Tidier Multinomial Logit

Sarah Klain

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```r
setwd("/Users/sarahklain/Documents/R_2015/wf_ce/CE/demog")

#install.packages("support.CEs")
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.2.4
```

```r
library(ggthemes)
```

```
## Warning: replacing previous import by 'grid::arrow' when loading 'ggthemes'
```

```
## Warning: replacing previous import by 'grid::unit' when loading 'ggthemes'
```

```
## Warning: replacing previous import by 'scales::alpha' when loading
## 'ggthemes'
```

```r
library(viridis)
suppressMessages(library(dplyr))
library(knitr)
library(tidyr)
library(broom)
#library(support.CEs)
library(survival)
library(mlogit)
```

```
## Loading required package: Formula
## Loading required package: maxLik
## Loading required package: miscTools
##
## Please cite the 'maxLik' package as:
## Henningsen, Arne and Toomet, Ott (2011). maxLik: A package for maximum likelihood estimation in R. C
##
## If you have questions, suggestions, or comments regarding the 'maxLik' package, please use a forum o
## https://r-forge.r-project.org/projects/maxlik/
```

```r
library(stargazer)
```

```
##
## Please cite as:
##
##  Hlavac, Marek (2015). stargazer: Well-Formatted Regression and Summary Statistics Tables.
##  R package version 5.2. http://CRAN.R-project.org/package=stargazer
```

Conditional Logit

Format data with demographic information using Tidyr. To make a unique row for each observation including demographic data I added column obs1-obs24 in excel.

These are columns 69-92 in cer_2016_01_08_dem2.csv

```r
ce_d <- read.csv("cer_2016_01_08_dem2.csv")
ce_d_s <- summary(ce_d[11:20])
# str(ce_d)
# knitr:: kable(ce_d_s, align = 'c', format = 'markdown', digits = 4)


#str(ce_d)
#head(ce_d)
dem_long <- tidyr::gather(ce_d, "obs", "obs1_24", 69:92)
#str(dem_long)
#summary(dem_long$ID)
#View(dem_long)
# 9624 observations

#I deleted NAs in excel

# write.csv(dem_long, "dem_long.csv")
```

I copied and pasted the demographic data from dem_long.csv into dswf_ml_dem2.csv

Make table of variable means

```r
wfml_d <- read.csv("dswf_ml_dem2.csv")
w_tbl <- tbl_df(wfml_d)

# tbl2 <- dplyr::select(w_tbl, ASC: coast_rec)
# View(tbl2)

# tbl3 <- dplyr::summarise_each(tbl2, funs(mean))

# knitr:: kable(tbl3, align = 'c', format = 'markdown', digits = 4)
```

Multinomial logit model

```r
wfml_d <- read.csv("dswf_ml_dem2.csv")

wfml_d2 <- mlogit.data(wfml_d, shape = "long", choice = "choice",
                    varying = 16:28, sep = "",
                    alt.levels = c(1, 2, 3),
                    alt.var = "ALT", id = "id")
```

```
## Warning in mlogit.data(wfml_d, shape = "long", choice = "choice", varying =
## 16:28, : variable ALT exists and will be replaced
```

2

```
# head(wfml_d2, 3)

ml.bl.st.mi1 <- mlogit(choice ~ small.loss + small.gain + big.gain +
                    municipal + private + cooperative +  mi4 + mi8 +
                    mi10 + bill  | -1, wfml_d2)

summary(ml.bl.st.mi1)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + private + cooperative + mi4 + mi8 + mi10 + bill |
##     -1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 1.49E-07
## gradient close to zero
##
## Coefficients :
##              Estimate Std. Error  t-value  Pr(>|t|)
## small.loss   1.328649   0.074989  17.7180 < 2.2e-16 ***
## small.gain   2.868386   0.092282  31.0829 < 2.2e-16 ***
## big.gain     3.739393   0.107598  34.7534 < 2.2e-16 ***
## municipal   -0.155583   0.076756  -2.0270  0.042665 *
## private     -0.486025   0.079067  -6.1470 7.895e-10 ***
## cooperative -0.315341   0.100031  -3.1524  0.001619 **
## mi4          0.214478   0.077932   2.7521  0.005921 **
## mi8          0.343995   0.075872   4.5339 5.791e-06 ***
## mi10         0.839584   0.109167   7.6908 1.465e-14 ***
## bill        -0.072229   0.005429 -13.3045 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2016.5
```

```
-1 * coef(ml.bl.st.mi1)[1:10]/coef(ml.bl.st.mi1)[10]
```

```
##  small.loss  small.gain    big.gain   municipal     private cooperative
##   18.394861   39.712196   51.771101   -2.154016   -6.728911   -4.365826
##         mi4         mi8        mi10        bill
##    2.969403    4.762542   11.623856   -1.000000
```

```
AIC(ml.bl.st.mi1)
```

```
## [1] 4052.907
```

```
#these outputs are the same as when I used support.CEs package
#from Croissant: coef(ml.Train)[-1]/coef(ml.Train)[1]
#divide by bill coefficient to obtain WTP associated with each attribute and level

#calc confidence intervals for WTP
#return calc CI later
```

Base: -30 biodiv, muni, mi1

```
ml.bl.pr.m1 <- mlogit(choice ~ small.loss + small.gain + big.gain +
                    municipal + state + cooperative +  mi4 + mi8 +
                    mi10 + bill  | -1, wfml_d2)

summary(ml.bl.pr.m1)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill |
##     -1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 9.04E-08
## gradient close to zero
##
## Coefficients :
##               Estimate Std. Error  t-value  Pr(>|t|)
## small.loss   1.2014503  0.0766236  15.6799 < 2.2e-16 ***
## small.gain   2.7021713  0.0902094  29.9544 < 2.2e-16 ***
## big.gain     3.5484831  0.1046925  33.8943 < 2.2e-16 ***
## municipal    0.1540434  0.0763415   2.0178 0.0436100 *
## state        0.2523805  0.0740748   3.4071 0.0006566 ***
## cooperative  0.0523997  0.0912655   0.5741 0.5658695
## mi4          0.0760983  0.0757092   1.0051 0.3148296
## mi8          0.2122526  0.0747441   2.8397 0.0045153 **
## mi10         0.6956839  0.1047829   6.6393 3.152e-11 ***
## bill        -0.0744172  0.0053812 -13.8291 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2030.5
```

```
-1 * coef(ml.bl.pr.m1)[1:10]/coef(ml.bl.pr.m1)[10]
```

```
##  small.loss  small.gain    big.gain   municipal       state cooperative
##  16.1447832  36.3110913  47.6836134   2.0699966   3.3914252   0.7041333
##         mi4         mi8        mi10        bill
##   1.0225893   2.8521962   9.3484239  -1.0000000
```

4

```r
AIC(ml.bl.pr.m1)
```

```
## [1] 4080.915
```

```r
ml.sl.pr.m1 <- mlogit(choice ~ big.loss + small.gain + big.gain +
                      state + municipal + cooperative +  mi4 + mi8 +
                      mi10 + bill  | -1, wfml_d2)

summary(ml.sl.pr.m1)
```

```
##
## Call:
## mlogit(formula = choice ~ big.loss + small.gain + big.gain +
##     state + municipal + cooperative + mi4 + mi8 + mi10 + bill |
##     -1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 6.63E-07
## gradient close to zero
##
## Coefficients :
##               Estimate Std. Error  t-value  Pr(>|t|)
## big.loss    -1.4205759  0.0974666 -14.5750 < 2.2e-16 ***
## small.gain   1.6996754  0.0749003  22.6925 < 2.2e-16 ***
## big.gain     2.6511850  0.0968176  27.3833 < 2.2e-16 ***
## state        0.6598198  0.0739705   8.9200 < 2.2e-16 ***
## municipal    0.5783788  0.0766636   7.5444 4.552e-14 ***
## cooperative  0.2989053  0.0995161   3.0036  0.002668 **
## mi4          0.6164658  0.0780994   7.8933 2.887e-15 ***
## mi8          0.7196326  0.0783226   9.1881 < 2.2e-16 ***
## mi10         1.2429830  0.1142411  10.8803 < 2.2e-16 ***
## bill        -0.0612718  0.0053831 -11.3823 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2028.9
```

```r
-1 * coef(ml.sl.pr.m1)[1:10]/coef(ml.sl.pr.m1)[10]
```

```
##    big.loss  small.gain    big.gain       state   municipal cooperative
##  -23.184816   27.739920   43.269237   10.768731    9.439557    4.878348
##         mi4         mi8        mi10        bill
##   10.061164   11.744920   20.286372   -1.000000
```

```r
AIC(ml.sl.pr.m1)
```

```
## [1] 4077.759
```

Multinomial logit, baseline: small gain, state, 1 mi

```
ml.sg.st.mi1 <- mlogit(choice ~ big.loss + small.loss + big.gain +
                    municipal + private + cooperative +  mi4 + mi8 +
                    mi10 + bill  | -1, wfml_d2)

summary(ml.sg.st.mi1)
```

```
##
## Call:
## mlogit(formula = choice ~ big.loss + small.loss + big.gain +
##     municipal + private + cooperative + mi4 + mi8 + mi10 + bill |
##     -1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 9.99E-07
## gradient close to zero
##
## Coefficients :
##              Estimate Std. Error  t-value  Pr(>|t|)
## big.loss    -2.5267194  0.1039796 -24.3001 < 2.2e-16 ***
## small.loss  -0.8587206  0.0689706 -12.4505 < 2.2e-16 ***
## big.gain     1.5384066  0.0821242  18.7327 < 2.2e-16 ***
## municipal    0.7772021  0.0787954   9.8636 < 2.2e-16 ***
## private      0.2197892  0.0726180   3.0266 0.0024728 **
## cooperative  0.3346420  0.0986862   3.3910 0.0006965 ***
## mi4          1.2343673  0.0827442  14.9179 < 2.2e-16 ***
## mi8          1.3016825  0.0805583  16.1583 < 2.2e-16 ***
## mi10         1.8581450  0.1066412  17.4243 < 2.2e-16 ***
## bill        -0.0169580  0.0048393  -3.5042 0.0004580 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2317.8
```

```
AIC(ml.sg.st.mi1)
```

```
## [1] 4655.653
```

```
-1 * coef(ml.sg.st.mi1)[1:10]/coef(ml.sg.st.mi1)[10]
```

```
##    big.loss  small.loss    big.gain   municipal     private cooperative
##  -148.99879   -50.63812    90.71871    45.83104    12.96081    19.73360
##         mi4         mi8        mi10        bill
##    72.78973    76.75926   109.57345    -1.00000
```

Explore with demographic variables

```
ml.bl.st.mi1.dem <- mlogit(choice ~ small.loss + small.gain +
                            big.gain +
                            municipal + private +
                            cooperative +
                            mi4 + mi8 + mi10 + bill +
                            age:ASC + female:ASC +
                            white:ASC + univ_degr:ASC +
                            income:ASC + wages:ASC +
                            self.emp:ASC + pol_dem:ASC +
                            pol_ind:ASC + pol_rep:ASC +
                            coast_rec:ASC
                          | 1, wfml_d2)

summary(ml.bl.st.mi1.dem)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + private + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + income:ASC +
##     wages:ASC + self.emp:ASC + pol_dem:ASC + pol_ind:ASC + pol_rep:ASC +
##     coast_rec:ASC | 1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 4.52E-07
## gradient close to zero
##
## Coefficients :
##                 Estimate Std. Error  t-value  Pr(>|t|)
## 2:(intercept) -0.0459744  0.0628305  -0.7317  0.464339
## 3:(intercept)  0.1589707  0.3719058   0.4274  0.669052
## small.loss     1.4956821  0.0961231  15.5601 < 2.2e-16 ***
## small.gain     3.0555266  0.1138552  26.8370 < 2.2e-16 ***
## big.gain       3.9148382  0.1255505  31.1814 < 2.2e-16 ***
## municipal     -0.0453323  0.0902503  -0.5023  0.615459
## private       -0.4145051  0.0850782  -4.8720 1.104e-06 ***
## cooperative   -0.2512120  0.1045780  -2.4022  0.016299 *
## mi4            0.3357082  0.0905389   3.7079  0.000209 ***
## mi8            0.4663470  0.0881779   5.2887 1.232e-07 ***
## mi10           0.9705291  0.1198765   8.0961 6.661e-16 ***
## bill          -0.0706400  0.0056360 -12.5338 < 2.2e-16 ***
## age:ASC       -0.0011757  0.0055857  -0.2105  0.833289
## ASC:female     0.1443150  0.1243814   1.1603  0.245942
## ASC:white      0.3327572  0.1501271   2.2165  0.026657 *
## ASC:univ_degr -0.1753969  0.1340234  -1.3087  0.190635
## ASC:income    -0.0233500  0.0242073  -0.9646  0.334752
## ASC:wages     -0.0912478  0.1349245  -0.6763  0.498858
```

```
## ASC:self.emp    0.1180486   0.2298464    0.5136   0.607533
## ASC:pol_dem    -0.2958184   0.2347159   -1.2603   0.207552
## ASC:pol_ind    -0.2056018   0.2364543   -0.8695   0.384563
## ASC:pol_rep    -0.2555626   0.2947730   -0.8670   0.385952
## ASC:coast_rec  -0.0350914   0.1267363   -0.2769   0.781868
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2006
## McFadden R^2:  0.34188
## Likelihood ratio test : chisq = 2084.1 (p.value = < 2.22e-16)
```

```
#stargazer(ml.wfml.dem2, type = "text")
# knitr:: kable(ml.wfml.dem2, align = 'c', format = 'markdown', digits = 4)

coef(ml.bl.st.mi1.dem)[1:21]/coef(ml.bl.st.mi1.dem)[12]
```

```
## 2:(intercept) 3:(intercept)     small.loss     small.gain      big.gain
##    0.65082691   -2.25043547   -21.17331479   -43.25493010   -55.41959761
##      municipal       private    cooperative            mi4            mi8
##    0.64173795    5.86785636     3.55623063    -4.75238377    -6.60174492
##          mi10          bill        age:ASC     ASC:female      ASC:white
##  -13.73909488    1.00000000     0.01664372    -2.04296480    -4.71060913
## ASC:univ_degr    ASC:income      ASC:wages    ASC:self.emp    ASC:pol_dem
##    2.48297012    0.33055008     1.29173048    -1.67113069     4.18769185
##   ASC:pol_ind
##    2.91055876
```

```
AIC(ml.bl.st.mi1.dem)
```

```
## [1] 4058.008
```

```
ml.bl.pr.mi1.dem2 <- mlogit(choice ~ small.loss + small.gain +
                      big.gain +
                      municipal + state +
                      cooperative +
                      mi4 + mi8 + mi10 + bill +
                      age:ASC + female:ASC +
                      white:ASC + univ_degr:ASC +
                      coast_rec:ASC
                    | 1, wfml_d2)

summary(ml.bl.pr.mi1.dem2)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + coast_rec:ASC |
##     1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
```

```
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 5 iterations, 0h:0m:0s
## g'(-H)^-1g = 4.34E-07
## gradient close to zero
##
## Coefficients :
##                  Estimate  Std. Error  t-value   Pr(>|t|)
## 2:(intercept) -0.04589166  0.06279967  -0.7308  0.4649241
## 3:(intercept)  0.97025046  0.26861428   3.6121  0.0003038 ***
## small.loss      1.49627485  0.09612753  15.5655 < 2.2e-16 ***
## small.gain      3.05528757  0.11383194  26.8403 < 2.2e-16 ***
## big.gain        3.91457853  0.12552865  31.1847 < 2.2e-16 ***
## municipal       0.36977424  0.08624735   4.2874 1.808e-05 ***
## state           0.41459066  0.08505109   4.8746 1.090e-06 ***
## cooperative     0.16335743  0.09743435   1.6766 0.0936228 .
## mi4             0.33721872  0.09050055   3.7262 0.0001944 ***
## mi8             0.46838834  0.08812021   5.3153 1.065e-07 ***
## mi10            0.97175657  0.11980857   8.1109 4.441e-16 ***
## bill           -0.07061699  0.00563389 -12.5343 < 2.2e-16 ***
## age:ASC        -0.00043308  0.00554104  -0.0782 0.9377023
## ASC:female      0.14500172  0.12348671   1.1742 0.2403032
## ASC:white       0.32767649  0.14960545   2.1903 0.0285046 *
## ASC:univ_degr  -0.20249293  0.13168932  -1.5377 0.1241327
## ASC:coast_rec  -0.04563721  0.12617118  -0.3617 0.7175697
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2007.9
## McFadden R^2:  0.34125
## Likelihood ratio test : chisq = 2080.3 (p.value = < 2.22e-16)
```

```r
AIC(ml.bl.pr.mi1.dem2)
```

```
## [1] 4049.827
```

```r
coef(ml.bl.pr.mi1.dem2)[1:21]/coef(ml.bl.pr.mi1.dem2)[12]
```

```
## 2:(intercept) 3:(intercept)    small.loss    small.gain      big.gain
##   0.649867118 -13.739617973 -21.188595694 -43.265616027 -55.433947877
##     municipal         state   cooperative           mi4           mi8
##  -5.236335290  -5.870976163  -2.313287873  -4.775320015  -6.632799584
##          mi10          bill       age:ASC    ASC:female     ASC:white
## -13.760945774   1.000000000   0.006132755  -2.053354529  -4.640193375
## ASC:univ_degr ASC:coast_rec          <NA>          <NA>          <NA>
##   2.867481720   0.646263926            NA            NA            NA
##          <NA>
##            NA
```

```
ml.bl.pr.mi1.dem3 <- mlogit(choice ~ small.loss + small.gain +
                        big.gain +
                        municipal + state +
                        cooperative +
                        mi4 + mi8 + mi10 + bill +
                        age:ASC + female:ASC +
                        white:ASC + univ_degr:ASC +
                        income:ASC +
                        self.emp:ASC + pol_dem:ASC +
                        pol_ind:ASC + pol_rep:ASC
                       + coast_rec:ASC +
                        oper:ASC + const_st:ASC +
                        wf_rec:ASC+
                        abuse_nep:ASC + bal_r_nep:ASC +
                        crisis_r_nep:ASC + spaceship_nep:ASC +
                      # bau_nep:ASC +
                     # extract_r_ins:ASC +
                      # loss_r_ins:ASC + decade_r_mor:ASC
                      # comm_rel:ASC + wild_rel:ASC +
                    # clean_inst:ASC + tech:ASC +
                      iden_rel:ASC + kin_rel:ASC +
                        right_r_mor:ASC + health_rel:ASC +
                        other_rel:ASC + kin_met:ASC +
                        resp_met:ASC + iden_met:ASC +
                        other_met:ASC
                      | 1, wfml_d2)

summary(ml.bl.pr.mi1.dem3)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + income:ASC +
##     self.emp:ASC + pol_dem:ASC + pol_ind:ASC + pol_rep:ASC +
##     coast_rec:ASC + oper:ASC + const_st:ASC + wf_rec:ASC + abuse_nep:ASC +
##     bal_r_nep:ASC + crisis_r_nep:ASC + spaceship_nep:ASC + iden_rel:ASC +
##     kin_rel:ASC + right_r_mor:ASC + health_rel:ASC + other_rel:ASC +
##     kin_met:ASC + resp_met:ASC + iden_met:ASC + other_met:ASC |
##     1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40694 0.48762 0.10543
##
## nr method
## 6 iterations, 0h:0m:1s
## g'(-H)^-1g = 9.34E-05
## successive function values within tolerance limits
##
## Coefficients :
##                   Estimate Std. Error  t-value  Pr(>|t|)
## 2:(intercept)    -0.0588518  0.0647275  -0.9092 0.3632317
```

```
## 3:(intercept)       1.6567222  1.0560874   1.5687 0.1167095
## small.loss          1.5119394  0.0981960  15.3972 < 2.2e-16 ***
## small.gain          3.1480577  0.1188750  26.4821 < 2.2e-16 ***
## big.gain            4.0094337  0.1301979  30.7949 < 2.2e-16 ***
## municipal           0.4001165  0.0888131   4.5051 6.633e-06 ***
## state               0.4131931  0.0880162   4.6945 2.672e-06 ***
## cooperative         0.1654529  0.1006505   1.6438 0.1002102
## mi4                 0.3170381  0.0934491   3.3926 0.0006923 ***
## mi8                 0.4716216  0.0915238   5.1530 2.564e-07 ***
## mi10                0.9958006  0.1244885   7.9991 1.332e-15 ***
## bill               -0.0740815  0.0058852 -12.5877 < 2.2e-16 ***
## age:ASC             0.0028410  0.0063443   0.4478 0.6542905
## ASC:female          0.0311329  0.1482260   0.2100 0.8336392
## ASC:white           0.1493938  0.1709931   0.8737 0.3822909
## ASC:univ_degr      -0.2897996  0.1454602  -1.9923 0.0463387 *
## ASC:income         -0.0154997  0.0283090  -0.5475 0.5840230
## ASC:self.emp        0.4180972  0.2413660   1.7322 0.0832357 .
## ASC:pol_dem        -0.8401194  0.2763560  -3.0400 0.0023659 **
## ASC:pol_ind        -0.8806189  0.2774015  -3.1745 0.0015008 **
## ASC:pol_rep        -1.2027916  0.3357024  -3.5829 0.0003398 ***
## ASC:coast_rec       0.2533261  0.1409423   1.7974 0.0722762 .
## ASC:oper           -0.0358968  0.1604462  -0.2237 0.8229664
## ASC:const_st       -0.2120193  0.0693620  -3.0567 0.0022378 **
## ASC:wf_rec          0.7186942  0.1156470   6.2145 5.147e-10 ***
## ASC:abuse_nep       0.5923054  0.1074424   5.5128 3.532e-08 ***
## ASC:bal_r_nep       0.1978522  0.0896857   2.2061 0.0273797 *
## ASC:crisis_r_nep   -0.1700878  0.0900005  -1.8899 0.0587774 .
## ASC:spaceship_nep  -0.1302804  0.0861544  -1.5122 0.1304898
## ASC:iden_rel        0.0411723  0.1004633   0.4098 0.6819348
## ASC:kin_rel        -0.3154271  0.1035519  -3.0461 0.0023185 **
## ASC:right_r_mor     0.1300248  0.0900297   1.4442 0.1486708
## ASC:heh_rel        -0.1255930  0.0726441  -1.7289 0.0838305 .
## ASC:other_rel      -0.0018374  0.1142058  -0.0161 0.9871635
## ASC:kin_met         0.1029166  0.0977093   1.0533 0.2922063
## ASC:resp_met       -0.1081652  0.1086998  -0.9951 0.3196965
## ASC:iden_met       -0.2171225  0.0864767  -2.5108 0.0120471 *
## ASC:other_met      -0.2871348  0.0851786  -3.3710 0.0007490 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -1827
## McFadden R^2:  0.38395
## Likelihood ratio test : chisq = 2277.3 (p.value = < 2.22e-16)
```

```r
-1 * coef(ml.bl.pr.mi1.dem3)[1:21]/coef(ml.bl.pr.mi1.dem3)[12]
```

```
## 2:(intercept) 3:(intercept)     small.loss     small.gain       big.gain
##   -0.79441987   22.36351577   20.40914329    42.49453421    54.12194811
##     municipal         state    cooperative            mi4            mi8
##    5.40103368    5.57754963     2.23339131     4.27958716     6.36625533
##          mi10          bill        age:ASC     ASC:female      ASC:white
##   13.44196499   -1.00000000     0.03835031     0.42025176     2.01661499
## ASC:univ_degr    ASC:income   ASC:self.emp     ASC:pol_dem    ASC:pol_ind
##   -3.91190422   -0.20922499     5.64374861   -11.34047891   -11.88716819
```

```
##   ASC:pol_rep
##   -16.23606482
```

```
AIC(ml.bl.pr.mi1.dem3)
```

```
## [1] 3729.997
```

```
ml.bl.pr.mi1.dem4 <- mlogit(choice ~ small.loss + small.gain +
                       big.gain +
                       municipal + state +
                       cooperative +
                       mi4 + mi8 + mi10 + bill +
                       age:ASC + female:ASC +
                       white:ASC + univ_degr:ASC +
                       income:ASC +
                       pol_dem:ASC + pol_ind:ASC + pol_rep:ASC
                      + coast_rec:ASC + mean_nep:ASC +
                       oper:ASC + wf_rec:ASC+ other_met:ASC
                     | 1, wfml_d2)
```

```
summary(ml.bl.pr.mi1.dem4)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + income:ASC +
##     pol_dem:ASC + pol_ind:ASC + pol_rep:ASC + coast_rec:ASC +
##     mean_nep:ASC + oper:ASC + wf_rec:ASC + other_met:ASC | 1,
##     data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40650 0.48812 0.10538
##
## nr method
## 6 iterations, 0h:0m:0s
## g'(-H)^-1g = 2.56E-05
## successive function values within tolerance limits
##
## Coefficients :
##                 Estimate Std. Error  t-value  Pr(>|t|)
## 2:(intercept) -0.0537967  0.0634709  -0.8476 0.3966719
## 3:(intercept)  4.2302118  0.6410672   6.5987 4.148e-11 ***
## small.loss     1.5062385  0.0964122  15.6229 < 2.2e-16 ***
## small.gain     3.1127274  0.1160632  26.8193 < 2.2e-16 ***
## big.gain       3.9767143  0.1274818  31.1944 < 2.2e-16 ***
## municipal      0.3742310  0.0871641   4.2934 1.760e-05 ***
## state          0.4038563  0.0861207   4.6894 2.740e-06 ***
## cooperative    0.1649009  0.0986717   1.6712 0.0946806 .
## mi4            0.3310272  0.0914404   3.6201 0.0002944 ***
## mi8            0.4751645  0.0894162   5.3141 1.072e-07 ***
## mi10           0.9841896  0.1216295   8.0917 6.661e-16 ***
```

```
## bill          -0.0731195  0.0057508 -12.7146 < 2.2e-16 ***
## age:ASC        0.0040537  0.0059954   0.6761 0.4989493
## ASC:female    -0.0173727  0.1303144  -0.1333 0.8939452
## ASC:white      0.1555914  0.1631370   0.9537 0.3402116
## ASC:univ_degr -0.2285136  0.1399946  -1.6323 0.1026156
## ASC:income     0.0090142  0.0259244   0.3477 0.7280570
## ASC:pol_dem   -0.7414285  0.2561247  -2.8948 0.0037941 **
## ASC:pol_ind   -0.7483160  0.2585134  -2.8947 0.0037953 **
## ASC:pol_rep   -1.0074616  0.3180685  -3.1674 0.0015379 **
## ASC:coast_rec  0.1696622  0.1347107   1.2595 0.2078657
## ASC:mean_nep   0.6319409  0.0945269   6.6853 2.304e-11 ***
## ASC:oper      -0.1360061  0.1520495  -0.8945 0.3710620
## ASC:wf_rec     0.8275663  0.1022103   8.0967 6.661e-16 ***
## ASC:other_met -0.3283684  0.0723632  -4.5378 5.685e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -1911.6
## McFadden R^2:  0.37286
## Likelihood ratio test : chisq = 2273 (p.value = < 2.22e-16)
```

```r
AIC(ml.bl.pr.mi1.dem4)
```

```
## [1] 3873.154
```

```r
ml.bl.pr.mi1.dem5 <- mlogit(choice ~ small.loss + small.gain +
                        big.gain +
                        municipal + state +
                        cooperative +
                        mi4 + mi8 + mi10 + bill +
                        age:ASC + female:ASC +
                        white:ASC + univ_degr:ASC +
                        income:ASC +
                        self.emp:ASC + pol_dem:ASC +
                        pol_ind:ASC + pol_rep:ASC
                      + coast_rec:ASC + mean_nep:ASC +
                        oper:ASC + const_st:ASC +
                        wf_rec:ASC+ crisis_r_nep:ASC + spaceship_nep:ASC +
                        right_r_mor:ASC + health_rel:ASC +
                        other_rel:ASC + kin_met:ASC + iden_met:ASC +
                        other_met:ASC
                      | 1, wfml_d2)

summary(ml.bl.pr.mi1.dem5)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + income:ASC +
##     self.emp:ASC + pol_dem:ASC + pol_ind:ASC + pol_rep:ASC +
##     coast_rec:ASC + mean_nep:ASC + oper:ASC + const_st:ASC +
##     wf_rec:ASC + crisis_r_nep:ASC + spaceship_nep:ASC + right_r_mor:ASC +
```

```
##      health_rel:ASC + other_rel:ASC + kin_met:ASC + iden_met:ASC +
##      other_met:ASC | 1, data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40774 0.48641 0.10585
##
## nr method
## 6 iterations, 0h:0m:1s
## g'(-H)^-1g = 8.26E-05
## successive function values within tolerance limits
##
## Coefficients :
##                    Estimate Std. Error  t-value  Pr(>|t|)
## 2:(intercept)     -0.0578253  0.0645662  -0.8956 0.3704687
## 3:(intercept)      2.6449035  0.9183319   2.8801 0.0039753 **
## small.loss         1.5128551  0.0980963  15.4221 < 2.2e-16 ***
## small.gain         3.1375221  0.1182686  26.5288 < 2.2e-16 ***
## big.gain           4.0110069  0.1299213  30.8726 < 2.2e-16 ***
## municipal          0.3880496  0.0885646   4.3815 1.178e-05 ***
## state              0.4142617  0.0877889   4.7188 2.372e-06 ***
## cooperative        0.1753313  0.1004127   1.7461 0.0807924 .
## mi4                0.3102860  0.0931341   3.3316 0.0008635 ***
## mi8                0.4699116  0.0911627   5.1546 2.541e-07 ***
## mi10               0.9988777  0.1240523   8.0521 8.882e-16 ***
## bill              -0.0738435  0.0058643 -12.5921 < 2.2e-16 ***
## age:ASC            0.0014509  0.0062511   0.2321 0.8164555
## ASC:female        -0.0352649  0.1466333  -0.2405 0.8099449
## ASC:white          0.1362956  0.1684717   0.8090 0.4185082
## ASC:univ_degr     -0.2094016  0.1445390  -1.4488 0.1474060
## ASC:income        -0.0178761  0.0275422  -0.6490 0.5163116
## ASC:self.emp       0.3992032  0.2345489   1.7020 0.0887546 .
## ASC:pol_dem       -0.9381944  0.2713135  -3.4580 0.0005443 ***
## ASC:pol_ind       -0.8521711  0.2725793  -3.1263 0.0017701 **
## ASC:pol_rep       -1.1286583  0.3305447  -3.4145 0.0006389 ***
## ASC:coast_rec      0.2650299  0.1382824   1.9166 0.0552907 .
## ASC:mean_nep       1.3154580  0.2468610   5.3287 9.890e-08 ***
## ASC:oper          -0.0566653  0.1593045  -0.3557 0.7220622
## ASC:const_st      -0.2463609  0.0660760  -3.7284 0.0001927 ***
## ASC:wf_rec         0.7432786  0.1117655   6.6503 2.924e-11 ***
## ASC:crisis_r_nep  -0.5097151  0.1291290  -3.9473 7.903e-05 ***
## ASC:spaceship_nep -0.3686568  0.1118122  -3.2971 0.0009769 ***
## ASC:right_r_mor    0.1697401  0.0826579   2.0535 0.0400217 *
## ASC:heh_rel       -0.0864093  0.0716184  -1.2065 0.2276159
## ASC:other_rel     -0.0669783  0.1115125  -0.6006 0.5480835
## ASC:kin_met        0.1654837  0.0906281   1.8260 0.0678556 .
## ASC:iden_met      -0.2265461  0.0800715  -2.8293 0.0046650 **
## ASC:other_met     -0.2973336  0.0827038  -3.5952 0.0003242 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -1840.6
## McFadden R^2:  0.38306
## Likelihood ratio test : chisq = 2285.6 (p.value = < 2.22e-16)
```

```
AIC(ml.bl.pr.mi1.dem5)
```

```
## [1] 3749.136
```

```
ml.bl.pr.mi1.dem6 <- mlogit(choice ~ small.loss + small.gain +
                       big.gain +
                       municipal + state +
                       cooperative +
                       mi4 + mi8 + mi10 + bill +
                       age:ASC + female:ASC +
                       white:ASC + univ_degr:ASC +
                       income:ASC + coast_rec:ASC
                       + oper:ASC + const_st:ASC +
                       wf_rec:ASC
                     | 1, wfml_d2)

summary(ml.bl.pr.mi1.dem6)
```

```
##
## Call:
## mlogit(formula = choice ~ small.loss + small.gain + big.gain +
##     municipal + state + cooperative + mi4 + mi8 + mi10 + bill +
##     age:ASC + female:ASC + white:ASC + univ_degr:ASC + income:ASC +
##     coast_rec:ASC + oper:ASC + const_st:ASC + wf_rec:ASC | 1,
##     data = wfml_d2, method = "nr", print.level = 0)
##
## Frequencies of alternatives:
##       1       2       3
## 0.40603 0.48806 0.10591
##
## nr method
## 6 iterations, 0h:0m:0s
## g'(-H)^-1g = 2.62E-06
## successive function values within tolerance limits
##
## Coefficients :
##                  Estimate Std. Error  t-value  Pr(>|t|)
## 2:(intercept) -0.0469108  0.0633088  -0.7410 0.4587028
## 3:(intercept)  2.3411519  0.4841910   4.8352 1.330e-06 ***
## small.loss     1.5102476  0.0970171  15.5668 < 2.2e-16 ***
## small.gain     3.1092652  0.1158000  26.8503 < 2.2e-16 ***
## big.gain       3.9664989  0.1272646  31.1673 < 2.2e-16 ***
## municipal      0.3908966  0.0870489   4.4905 7.104e-06 ***
## state          0.4029916  0.0859479   4.6888 2.748e-06 ***
## cooperative    0.1624341  0.0985479   1.6483 0.0992961 .
## mi4            0.3482962  0.0913544   3.8126 0.0001375 ***
## mi8            0.4882832  0.0893511   5.4648 4.635e-08 ***
## mi10           0.9903488  0.1213384   8.1619 2.220e-16 ***
## bill          -0.0718610  0.0057303 -12.5404 < 2.2e-16 ***
## age:ASC        0.0043331  0.0057688   0.7511 0.4525788
## ASC:female     0.2874809  0.1284755   2.2376 0.0252451 *
## ASC:white      0.3552805  0.1555475   2.2841 0.0223678 *
```

```
## ASC:univ_degr -0.2870024  0.1373803  -2.0891 0.0366980 *
## ASC:income    -0.0405453  0.0252842  -1.6036 0.1088065
## ASC:coast_rec  0.0928330  0.1306455   0.7106 0.4773497
## ASC:oper      -0.0925042  0.1502074  -0.6158 0.5379980
## ASC:const_st  -0.3160672  0.0598655  -5.2796 1.294e-07 ***
## ASC:wf_rec     0.6626088  0.1025460   6.4616 1.036e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -1945.4
## McFadden R^2:  0.35904
## Likelihood ratio test : chisq = 2179.5 (p.value = < 2.22e-16)
```

```
AIC(ml.bl.pr.mi1.dem6)
```

```
## [1] 3932.773
```

Mixed Logit

"'{r}

mixed logits take ~5 min to run

mx.bl.st.mi1 <- mlogit(choice ~ small.loss + small.gain + big.gain + municipal + private + cooperative + mi4 + mi8 + mi10 + bill, wfml_d2, panel = TRUE, rpar = c(small.loss = "n", small.gain = "n", big.gain = "n", municipal = "n", private = "n", cooperative = "n", mi4 = "n", mi8 = "n", mi10 = "n", bill = "n"), correlation = TRUE, R = 100, halton = NA)

summary(mx.bl.st.mi1) -1 * (coef(mx.bl.st.mi1)[3:12]/coef(mx.bl.st.mi1)[12]) AIC(mx.bl.st.mi1) # "'

"'{r}

mx.bl.pr.mi1 <- mlogit(choice ~ small.loss + small.gain + big.gain + municipal + state + cooperative + mi4 + mi8 + mi10 + bill, wfml_d2, panel = TRUE, rpar = c(small.loss = "n", small.gain = "n", big.gain = "n", municipal = "n", state = "n", cooperative = "n", mi4 = "n", mi8 = "n", mi10 = "n", bill = "n"), correlation = TRUE, R = 100, halton = NA)

summary(mx.bl.pr.mi1) -1 * (coef(mx.bl.pr.mi1)[3:12]/coef(mx.bl.pr.mi1)[12]) AIC(mx.bl.pr.mi1)

```
#```{r}
mx.bl.pr.mi1.dem <- mlogit(choice ~ small.loss + small.gain + big.gain +
                 municipal + state + cooperative +
                 mi4 + mi8 + mi10 + bill,
               wfml_d2, panel = TRUE, rpar = c(small.loss = "n", small.gain = "n", big.gain = "n", mu

# summary(mx.bl.pr.mi1.dem)
# -1 * (coef(mx.bl.pr.mi1.dem)[3:12]/coef(mx.bl.pr.mi1.dem)[12])
# AIC(mx.bl.pr.mi1.dem)
```

What does panel do?

```
{r} ### takes 10 min to run with no panel wf.mxlc.np <- mlogit(choice ~ small.loss +
small.gain + big.gain + municipal + private + cooperative + mi4 + mi8 + mi10 + bill,
wfml2, panel = FALSE, rpar = c(small.loss = "n", small.gain = "n", big.gain = "n", municipal
= "n", private = "n", cooperative = "n", mi4 = "n", mi8 = "n", mi10 = "n", bill = "n"),
correlation = TRUE, R = 100, halton = NA) ###
```

summary(wf.mxlc.np)

Trying not correlated

```
# mx.bl.st.mi1.notcor <- update(mx.bl.st.mi1, correlation = FALSE)
# summary(mx.bl.st.mi1.notcor)
```

Translate to dollar values Normalize with bill

```
# big.gain.value <- rpar(wf.mxlc, "big.gain", norm = "bill")
# summary(big.gain.value)
# med(big.gain.value)
# mean(big.gain.value)
```

Use AIC to compare models

```
AIC(ml.bl.st.mi1)
```

```
## [1] 4052.907
```

```
AIC(ml.bl.pr.m1)
```

```
## [1] 4080.915
```

```
AIC(ml.sl.pr.m1)
```

```
## [1] 4077.759
```

```
AIC(ml.sg.st.mi1)
```

```
## [1] 4655.653
```

```
AIC(ml.bl.st.mi1.dem)
```

```
## [1] 4058.008
```

```
AIC(ml.bl.pr.mi1.dem2)
```

```
## [1] 4049.827
```

```
AIC(ml.bl.pr.mi1.dem2)
```

```
## [1] 4049.827
```

```
AIC(ml.bl.pr.mi1.dem3)
```

```
## [1] 3729.997
```

```
AIC(ml.bl.pr.mi1.dem5)
```

```
## [1] 3749.136
```

```
AIC(ml.bl.pr.mi1.dem6)
```

```
## [1] 3932.773
```

```
# AIC(mx.bl.pr.mi1)
```

Likelihood Ratio Test

```
# lrtest(ml.bl.pr.mi1.dem6, ml.bl.pr.mi1.dem2)
```

Interact with demographics e.g., age:mi4

goodness of fit lrtest AIC

demographics test to see if panel = true or false, see how output differs find best "base" model based on AIC and lrtest