```
# Multinomial Probit and Logit Models in R
# Copyright 2013 by Ani Katchova

# install.packages("mlogit")
library(mlogit)

mydata<- read.csv("C:/Econometrics/Data/multinomial_fishing1.csv")
attach(mydata)

# Descriptive statistics
table(mode)

# Reshaping the data from wide to long format
#mydata$mode<-as.factor(mydata$mode)
mldata<-mlogit.data(mydata, varying=4:15, choice="mode", shape="wide")
mldata[1:20,]

# Multinomial logit model coefficients
mlogit.model1 <- mlogit(mode ~ 1 | income, data=mldata, reflevel="charter")
summary(mlogit.model1)

# Multinomial logit model coefficients (with different base outcome)
mlogit.model2 <- mlogit(mode ~ 1 | income, data = mldata, reflevel="pier")
summary(mlogit.model2)

# Multinomial logit model odds ratios
exp(coef(mlogit.model1))


# Conditional logit model
clogit.model1 <- mlogit(mode ~ price+catch |income, data = mldata, reflevel="charter")
summary(clogit.model1)

clogit.model2 <- mlogit(mode ~ price+catch | income, data = mldata, reflevel="pier")
summary(clogit.model2)


# Setting mean values for variables to use for marginal effects
m <- mlogit(mode ~ price+catch |income, data = mldata, reflevel="charter")
z <- with(mldata, data.frame(price = tapply(price, index(m)$alt, mean),
                             catch = tapply(catch, index(m)$alt, mean), income =
mean(income)))

# Multinomial logit model marginal effects
effects(mlogit.model1, covariate = "income", data = z)

# Conditional logit model marginal effects
effects(clogit.model1, covariate = "income", data = z)
effects(clogit.model1, covariate = "price", data = z)
effects(clogit.model1, covariate = "catch", data = z)

# Multinomial probit model coefficients
#mprobit.model1 <- mlogit(mode ~ 1 | income, data = mldata, reflevel="charter",
probit=TRUE)
#summary(mprobit.model1)
```

```
# Hauseman-McFadden test of independence of irrelevant alternatives
m1<- mlogit(mode ~ 1 | income, data = mldata, reflevel="beach")
m2<- mlogit(mode ~ 1 | income, data = mldata, reflevel="beach", alt.subset=c("beach",
"pier", "private"))
hmftest(m1, m2)
```

```
> # Multinomial Probit and Logit Models in R
> # Copyright 2013 by Ani Katchova
>
> # install.packages("mlogit")
> library(mlogit)
Loading required package: Formula
Loading required package: statmod
Loading required package: lmtest
Loading required package: zoo

Attaching package: ‘zoo’

The following object(s) are masked from ‘package:base’:

    as.Date, as.Date.numeric

Loading required package: maxLik
Loading required package: miscTools
Loading required package: MASS
>
> mydata<- read.csv("C:/Econometrics/Data/multinomial_fishing1.csv")
> attach(mydata)
>
> # Descriptive statistics
> table(mode)
mode
  beach charter    pier private
    134     452     178     418
>
> # Reshaping the data from wide to long format
> #mydata$mode<-as.factor(mydata$mode)
> mldata<-mlogit.data(mydata, varying=4:15, choice="mode", shape="wide")
> mldata[1:20,]
           mode   price catchrate   income mode1     alt d  catch chid
1.beach   FALSE 157.930    0.5391 7.083332     4   beach 0 0.0678    1
1.charter  TRUE 182.930    0.5391 7.083332     4 charter 1 0.5391    1
1.pier    FALSE 157.930    0.5391 7.083332     4    pier 0 0.0503    1
1.private FALSE 157.930    0.5391 7.083332     4 private 0 0.2601    1
2.beach   FALSE  15.114    0.4671 1.250000     4   beach 0 0.1049    2
2.charter  TRUE  34.534    0.4671 1.250000     4 charter 1 0.4671    2
2.pier    FALSE  15.114    0.4671 1.250000     4    pier 0 0.0451    2
2.private FALSE  10.534    0.4671 1.250000     4 private 0 0.1574    2
3.beach   FALSE 161.874    0.2413 3.750000     3   beach 0 0.5333    3
3.charter FALSE  59.334    0.2413 3.750000     3 charter 0 1.0266    3
3.pier    FALSE 161.874    0.2413 3.750000     3    pier 0 0.4522    3
3.private  TRUE  24.334    0.2413 3.750000     3 private 1 0.2413    3
4.beach   FALSE  15.134    0.0789 2.083333     2   beach 0 0.0678    4
4.charter FALSE  84.930    0.0789 2.083333     2 charter 0 0.5391    4
4.pier     TRUE  15.134    0.0789 2.083333     2    pier 1 0.0789    4
4.private FALSE  55.930    0.0789 2.083333     2 private 0 0.1643    4
5.beach   FALSE 106.930    0.1082 4.583332     3   beach 0 0.0678    5
5.charter FALSE  71.014    0.1082 4.583332     3 charter 0 0.3240    5
5.pier    FALSE 106.930    0.1082 4.583332     3    pier 0 0.0503    5
5.private  TRUE  41.514    0.1082 4.583332     3 private 1 0.1082    5
>
```

```
> # Multinomial logit model coefficients
> mlogit.model1 <- mlogit(mode ~ 1 | income, data=mldata, reflevel="charter")
> summary(mlogit.model1)

Call:
mlogit(formula = mode ~ 1 | income, data = mldata, reflevel = "charter",
    method = "nr", print.level = 0)

Frequencies of alternatives:
charter   beach    pier private
0.38240 0.11337 0.15059 0.35364

nr method
4 iterations, 0h:0m:0s
g'(-H)^-1g = 8.32E-07
gradient close to zero

Coefficients :
                     Estimate Std. Error t-value  Pr(>|t|)
beach:(intercept)   -1.341291   0.194517 -6.8955 5.367e-12 ***
pier:(intercept)    -0.527141   0.177784 -2.9651  0.003026 **
private:(intercept) -0.602371   0.136096 -4.4261 9.597e-06 ***
beach:income         0.031640   0.041846  0.7561  0.449591
pier:income         -0.111763   0.043979 -2.5413  0.011046 *
private:income       0.123546   0.027911  4.4265 9.577e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Log-Likelihood: -1477.2
McFadden R^2:  0.013736
Likelihood ratio test : chisq = 41.145 (p.value = 6.0931e-09)
>
> # Multinomial logit model coefficients (with different base outcome)
> mlogit.model2 <- mlogit(mode ~ 1 | income, data = mldata, reflevel="pier")
> summary(mlogit.model2)

Call:
mlogit(formula = mode ~ 1 | income, data = mldata, reflevel = "pier",
    method = "nr", print.level = 0)

Frequencies of alternatives:
   pier   beach charter private
0.15059 0.11337 0.38240 0.35364

nr method
4 iterations, 0h:0m:0s
g'(-H)^-1g = 8.32E-07
gradient close to zero

Coefficients :
                     Estimate Std. Error t-value  Pr(>|t|)
beach:(intercept)   -0.814150   0.228632 -3.5610 0.0003695 ***
charter:(intercept)  0.527141   0.177784  2.9651 0.0030262 **
private:(intercept) -0.075229   0.183240 -0.4106 0.6814007
beach:income         0.143403   0.053288  2.6911 0.0071223 **
```

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charter:income       0.111763   0.043979  2.5413 0.0110455 *
private:income       0.235309   0.043668  5.3886 7.101e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Log-Likelihood: -1477.2
McFadden R^2:  0.013736
Likelihood ratio test : chisq = 41.145 (p.value = 6.0931e-09)
>
> # Multinomial logit model odds ratios
> exp(coef(mlogit.model1))
  beach:(intercept)    pier:(intercept) private:(intercept)
          0.2615077           0.5902901           0.5475121
       beach:income         pier:income      private:income
          1.0321457           0.8942561           1.1315023
attr(,"fixed")
  beach:(intercept)    pier:(intercept) private:(intercept)
              FALSE               FALSE               FALSE
       beach:income         pier:income      private:income
              FALSE               FALSE               FALSE
>
>
> # Conditional logit model
> clogit.model1 <- mlogit(mode ~ price+catch |income, data = mldata,
reflevel="charter")
> summary(clogit.model1)

Call:
mlogit(formula = mode ~ price + catch | income, data = mldata,
    reflevel = "charter", method = "nr", print.level = 0)

Frequencies of alternatives:
charter   beach    pier private
0.38240 0.11337 0.15059 0.35364

nr method
7 iterations, 0h:0m:0s
g'(-H)^-1g = 1.37E-05
successive function values within tolerance limits

Coefficients :
                     Estimate Std. Error  t-value  Pr(>|t|)
beach:(intercept)   -1.6943657  0.2240506  -7.5624 3.952e-14 ***
pier:(intercept)    -0.9164063  0.2072648  -4.4214 9.805e-06 ***
private:(intercept) -1.1670869  0.1590475  -7.3380 2.169e-13 ***
price               -0.0251166  0.0017317 -14.5042 < 2.2e-16 ***
catch                0.3577820  0.1097733   3.2593  0.001117 **
beach:income         0.0332917  0.0503409   0.6613  0.508403
pier:income         -0.0942854  0.0500600  -1.8834  0.059640 .
private:income       0.1227315  0.0286306   4.2867 1.813e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Log-Likelihood: -1215.1
McFadden R^2:  0.18868
```

```
Likelihood ratio test : chisq = 565.17 (p.value = < 2.22e-16)
>
> clogit.model2 <- mlogit(mode ~ price+catch | income, data = mldata, reflevel="pier")
> summary(clogit.model2)

Call:
mlogit(formula = mode ~ price + catch | income, data = mldata,
    reflevel = "pier", method = "nr", print.level = 0)

Frequencies of alternatives:
   pier   beach charter private
0.15059 0.11337 0.38240 0.35364

nr method
7 iterations, 0h:0m:0s
g'(-H)^-1g = 1.37E-05
successive function values within tolerance limits

Coefficients :
                     Estimate Std. Error  t-value  Pr(>|t|)
beach:(intercept)   -0.7779594  0.2204939  -3.5283 0.0004183 ***
charter:(intercept)  0.9164063  0.2072648   4.4214 9.805e-06 ***
private:(intercept) -0.2506806  0.2039395  -1.2292 0.2190004
price               -0.0251166  0.0017317 -14.5042 < 2.2e-16 ***
catch                0.3577820  0.1097733   3.2593 0.0011170 **
beach:income         0.1275771  0.0506395   2.5193 0.0117582 *
charter:income       0.0942854  0.0500600   1.8834 0.0596396 .
private:income       0.2170169  0.0500582   4.3353 1.456e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Log-Likelihood: -1215.1
McFadden R^2:  0.18868
Likelihood ratio test : chisq = 565.17 (p.value = < 2.22e-16)
>
>
> # Setting mean values for variables to use for marginal effects
> m <- mlogit(mode ~ price+catch |income, data = mldata, reflevel="charter")
> z <- with(mldata, data.frame(price = tapply(price, index(m)$alt, mean),
+                              catch = tapply(catch, index(m)$alt, mean), income =
mean(income)))
>
> # Multinomial logit model marginal effects
> effects(mlogit.model1, covariate = "income", data = z)
      charter         beach          pier       private
-1.201367e-02  7.495845e-05 -2.065980e-02  3.259851e-02
>
> # Conditional logit model marginal effects
> effects(clogit.model1, covariate = "income", data = z)
      charter         beach          pier       private
-0.0217339246 -0.0007214181 -0.0093059734  0.0317613161
> effects(clogit.model1, covariate = "price", data = z)
              charter         beach          pier       private
charter -0.0062430047  6.091542e-04  7.642235e-04  0.0048696270
beach    0.0006091541 -1.249124e-03  8.681094e-05  0.0005531588
```

```
pier     0.0007642234  8.681094e-05 -1.545008e-03  0.0006939736
private  0.0048696270  5.531588e-04  6.939737e-04 -0.0061167595
> effects(clogit.model1, covariate = "catch", data = z)
             charter        beach         pier      private
charter  0.088930726 -0.008677316 -0.010886256 -0.069367154
beach   -0.008677329  0.017793621 -0.001236612 -0.007879681
pier    -0.010886272 -0.001236612  0.022008455 -0.009885571
private -0.069367164 -0.007879671 -0.009885559  0.087132394
>
> # Multinomial probit model coefficients
> #mprobit.model1 <- mlogit(mode ~ 1 | income, data = mldata, reflevel="charter",
probit=TRUE)
> #summary(mprobit.model1)
>
>
> # Hauseman-McFadden test of independence of irrelevant alternatives
> m1<- mlogit(mode ~ 1 | income, data = mldata, reflevel="beach")
> m2<- mlogit(mode ~ 1 | income, data = mldata, reflevel="beach",
alt.subset=c("beach", "pier", "private"))
> hmftest(m1, m2)

       Hausman-McFadden test

data:  mldata
chisq = 14.701, df = 4, p-value = 0.005363
alternative hypothesis: IIA is rejected
```