0.00994165  12.1661 < 2.2e-16 ***
## location_UK.Q9_PC2  0.03224580  0.01248039   2.5837 0.0097742 **
## location_UK.Q10_PC1 0.06476559  0.00791481   8.1828 2.220e-16 ***
## location_UK.Q10_PC2 -0.02782876  0.02700235  -1.0306 0.3027261
## certificate_NGO.co2_value -0.08220766  0.01879864  -4.3731 1.225e-05 ***
## certificate_NGO.framing_effectconsequence -0.03539828  0.07363322  -0.4807 0.6307027
## certificate_NGO.framing_effectMetOffice -0.05219881  0.06263252  -0.8334 0.4046113
## certificate_NGO.framing_effectUN -0.05901687  0.07274143  -0.8113 0.4171796
```

```

## certificate_NGO.Q9_PC1          0.16602530  0.00990059  16.7692 < 2.2e-16 ***
## certificate_NGO.Q9_PC2          0.04915647  0.01266824   3.8803 0.0001043 ***
## certificate_NGO.Q10_PC1         0.00699579  0.00795140   0.8798 0.3789580
## certificate_NGO.Q10_PC2        -0.08155623  0.02770034  -2.9442 0.0032376 **
## certificate_UK.co2_value        -0.06361963  0.01969105  -3.2309 0.0012341 **
## certificate_UK.framing_effectconsequence -0.10930028  0.07689856  -1.4214 0.1552131
## certificate_UK.framing_effectMetOffice -0.02719546  0.06552118  -0.4151 0.6780953
## certificate_UK.framing_effectUN  -0.06767551  0.07674313  -0.8818 0.3778609
## certificate_UK.Q9_PC1           0.16535170  0.01169977  14.1329 < 2.2e-16 ***
## certificate_UK.Q9_PC2           0.04873628  0.01352402   3.6037 0.0003137 ***
## certificate_UK.Q10_PC1          0.01174857  0.00816681   1.4386 0.1502711
## certificate_UK.Q10_PC2        -0.04333585  0.02809553  -1.5424 0.1229652
## project_renewable.co2_value     -0.03588449  0.02072241  -1.7317 0.0833314 .
## project_renewable.framing_effectconsequence -0.02527322  0.08299680  -0.3045 0.7607406
## project_renewable.framing_effectMetOffice -0.19577489  0.06960092  -2.8128 0.0049109 **
## project_renewable.framing_effectUN  -0.06470120  0.08115502  -0.7973 0.4253033
## project_renewable.Q9_PC1        0.15475482  0.01124535  13.7617 < 2.2e-16 ***
## project_renewable.Q9_PC2        0.04210708  0.01403949   2.9992 0.0027070 **
## project_renewable.Q10_PC1       0.00225653  0.00868780   0.2597 0.7950679
## project_renewable.Q10_PC2       -0.11151279  0.03076743  -3.6244 0.0002897 ***
## project_landfill.co2_value       0.00838006  0.02356438   0.3556 0.7221223
## project_landfill.framing_effectconsequence -0.01331815  0.09311875  -0.1430 0.8862718
## project_landfill.framing_effectMetOffice -0.17762941  0.07957091  -2.2323 0.0255924 *
## project_landfill.framing_effectUN  -0.07160144  0.09113310  -0.7857 0.4320551
## project_landfill.Q9_PC1         0.12716720  0.01371040   9.2752 < 2.2e-16 ***
## project_landfill.Q9_PC2         0.02149214  0.01614772   1.3310 0.1831986
## project_landfill.Q10_PC1       -0.03255943  0.01000728  -3.2536 0.0011396 **
## project_landfill.Q10_PC2        0.02634585  0.03395836   0.7758 0.4378506
## project_manure.co2_value        -0.01701421  0.02113548  -0.8050 0.4208156
## project_manure.framing_effectconsequence 0.00237170  0.08295967   0.0286 0.9771927
## project_manure.framing_effectMetOffice 0.00076716  0.07124809   0.0108 0.9914090
## project_manure.framing_effectUN    0.01433529  0.08237748   0.1740 0.8618501
## project_manure.Q9_PC1           0.12142771  0.01125334  10.7904 < 2.2e-16 ***
## project_manure.Q9_PC2           0.04088936  0.01474357   2.7734 0.0055479 **
## project_manure.Q10_PC1         -0.02272610  0.00893241  -2.5442 0.0109519 *
## project_manure.Q10_PC2          0.00906077  0.03033887   0.2987 0.7652053
## sd.location_EU                  0.89410009  0.03535782  25.2872 < 2.2e-16 ***
## sd.location_UK                  0.95459877  0.03469485  27.5141 < 2.2e-16 ***
## sd.certificate_NGO              0.82379472  0.03681294  22.3779 < 2.2e-16 ***
## sd.certificate_UK              0.83651019  0.03678613  22.7398 < 2.2e-16 ***
## sd.project_renewable            0.98556679  0.04106756  23.9987 < 2.2e-16 ***
## sd.project_landfill            0.78778034  0.04456832  17.6758 < 2.2e-16 ***
## sd.project_manure              0.96377361  0.03904801  24.6818 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -18662
## Number of observations: 12760
## Number of iterations: 17
## 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

##					
##	Willingness-to-pay respect to: price				
##					
##		Estimate	Std. Error	t-value	Pr(> t)
## I		-27.580846	2.142034	-12.8760	< 2.2e-16 ***
## location_EU		3.429654	1.191303	2.8789	0.0039905 **
## location_UK		9.578006	1.256983	7.6198	2.531e-14 ***
## certificate_NGO		6.389408	1.177629	5.4257	5.774e-08 ***
## certificate_UK		14.775480	1.491935	9.9036	< 2.2e-16 ***
## project_renewable		8.318107	1.333530	6.2377	4.442e-10 ***
## project_landfill		-5.920910	1.474451	-4.0157	5.928e-05 ***
## project_manure		-2.963682	1.280566	-2.3144	0.0206484 *
## location_EU.co2_value		-0.524647	0.368991	-1.4218	0.1550718
## location_EU.framing_effectconsequence		-2.909637	1.449666	-2.0071	0.0447381 *
## location_EU.framing_effectMetOffice		-3.471480	1.243126	-2.7925	0.0052296 **
## location_EU.framing_effectUN		-2.837680	1.424070	-1.9927	0.0462992 *
## location_EU.Q9_PC1		2.689291	0.259727	10.3543	< 2.2e-16 ***
## location_EU.Q9_PC2		0.202121	0.249952	0.8086	0.4187216
## location_EU.Q10_PC1		0.327337	0.151852	2.1556	0.0311129 *
## location_EU.Q10_PC2		-0.450598	0.517448	-0.8708	0.3838588
## location_UK.co2_value		-1.285287	0.350177	-3.6704	0.0002422 ***
## location_UK.framing_effectconsequence		-3.392399	1.395431	-2.4311	0.0150541 *
## location_UK.framing_effectMetOffice		-1.268823	1.183628	-1.0720	0.2837298
## location_UK.framing_effectUN		-1.313405	1.369500	-0.9590	0.3375387
## location_UK.Q9_PC1		2.268935	0.216359	10.4869	< 2.2e-16 ***
## location_UK.Q9_PC2		0.604901	0.236527	2.5574	0.0105450 *
## location_UK.Q10_PC1		1.214941	0.163335	7.4383	1.019e-13 ***
## location_UK.Q10_PC2		-0.522041	0.506500	-1.0307	0.3026898
## certificate_NGO.co2_value		-1.542137	0.362346	-4.2560	2.081e-05 ***
## certificate_NGO.framing_effectconsequence		-0.664038	1.381535	-0.4807	0.6307635
## certificate_NGO.framing_effectMetOffice		-0.979200	1.175899	-0.8327	0.4050001
## certificate_NGO.framing_effectUN		-1.107100	1.364993	-0.8111	0.4173272
## certificate_NGO.Q9_PC1		3.114477	0.243297	12.8011	< 2.2e-16 ***
## certificate_NGO.Q9_PC2		0.922129	0.242066	3.8094	0.0001393 ***
## certificate_NGO.Q10_PC1		0.131234	0.149380	0.8785	0.3796596
## certificate_NGO.Q10_PC2		-1.529917	0.524424	-2.9173	0.0035304 **
## certificate_UK.co2_value		-1.193444	0.375289	-3.1801	0.0014724 **
## certificate_UK.framing_effectconsequence		-2.050369	1.446408	-1.4176	0.1563194
## certificate_UK.framing_effectMetOffice		-0.510161	1.229338	-0.4150	0.6781506
## certificate_UK.framing_effectUN		-1.269528	1.440945	-0.8810	0.3782971
## certificate_UK.Q9_PC1		3.101841	0.274732	11.2904	< 2.2e-16 ***
## certificate_UK.Q9_PC2		0.914246	0.256644	3.5623	0.0003676 ***
## certificate_UK.Q10_PC1		0.220392	0.154042	1.4307	0.1525098
## certificate_UK.Q10_PC2		-0.812939	0.528331	-1.5387	0.1238794
## project_renewable.co2_value		-0.673159	0.390360	-1.7245	0.0846255 .
## project_renewable.framing_effectconsequence		-0.474102	1.556996	-0.3045	0.7607487
## project_renewable.framing_effectMetOffice		-3.672551	1.317715	-2.7871	0.0053189 **
## project_renewable.framing_effectUN		-1.213733	1.523133	-0.7969	0.4255287
## project_renewable.Q9_PC1		2.903053	0.260439	11.1468	< 2.2e-16 ***
## project_renewable.Q9_PC2		0.789889	0.265152	2.9790	0.0028919 **
## project_renewable.Q10_PC1		0.042330	0.163033	0.2596	0.7951399
## project_renewable.Q10_PC2		-2.091874	0.588773	-3.5529	0.0003810 ***


```

## project_landfill.co2_value          0.157202    0.442095    0.3556 0.7221524
## project_landfill.framing_effectconsequence -0.249836    1.746707   -0.1430 0.8862645
## project_landfill.framing_effectMetOffice -3.332159    1.501104   -2.2198 0.0264320 *
## project_landfill.framing_effectUN      -1.343175    1.710854   -0.7851 0.4324005
## project_landfill.Q9_PC1                2.385536    0.285899    8.3440 < 2.2e-16 ***
## project_landfill.Q9_PC2                0.403172    0.303358    1.3290 0.1838382
## project_landfill.Q10_PC1              -0.610784    0.190778   -3.2016 0.0013669 **
## project_landfill.Q10_PC2               0.494223    0.637304    0.7755 0.4380503
## project_manure.co2_value              -0.319170    0.396783   -0.8044 0.4211682
## project_manure.framing_effectconsequence 0.044491    1.556292    0.0286 0.9771934
## project_manure.framing_effectMetOffice 0.014391    1.336552    0.0108 0.9914090
## project_manure.framing_effectUN        0.268916    1.545507    0.1740 0.8618663
## project_manure.Q9_PC1                 2.277868    0.239144    9.5251 < 2.2e-16 ***
## project_manure.Q9_PC2                 0.767045    0.279928    2.7401 0.0061411 **
## project_manure.Q10_PC1                -0.426320    0.169509   -2.5150 0.0119021 *
## project_manure.Q10_PC2                0.169972    0.569061    0.2987 0.7651783
## sd.location_EU                       16.772467    1.126092   14.8944 < 2.2e-16 ***
## sd.location_UK                       17.907365    1.155327   15.4998 < 2.2e-16 ***
## sd.certificate_NGO                   15.453605    1.071233   14.4260 < 2.2e-16 ***
## sd.certificate_UK                   15.692135    1.106511   14.1816 < 2.2e-16 ***
## sd.project_renewable                 18.488295    1.277899   14.4677 < 2.2e-16 ***
## sd.project_landfill                 14.778010    1.160884   12.7300 < 2.2e-16 ***
## sd.project_manure                   18.079476    1.215182   14.8780 < 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 seems to mitigate the preference for location.

Latent Class Models, Marginal Utility Without Interaction Terms

This specification allows marginal utility parameters 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmn1(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:6s
##
## 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 **
## 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)    -0.149983959  0.31567659 -0.47511904 0.6347021
## co2_value      -0.062426525  0.05376809 -1.16103288 0.2456285
## framing_effectconsequence  0.084897472  0.17910269  0.47401562 0.6354888
## framing_effectMetOffice    0.029019525  0.15531606  0.18684175 0.8517847
## framing_effectUN           0.211272942  0.17884787  1.18129975 0.2374837
## Q9_PC1          -0.004564753  0.02456431 -0.18582863 0.8525792
## Q9_PC2           0.023945740  0.03251407  0.73647310 0.4614428
## Q10_PC1          0.028215217  0.02405627  1.17288399 0.2408423
## Q10_PC2         -0.010359090  0.07100578 -0.14589080 0.8840076
## age_group35_54   -0.066550842  0.14920830 -0.44602640 0.6555782
## age_group55_     0.111347702  0.17249486  0.64551315 0.5185947
```

```
## is_women -0.110452853 0.12078982 -0.91442188 0.3604952
## diet_typeFlexitarian -0.183729298 0.16724314 -1.09857599 0.2719531
## diet_typeVegan_Vegetarian -0.096426840 0.22442044 -0.42967048 0.6674354
## education_levelDegree -0.029093947 0.13310473 -0.21857937 0.8269777
## education_levelPostgraduate -0.011785081 0.17108551 -0.06888416 0.9450818
## hh_size 0.052519069 0.06372989 0.82408846 0.4098893
## income_level30_50k 0.031553116 0.13564570 0.23261421 0.8160610
## income_level50_ 0.121105992 0.15493393 0.78166216 0.4344131
## n_children -0.032906571 0.09032623 -0.36430803 0.7156280
## is_shopper -0.008792004 0.14447281 -0.06085577 0.9514741
## where_liveRuralarea -0.165097285 0.19340100 -0.85365268 0.3932975
## where_liveTownorsuburb -0.025255604 0.14988913 -0.16849523 0.8661937
```

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

The marginal utility coefficients are:

```
##
## Model estimated on: Thu Sep 19 10:23:44 PM 2024
##
## Call:
## gmm1(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)   -1.200192938  0.57146938 -2.10018764 0.035712338
## co2_value      -0.089546545  0.09870194 -0.90724197 0.364278853
## framing_effectconsequence -0.174497590  0.33223056 -0.52523039 0.599423038
## framing_effectMetOffice    0.118729938  0.27258967  0.43556287 0.663153914
## framing_effectUN           0.136305864  0.32163340  0.42379262 0.671717058
## Q9_PC1          -0.098124991  0.03779067 -2.59654037 0.009416784
## Q9_PC2          -0.015006169  0.06106078 -0.24575789 0.805869654
## Q10_PC1         0.046928028  0.04439955  1.05694825 0.290535207
## Q10_PC2        -0.059367866  0.13124772 -0.45233445 0.651028063
## age_group35_54  -0.211556654  0.27050249 -0.78208765 0.434163065
## age_group55_    -0.155906887  0.30457468 -0.51188394 0.608732238
## is_women        -0.181161495  0.21687437 -0.83532920 0.403532378
## diet_typeFlexitarian -0.112570392  0.29519274 -0.38134539 0.702946979
## diet_typeVegan_Vegetarian -0.695311606  0.47459484 -1.46506356 0.142903577
## education_levelDegree    0.144657256  0.23677899  0.61093789 0.541240698
## education_levelPostgraduate 0.124062526  0.31028794  0.39983032 0.689281494
## hh_size        -0.065718438  0.11891431 -0.55265376 0.580500519
## income_level30_50k -0.277385197  0.24723136 -1.12196606 0.261876872
## income_level50_    -0.059710521  0.27842045 -0.21446169 0.830187038
## n_children     -0.001985845  0.17051358 -0.01164626 0.990707839
## is_shopper     -0.190155187  0.25497474 -0.74578050 0.455800022
## where_liveRuralarea    0.162394440  0.36503317  0.44487584 0.656409480
## where_liveTownorsuburb  0.407572898  0.28731975  1.41853423 0.156034853
##
## $Class_3

```

	coef	se	z	p_val
## (Intercept)	-0.03364188	0.33155043	-0.10146838	0.91917866
## co2_value	-0.08885280	0.05636304	-1.57643724	0.11492507
## framing_effectconsequence	0.05918829	0.18762297	0.31546398	0.75240939
## framing_effectMetOffice	0.07805707	0.16339423	0.47772230	0.63284787
## framing_effectUN	0.28117046	0.18809870	1.49480277	0.13496592
## Q9_PC1	-0.02518443	0.02709806	-0.92938128	0.35269153
## Q9_PC2	0.01695829	0.03420063	0.49584725	0.62000219
## Q10_PC1	0.03002545	0.02515003	1.19385338	0.23253533
## Q10_PC2	-0.02046908	0.07429723	-0.27550256	0.78293016
## age_group35_54	-0.10412838	0.15642164	-0.66569041	0.50560901
## age_group55_	0.14692233	0.18181488	0.80808752	0.41904020
## is_women	-0.13264861	0.12694275	-1.04494828	0.29604687
## diet_typeFlexitarian	-0.29870212	0.17600798	-1.69709423	0.08967885
## diet_typeVegan_Vegetarian	-0.29710989	0.23311372	-1.27452768	0.20247647
## education_levelDegree	0.05773852	0.14002979	0.41233029	0.68009735
## education_levelPostgraduate	0.03462402	0.17962690	0.19275523	0.84715067
## hh_size	0.03967065	0.06671657	0.59461468	0.55210106
## income_level30_50k	0.01121950	0.14235074	0.07881589	0.93717907
## income_level50_	0.13510254	0.16299918	0.82885414	0.40718695
## n_children	-0.02464829	0.09437299	-0.26117950	0.79395409
## is_shopper	-0.05943277	0.15242382	-0.38991783	0.69659731
## where_liveRuralarea	-0.10522863	0.20199565	-0.52094505	0.60240505
## where_liveTownorsuburb	0.06348247	0.15645723	0.40574965	0.68492655

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

Latent Class Models, Marginal Utility 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmn1(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##       method = "bh11", 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:27s
```

```

##
## 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 Sep 19 10:23:44 PM 2024
##
## Call:
## gmn1(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:33s
##
## 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 Sep 19 10:23:45 PM 2024
##
## Call:
## gmm1(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:21s
##
## 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_level130_50k 0.25311800 0.2911211 0.86945950 0.38459585
## income_level150_ -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_level130_50k 0.48765094 0.2578450 1.89125596 0.05859018
## income_level150_ 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_level130_50k 0.40740149 0.2512431 1.6215433 0.10490118
## income_level150_ 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 estimate a model with more than 4 classes due to lack of variation, i.e., singular hessian matrix.