Package ‘mlogit’

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**mlogit-package**

**mlogit package: estimation of random utility discrete choice models by maximum likelihood**

**Description**

mlogit provides a model description interface (enhanced formula-data), a very versatile estimation function and a testing infrastructure to deal with random utility models.

**Details**

For a gentle and comprehensive introduction to the package, see the package's vignettes.
Stated Preferences for Car Choice

Description

a sample of 4654 individuals

Format

A dataframe containing:

- choice: choice of a vehicle among 6 propositions,
- college: college education?,
- hsg2: size of household greater than 2?
- coml5: commute lower than 5 miles a day?,
- typez: body type, one of regcar (regular car), sportuv (sport utility vehicle), sportcar, stwagon (station wagon), truck, van, for each proposition z from 1 to 6,
- fuelz: fuel for proposition z, one of gasoline, methanol, cng (compressed natural gas), electric.,
- pricez: price of vehicle divided by the logarithm of income,
- rangez: hundreds of miles vehicle can travel between refuelings/rechargings,
- accz: acceleration, tens of seconds required to reach 30 mph from stop,
- speedz: highest attainable speed in hundreds of mph,
- pollutionz: tailpipe emissions as fraction of those for new gas vehicle,
- sizez: 0 for a mini, 1 for a subcompact, 2 for a compact and 3 for a mid-size or large vehicle,
- spacez: fraction of luggage space in comparable new gas vehicle,
- costz: cost per mile of travel (tens of cents): home recharging for electric vehicle, station refueling otherwise,
- stationz: fraction of stations that can refuel/recharge vehicle.

Source

Journal of Applied Econometrics data archive.

References

Catsup  

**Choice of Brand for Catsup**

**Description**

A sample of 2798 individuals

**Format**

A dataframe containing:
- id: individuals identifiers,
- choice: one of heinz41, heinz32, heinz28, hunts32,
- disp.z: is there a display for brand z?
- feat.z: is there a newspaper feature advertisement for brand z?
- price.z: price of brand z.

**Source**


**References**


---

**cor.mlogit**  

**Correlation structure of the random parameters**

**Description**

Functions that extract the correlation structure of a mlogit object

**Usage**

```r
cor.mlogit(x)
cov.mlogit(x)
```

**Arguments**

- `x` an mlogit object with random parameters and `correlation = TRUE`.

**Details**

These functions are deprecated, use `vcov` instead.
**Value**

A numerical matrix which returns either the correlation or the covariance matrix of the random parameters.

**Author(s)**

Yves Croissant

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<table>
<thead>
<tr>
<th>Cracker</th>
<th><strong>Choice of Brand for Crackers</strong></th>
</tr>
</thead>
</table>

**Description**

a sample of 3292 individuals cross-section

**Format**

A dataframe containing:

- id: individuals identifiers,
- choice: one of sunshine, keebler, nabisco, private,
- disp.z: is there a display for brand z?
- feat.z: is there a newspaper feature advertisement for brand z?
- price.z: price of brand z.

**Source**


**References**


Functions used to describe the characteristics of estimated random parameters

Description

Functions used to describe the characteristics of estimated random parameters

Usage

stdev(x, ...)

rg(x, ...)

med(x, ...)

## S3 method for class 'rpar'
mean(x, norm = NULL, ...)

## S3 method for class 'rpar'
med(x, norm = NULL, ...)

## S3 method for class 'rpar'
stdev(x, norm = NULL, ...)

## S3 method for class 'rpar'
rg(x, norm = NULL, ...)

## S3 method for class 'mlogit'
mean(x, par = NULL, norm = NULL, ...)

## S3 method for class 'mlogit'
med(x, par = NULL, norm = NULL, ...)

## S3 method for class 'mlogit'
stdev(x, par = NULL, norm = NULL, ...)

## S3 method for class 'mlogit'
rg(x, par = NULL, norm = NULL, ...)

qrpar(x, ...)

prpar(x, ...)

drpar(x, ...)

## S3 method for class 'rpar'
qrpar(x, norm = NULL, ...)

## S3 method for class 'rpar'
prpar(x, norm = NULL, ...)

## S3 method for class 'rpar'

drpar(x, norm = NULL, ...)

## S3 method for class 'mlogit'
qrpar(x, par = 1, y = NULL, norm = NULL, ...)

## S3 method for class 'mlogit'
prpar(x, par = 1, y = NULL, norm = NULL, ...)

## S3 method for class 'mlogit'
drpar(x, par = 1, y = NULL, norm = NULL, ...)

Arguments

x

a mlogit or a rpar object,

... further arguments.

norm the variable used for normalization if any: for the mlogit method, this should be the name of the parameter, for the rpar method the absolute value of the parameter,

par the required parameter(s) for the mlogit methods (either the name or the position of the parameter(s). If NULL, all the random parameters are used.

y values for which the function has to be evaluated,

Details

rpar objects contain all the relevant information about the distribution of random parameters. These functions enables to obtain easily descriptive statistics, density, probability and quantiles of the distribution.

mean, med, stdev and rg compute respectively the mean, the median, the standard deviation and the range of the random parameter. qrpar, prpar, drpar return functions that compute the quantiles, the probability and the density of the random parameters (note that sd and range are not generic function in R and that median is, but without ...).

Value

a numeric vector for qrpar, drpar and prpar, a numeric vector for mean, stdev and med and a numeric matrix for rg.

Author(s)

Yves Croissant
See Also

mlogit() for the estimation of random parameters logit models and rpar() for the description of rpar objects.

effects.mlogit

Marginal effects of the covariates

Description

The effects method for mlogit objects computes the marginal effects of the selected covariate on the probabilities of choosing the alternatives.

Usage

## S3 method for class 'mlogit'
effects(
  object, 
  covariate = NULL, 
  type = c("aa", "ar", "rr", "ra"), 
  data = NULL, 
  ... 
)

Arguments

- **object**: a mlogit object,
- **covariate**: the name of the covariate for which the effect should be computed,
- **type**: the effect is a ratio of two marginal variations of the probability and of the covariate; these variations can be absolute "a" or relative "r". This argument is a string that contains two letters, the first refers to the probability, the second to the covariate,
- **data**: a data.frame containing the values for which the effects should be calculated. The number of lines of this data.frame should be equal to the number of alternatives,
- **...**: further arguments.

Value

If the covariate is alternative specific, a $J \times J$ matrix is returned, $J$ being the number of alternatives. Each line contains the marginal effects of the covariate of one alternative on the probability to choose any alternative. If the covariate is individual specific, a vector of length $J$ is returned.

Author(s)

Yves Croissant
See Also

mlogit() for the estimation of multinomial logit models.

Examples

data("Fishing", package = "mlogit")
library("zoo")
Fish <- mlogit.data(Fishing, varying = c(2:9), shape = "wide", choice = "mode")
m <- mlogit(mode ~ price | income | catch, data = Fish)
# compute a data.frame containing the mean value of the covariates in
# the sample
z <- with(Fish, data.frame(price = tapply(price, index(m)$alt, mean),
                         catch = tapply(catch, index(m)$alt, mean),
                         income = mean(income)))
# compute the marginal effects (the second one is an elasticity
effects(m, covariate = "income", data = z)
effects(m, covariate = "price", type = "rr", data = z)
effects(m, covariate = "catch", type = "ar", data = z)

Electricity

Stated preference data for the choice of electricity suppliers

Description

A sample of 2308 households in the United States

Format

A dataframe containing:

- choice: the choice of the individual, one of 1, 2, 3, 4,
- id: the individual index,
- pfi: fixed price at a stated cents per kWh, with the price varying over suppliers and experiments, for scenario i=(1, 2, 3, 4),
- cli: the length of contract that the supplier offered, in years (such as 1 year or 5 years.) During this contract period, the supplier guaranteed the prices and the buyer would have to pay a penalty if he/she switched to another supplier. The supplier could offer no contract in which case either side could stop the agreement at any time. This is recorded as a contract length of 0,
- loci: is the supplier a local company,
- wki: is the supplier a well-known company,
- todi: a time-of-day rate under which the price is 11 cents per kWh from 8am to 8pm and 5 cents per kWh from 8pm to 8am. These TOD prices did not vary over suppliers or experiments: whenever the supplier was said to offer TOD, the prices were stated as above.
• seas: a seasonal rate under which the price is 10 cents per kWh in the summer, 8 cents per kWh in the winter, and 6 cents per kWh in the spring and fall. Like TOD rates, these prices did not vary. Note that the price is for the electricity only, not transmission and distribution, which is supplied by the local regulated utility.

Source

Kenneth Train’s home page.

References


Fishing

Choice of Fishing Mode

Description

A sample of 1182 individuals in the United-States for the choice of 4 alternative fishing modes.

Format

A dataframe containing:

• mode: recreation mode choice, one of : beach, pier, boat and charter,
• price.beach: price for beach mode
• price.pier: price for pier mode,
• price.boat: price for private boat mode,
• price.charter: price for charter boat mode,
• catch.beach: catch rate for beach mode,
• catch.pier: catch rate for pier mode,
• catch.boat: catch rate for private boat mode,
• catch.charter: catch rate for charter boat mode,
• income: monthly income,

Source

References


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**Game**

*Ranked data for gaming platforms*

### Description

A sample of 91 Dutch individuals

### Format

A dataframe containing:

- ch.Platform: where platform is one of Xbox, PlayStation, PSPortable, GameCube, GameBoy and PC. This variables contain the ranking of the platforms from 1 to 6,
- own.Platform: these 6 variables are dummies which indicate whether the given platform is already owned by the respondent,
- age: the age of the respondent,
- hours: hours per week spent on gaming.

### Details

The data are also provided in long format (use in this case `data(Game2)`). In this case, the alternative and the choice situation are respectively indicated in the `platform` and `chid` variables.

### Source

*Journal of Applied Econometrics data archive.*

### References

Description
A sample of 250 Californian households

Format
A dataframe containing:
- `depvar`: heating system, one of `gcc` (gas central heat with cooling), `ecc` (electric central resistance heat with cooling), `erc` (electric room resistance heat with cooling), `hpc` (electric heat pump which provides cooling also), `gc` (gas central heat without cooling), `ec` (electric central resistance heat without cooling), `er` (electric room resistance heat without cooling),
- `ich.z`: installation cost of the heating portion of the system,
- `icca`: installation cost for cooling,
- `och.z`: operating cost for the heating portion of the system,
- `occa`: operating cost for cooling,
- `income`: annual income of the household.

Source
Kenneth Train’s home page.

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Description
A sample of 900 Californian households

Format
A dataframe containing:
- `idcase`: id,
- `depvar`: heating system, one of `gc` (gas central), `gr` (gas room), `ec` (electric central), `er` (electric room), `hp` (heat pump),
- `ic.z`: installation cost for heating system `z` (defined for the 5 heating systems),
- `oc.z`: annual operating cost for heating system `z` (defined for the 5 heating systems),
- `pb.z`: ratio `oc.z/ic.z` ,
- `income`: annual income of the household,
- `agehed`: age of the household head
- `rooms`: numbers of rooms in the house,
hmftest  

Source
Kenneth Train’s home page.

hmftest  
Hausman-McFadden Test

Description
Test the IIA hypothesis (independence of irrelevant alternatives) for a multinomial logit model.

Usage
hmftest(x, ...)

## S3 method for class 'formula'
hmftest(x, alt.subset, ...)

## S3 method for class 'mlogit'
hmftest(x, z, ...)

Arguments
- **x**: an object of class mlogit or a formula,
- **...**: further arguments passed to mlogit for the formula method.
- **alt.subset**: a subset of alternatives,
- **z**: an object of class mlogit or a subset of alternatives for the mlogit method. This should be the same model as x estimated on a subset of alternatives,

Details
This is an implementation of the Hausman’s consistency test for multinomial logit models. If the independance of irrelevant alternatives applies, the probability ratio of every two alternatives depends only on the characteristics of these alternatives. Consequently, the results obtained on the estimation with all the alternatives or only on a subset of them are consistent, but more efficient in the first case. On the contrary, only the results obtained from the estimation on a relevant subset are consistent. To compute this test, one needs a model estimated with all the alternatives and one model estimated on a subset of alternatives. This can be done by providing two objects of class mlogit, one object of class mlogit and a character vector indicating the subset of alternatives, or a formula and a subset of alternatives.

Value
an object of class “htest”.

Author(s)
Yves Croissant
References


Examples

```r
## from Greene's Econometric Analysis p. 731

data("TravelMode", package="AER")
TravelMode <- mlogit.data(TravelMode, choice="choice", shape="long",
alt.var="mode", chid.var="individual")

## Create a variable of income only for the air mode
TravelMode$avinc <- with(TravelMode,(mode=="air")*income)

## Estimate the model on all alternatives, with car as the base level
## like in Greene's book.
#x <- mlogit(choice~wait+gcost+avinc, TravelMode, reflevel="car")
x <- mlogit(choice~wait+gcost+avinc, TravelMode)

## Estimate the same model for ground modes only (the variable avinc
## must be dropped because it is 0 for every observation

g <- mlogit(choice=wait+gcost, TravelMode, reflevel="car",
  alt.subset=c("car","bus","train"))

## Compute the test
hmftest(x,g)
```

---

**JapaneseFDI**

**Japanese Foreign Direct Investment in European Regions**

**Description**

A sample of 452 Japanese production units in Europe

**Format**

A dataframe containing:

- firm: the investment id,
- country: the country,
- region: the region (nuts1 nomenclature),
- choice: a dummy indicating the chosen region.
• choice.c: the chosen country,
• wage: wage rate in the region,
• unemp: unemployment rate in the region,
• elig: is the country eligible to european subsidies,
• area: the area of the region,
• scrate: social charge rate (country level),
• ctaxrate: corporate tax rate (country level),
• gdp: regional gdp,
• harris: harris’ market potential,
• krugman: krugman’s market potential,
• domind: domestic industry count,
• japind: japan industry count,
• network: network count.

Source
kindly provided by Thierry Mayer

References

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**logsum**

*Compute the log-sum or inclusive value/utility*

---

**Description**

The `logsum` function computes the inclusive value, or inclusive utility, which is used to compute the surplus and to estimate the two steps nested logit model.

**Usage**

```r
logsum(
  coef,
  X = NULL,
  formula = NULL,
  data = NULL,
  type = NULL,
  output = c("chid", "obs")
)
```
Arguments

- **coef**: a numerical vector or a `mlogit` object, from which the `coef` vector is extracted.
- **X**: a matrix or a `mlogit` object from which the `model.matrix` is extracted.
- **formula**: a formula or a `mlogit` object from which the `formula` is extracted.
- **data**: a `data.frame` or a `mlogit` object from which the `model.frame` is extracted.
- **type**: either "group" or "global": if a `group` argument has been provided in the `mlogit.data`, the inclusive values are by default computed for every group, otherwise, a unique global inclusive value is computed for each choice situation.
- **output**: the shape of the results: if "chid", the results is a vector (if `type = "global"`) or a matrix (if `type = "region") with row number equal to the number of choice situation, if "obs" a vector of length equal to the number of lines of the data in long format is returned.

Details

The inclusive value, or inclusive utility, or log-sum is the log of the denominator of the probabilities of the multinomial logit model. If a "group" variable is provided in the "mlogit.data" function, the denominator can either be the one of the multinomial model or those of the lower model of the nested logit model.

If only one argument (coef) is provided, it should a `mlogit` object and in this case, the coefficients and the `model.matrix` are extracted from this model.

In order to provide a different `model.matrix`, further arguments could be used. X is a matrix or a `mlogit from which the model.matrix is extracted. The formula-data interface can also be used to construct the relevant model.matrix.

Value

either a vector or a matrix.

Author(s)

Yves Croissant

See Also

- `mlogit()` for the estimation of a multinomial logit model.

---

**mFormula**

Model formula for logit models

Description

Two kinds of variables are used in logit models: alternative specific and individual specific variables. `mFormula` provides a relevant class to deal with this specificity and suitable methods to extract the elements of the model.
Usage

mFormula(object)

## S3 method for class 'formula'
mFormula(object)

is.mFormula(object)

## S3 method for class 'mFormula'
model.frame(
  formula,
  data,
  ...,
  lhs = NULL,
  rhs = NULL,
  alt.subset = NULL,
  reflevel = NULL
)

## S3 method for class 'mFormula'
model.matrix(object, data, ...)

Arguments

- **object** for the mFormula function, a formula, for the update and model.matrix methods, a mFormula object,
- **formula** a mFormula object,
- **data** a data.frame,
- **...** further arguments.
- **lhs** see Formula,
- **rhs** see Formula,
- **alt.subset** a vector of subset of alternatives one want to select,
- **reflevel** the alternative selected to be the reference alternative,

Details

Let J being the number of alternatives. The formula may include alternative-specific and individual specific variables. For the latter, \( J - 1 \) coefficients are estimated for each variable. For the former, only one (generic) coefficient or \( J \) different coefficient may be estimated.

A mFormula is a formula for which the right hand side may contain three parts: the first one contains the alternative specific variables with generic coefficient, \( i.e. \) a unique coefficient for all the alternatives; the second one contains the individual specific variables for which one coefficient is estimated for all the alternatives except one of them; the third one contains the alternative specific variables with alternative specific coefficients. The different parts are separated by a \(|\) sign. If a standard formula is written, it is assumed that there are only alternative specific variables with generic coefficients.
The intercept is necessarily alternative specific (a generic intercept is not identified because only utility differences are relevant). Therefore, it deals with the second part of the formula. As it is usual in R, the default behaviour is to include an intercept. A model without an intercept may be specified by including +0 or -1 in the second right-hand side part of the formula. +0 or -1 in the first and in the third part of the formula are simply ignored.

Specific methods are provided to build correctly the model matrix and to update the formula. The mFormula function is not intended to be use directly. While using the mlogit() function, the first argument is automatically coerced to a mFormula object.

Value

an object of class mFormula.

Author(s)

Yves Croissant

Examples

data("Fishing", package = "mlogit")
Fish <- mlogit.data(Fishing, varying = c(2:9), shape = "wide", choice = "mode")

# a formula with to alternative specific variables (price and catch) and an intercept
f1 <- mFormula(mode ~ price + catch)
head(model.matrix(f1, Fish), 2)

# same, with an individual specific variable (income)
f2 <- mFormula(mode ~ price + catch | income)
head(model.matrix(f2, Fish), 2)

# same, without an intercept
f3 <- mFormula(mode ~ price + catch | income + 0)
head(model.matrix(f3, Fish), 2)

# same as f2, but now, coefficients of catch are alternative
# specific
f4 <- mFormula(mode ~ price | income | catch)
head(model.matrix(f4, Fish), 2)

---

miscmethods.mlogit    Methods for mlogit objects

Description

Miscellaneous methods for mlogit objects.
Usage

## S3 method for class 'mlogit'
residuals(object, outcome = TRUE, ...)

## S3 method for class 'mlogit'
df.residual(object, ...)

## S3 method for class 'mlogit'
terms(x, ...)

## S3 method for class 'mlogit'
model.matrix(object, ...)

model.response.mlogit(object, ...)

## S3 method for class 'mlogit'
update(object, new, ...)

## S3 method for class 'mlogit'
print(
  x,
  digits = max(3,getOption("digits") - 2),
  width = getOption("width"),
  ...
)

## S3 method for class 'mlogit'
logLik(object, ...)

## S3 method for class 'mlogit'
summary(object, ..., type = c("chol", "cov", "cor"))

## S3 method for class 'summary.mlogit'
print(
  x,
  digits = max(3,getOption("digits") - 2),
  width = getOption("width"),
  ...
)

## S3 method for class 'mlogit'
index(x, ...)

## S3 method for class 'mlogit'
predict(object, newdata = NULL, returnData = FALSE, ...)

## S3 method for class 'mlogit'
fitted(
mlogit

Multinomial logit model

Description

Estimation by maximum likelihood of the multinomial logit model, with alternative-specific and/or individual specific variables.
mlogit

Usage

mlogit(
  formula,
  data,
  subset,
  weights,
  na.action,
  start = NULL,
  alt.subset = NULL,
  reflevel = NULL,
  nests = NULL,
  un.nest.el = FALSE,
  unscaled = FALSE,
  heterosc = FALSE,
  rpar = NULL,
  probit = FALSE,
  R = 40,
  correlation = FALSE,
  halton = NULL,
  random.nb = NULL,
  panel = FALSE,
  estimate = TRUE,
  seed = 10,
  ...
)

Arguments

formula        a symbolic description of the model to be estimated,
data            the data: an mlogit.data object or an ordinary data.frame,
subset         an optional vector specifying a subset of observations for mlogit,
weights        an optional vector of weights,
na.action       a function which indicates what should happen when the data contains NAs,
start           a vector of starting values,
alts subset     a vector of character strings containing the subset of alternative on which the
                  model should be estimated,
reflevel        the base alternative (the one for which the coefficients of individual-specific
                  variables are normalized to 0),
nests           a named list of characters vectors, each names being a nest, the corresponding
                  vector being the set of alternatives that belong to this nest,
un.nest.el      a boolean, if TRUE, the hypothesis of unique elasticity is imposed for nested logit
                  models,
unscaled        a boolean, if TRUE, the unscaled version of the nested logit model is estimated,
heterosc        a boolean, if TRUE, the heteroscedastic logit model is estimated,
mlogit

rpar a named vector whose names are the random parameters and values the distribution: 'n' for normal, 'l' for log-normal, 't' for truncated normal, 'u' for uniform,
probit if TRUE, a multinomial probit model is estimated,
R the number of function evaluation for the gaussian quadrature method used if heterosc = TRUE, the number of draws of pseudo-random numbers if rpar is not NULL,
correlation only relevant if rpar is not NULL, if true, the correlation between random parameters is taken into account,
halton only relevant if rpar is not NULL, if not NULL, halton sequence is used instead of pseudo-random numbers. If halton = NA, some default values are used for the prime of the sequence (actually, the primes are used in order) and for the number of elements dropped. Otherwise, halton should be a list with elements prime (the primes used) and drop (the number of elements dropped).
random.nb only relevant if rpar is not NULL, a user-supplied matrix of random,
panel only relevant if rpar is not NULL and if the data are repeated observations of the same unit; if TRUE, the mixed-logit model is estimated using panel techniques,
estimate a boolean indicating whether the model should be estimated or not: if not, the model.frame is returned,
seed the seed to use for random numbers (for mixed logit and probit models),
... further arguments passed to mlogit.data or mlogit.optim.

Details

For how to use the formula argument, see mFormula().

The data argument may be an ordinary data.frame. In this case, some supplementary arguments should be provided and are passed to mlogit.data(). Note that it is not necessary to indicate the choice argument as it is deduced from the formula.

The model is estimated using the mlogit.optim(). function.

The basic multinomial logit model and three important extenstions of this model may be estimated.

If heterosc=TRUE, the heteroscedastic logit model is estimated. \( J - 1 \) extra coefficients are estimated that represent the scale parameter for \( J - 1 \) alternatives, the scale parameter for the reference alternative being normalized to 1. The probabilities don’t have a closed form, they are estimated using a gaussian quadrature method.

If nests is not NULL, the nested logit model is estimated.

If rpar is not NULL, the random parameter model is estimated. The probabilities are approximated using simulations with \( R \) draws and halton sequences are used if halton is not NULL. Pseudo-random numbers are drawn from a standard normal and the relevant transformations are performed to obtain numbers drawn from a normal, log-normal, censored-normal or uniform distribution. If correlation = TRUE, the correlation between the random parameters are taken into account by estimating the components of the cholesky decomposition of the covariance matrix. With \( G \) random parameters, without correlation \( G \) standard deviations are estimated, with correlation \( G \times (G + 1) / 2 \) coefficients are estimated.
**mlogit**

### Value

An object of class "mlogit", a list with elements:

- coefficients: the named vector of coefficients,
- logLik: the value of the log-likelihood,
- hessian: the hessian of the log-likelihood at convergence,
- gradient: the gradient of the log-likelihood at convergence,
- call: the matched call,
- est.stat: some information about the estimation (time used, optimisation method),
- freq: the frequency of choice,
- residuals: the residuals,
- fitted.values: the fitted values,
- formula: the formula (a mFormula object),
- expanded.formula: the formula (a formula object),
- model: the model frame used,
- index: the index of the choice and of the alternatives.

### Author(s)

Yves Croissant

### References


### See Also

- [mlogit.data()](#) to shape the data.
- [nnet::multinom()](#) from package nnet performs the estimation of the multinomial logit model with individual specific variables.
- [mlogit.optim()](#) details about the optimization function.

### Examples

```r
## Cameron and Trivedi's Microeconometrics p.493 There are two
## alternative specific variables : price and catch one individual
## specific variable (income) and four fishing mode : beach, pier, boat,
## charter

data("Fishing", package = "mlogit")
```
```r
Fish <- mlogit.data(Fishing, varying = c(2:9), shape = "wide", choice = "mode")

## a pure "conditional" model
summary(mlogit(mode ~ price + catch, data = Fish))

## a pure "multinomial model"
summary(mlogit(mode ~ 0 | income, data = Fish))

## which can also be estimated using multinom (package nnet)
library("nnet")
summary(multinom(mode ~ income, data = Fishing))

## a "mixed" model
m <- mlogit(mode ~ price+ catch | income, data = Fish)
summary(m)

## same model with charter as the reference level
m <- mlogit(mode ~ price+ catch | income, data = Fish, reflevel = "charter")

## same model with a subset of alternatives : charter, pier, beach
m <- mlogit(mode ~ price+ catch | income, data = Fish,
            alt.subset = c("charter", "pier", "beach"))

## model on unbalanced data i.e. for some observations, some
## alternatives are missing
# a data.frame in wide format with two missing prices
Fishing2 <- Fishing
Fishing2[1, "price.pier"] <- Fishing2[3, "price.beach"] <- NA
mlogit(mode=price+catch|income, Fishing2, shape="wide", choice="mode", varying = 2:9)

# a data.frame in long format with three missing lines
data("TravelMode", package = "AER")
Tr2 <- TravelMode[-c(2, 7, 9),]
mlogit(choice=wait+gcost|income+size, Tr2, shape = "long",
       chid.var = "individual", alt.var="mode", choice = "choice")

## An heteroscedastic logit model
data("TravelMode", package = "AER")
hl <- mlogit(choice ~ wait + travel + vcost, TravelMode,
          shape = "long", chid.var = "individual", alt.var = "mode",
          method = "bfgs", heterosc = TRUE, tol = 10)

## A nested logit model
TravelMode$incomeother <- with(TravelMode, ifelse(mode %in% c('air', 'car'), income, 0))

# Hensher and Greene (2002), table 1 p.8-9 model 5
nl <- mlogit(choice=gcost+wait+incomeother, TravelMode,
            shape='long', alt.var='mode',
            nests=list(public=c('train', 'bus'), other=c('car','air')))

# same with a comon nest elasticity (model 1)
```
mlogit.data

data.frame for logit model

Description

shape a data.frame in a suitable form for the use of the mlogit function.

Usage

mlogit.data(
data,  
choice = NULL,  
shape = c("long", "wide"),  
varying = NULL,  
sep = ".",  
alt.var = NULL,  
chid.var = NULL,  
alt.levels = NULL,  
id.var = NULL,  
un.nest.el = TRUE
)

## a probit model
## Not run:
pr <- mlogit(choice ~ wait + travel + vcost, TravelMode,  
shape = "long", chid.var = "individual", alt.var = "mode",  
probit = TRUE)
## End(Not run)

## a mixed logit model
## Not run:
rpl <- mlogit(mode ~ price+ catch | income, Fishing, varying = 2:9,  
shape = 'wide', rpar = c(price= 'n', catch = 'n'),  
correlation = TRUE, halton = NA,  
R = 10, tol = 10, print.level = 0)
summary(rpl)
rpar(rpl)
cor.mlogit(rpl)
cov.mlogit(rpl)
rpar(rpl, "catch")
summary(rpar(rpl, "catch"))
## End(Not run)

# a ranked ordered model
# Not run:
data("Game", package = "mlogit")
g <- mlogit(ch~own|hours, Game, choice='ch', varying = 1:12,  
ranked=TRUE, shape="wide", reflevel="PC")
group.var = NULL,
opposite = NULL,
drop.index = FALSE,
ranked = FALSE,
subset = NULL,
  ...
)

## S3 method for class 'mlogit.data'
print(x, ...)

## S3 method for class 'mlogit.data'
index(x, ...)

## S3 method for class 'mlogit.data'
x[i, j, drop = TRUE]

## S3 method for class 'mlogit.data'
x[[y]]

## S3 method for class 'mlogit.data'
x$y

## S3 replacement method for class 'mlogit.data'
object$y <- value

## S3 replacement method for class 'mlogit.data'
object[[y]] <- value

## S3 method for class 'mlogit.data'
mean(x, ...)

### Arguments

data a data.frame,
choice the variable indicating the choice made: it can be either a logical vector, a nu-
  merical vector with 0 where the alternative is not chosen, a factor with level
  'yes' when the alternative is chosen
shape the shape of the data.frame: whether long if each row is an alternative or wide
  if each row is an observation,
various the indexes of the variables that are alternative specific,
sep the seperator of the variable name and the alternative name (only relevant for a
  wide data.frame),
alt.var the name of the variable that contains the alternative index (for a long data.frame
  only) or the name under which the alternative index will be stored (the default
  name is alt),
chid.var the name of the variable that contains the choice index or the name under which
  the choice index will be stored,
mlogit.data

alt.levels  the name of the alternatives: if null, for a wide data.frame, they are guessed from the variable names and the choice variable (both should be the same), for a long data.frame, they are guessed from the alt.var argument,

id.var      the name of the variable that contains the individual index if any,
group.var   the name of the variable that contains the group index if any,
opposite    returns the opposite of the specified variables,
drop.index  should the index variables be dropped from the data.frame,
ranked      a logical value which is true if the response is a rank,
subset      a logical expression which defines the subset of observations to be selected,
...         further arguments passed to reshape.
x, object   a mlogit.data or a pseries object,
i          the rows to extract,
j          the columns to extract,
drop        a boolean, equal to FALSE if one wants that a data.frame is always returned,
y          the column of the data.frame to extract or to replace,
value       the replacement value,

Value

A mlogit.data object, which is a data.frame in long format, i.e. one line for each alternative. It has a index attribute, which is a data.frame that contains the index of the choice made (chid), the index of the alternative (alt) and, if any, the index of the individual (id) and of the alternative groups (group). The choice variable is a boolean which indicates the choice made. This function use stats::reshape() if the data.frame is in wide format.

Author(s)

Yves Croissant

See Also

stats::reshape()

Examples

# ModeChoice is a long data.frame

data("TravelMode", package = "AER")
TM <- mlogit.data(TravelMode, choice = "choice", shape = "long",
                alt.levels = c("air", "train", "bus", "car"))

# Same but the alt variable called mode is provided

TM <- mlogit.data(TravelMode ,choice = "choice", shape = "long",
                alt.var = "mode")
# Same but the chid variable called individual is provided

TM <- mlogit.data(TravelMode, choice = "choice",
    shape = "long", id.var = "individual",
    alt.levels = c("air", "train", "bus", "car"))

# Same but with two own provided variables

TM <- mlogit.data(TravelMode, choice = "choice", shape = "long",
    id.var = "individual", alt.var = "mode")

# Same but with two own provided variables which are deleted from the
# data.frame

TM <- mlogit.data(TravelMode, choice = "choice", shape = "long",
    id.var = "individual", alt.var = "mode", drop.index = TRUE)

# Train is a wide data.frame with columns 'choiceid' is the choice
# index, the alternatives are named "ch1" and "ch2", the opposite of
# the variables is returned

data("Train", package = "mlogit")
Train <- mlogit.data(Train, choice = "choice", shape = "wide",
    varying = 4:11, alt.levels = c("A", "B"), sep = ".",
    opposite = c("price", "time", "change", "comfort"))

data("HC", package = "mlogit")
HC <- mlogit.data(HC, choice = "depvar", varying=c(2:8, 10:16), shape="wide")

# Game is a data.frame in wide format for which the response is a
# ranking variable

data("Game", package = "mlogit")
G <- mlogit.data(Game, shape="wide", varying = 1:12, alt.var = 'platform',
    drop.index = TRUE, choice="ch", ranked =TRUE)

# Game2 contains the same data, but in long format

data("Game2", package = "mlogit")
G2 <- mlogit.data(Game2, shape='long', choice="ch", alt.var = 'platform', ranked = TRUE)

mlogit.optim

Non-linear minimization routine

Description

This function performs efficiently the optimization of the likelihood functions for multinomial logit
models
Usage

mlogit.optim(
  logLik,
  start,
  method = c("bfgs", "nr", "bhhh"),
  iterlim = 2000,
  tol = 1e-06,
  ftol = 1e-08,
  steptol = 1e-10,
  print.level = 0,
  constPar = NULL,
  ...
)

Arguments

logLik the likelihood function to be maximized,
start the initial value of the vector of coefficients,
method the method used, one of 'nr' for Newton-Ralphson, 'bhhh' for Berndt-Hausman-Hall-Hall and 'bfgs',
iterlim the maximum number of iterations,
tol the value of the criteria for the gradient,
ftol the value of the criteria for the function,
steptol the value of the criteria for the step,
print.level one of (0, 1, 2), the details of the printing messages. If 'print.level = 0', no information about the optimization process is provided, if 'print.level = 1' the value of the likelihood, the step and the stopping criteria is printing, if 'print.level = 2' the vectors of the parameters and the gradient are also printed.
constPar a numeric or a character vector which indicates that some parameters should be treated as constant,
... further arguments passed to f.

Details

The optimization is performed by updating, at each iteration, the vector of parameters by the amount step * direction, where step is a positive scalar and direction = H^-1 * g, where g is the gradient and H^-1 is an estimation of the inverse of the hessian. The choice of H^-1 depends on the method chosen:

if method = 'nr', H is the hessian (i.e. is the second derivatives matrix of the likelihood function),
if method = 'bhhh', H is the outer-product of the individual contributions of each individual to the gradient,
if method = 'bfgs', H^-1 is updated at each iteration using a formula that uses the variations of the vector of parameters and the gradient. The initial value of the matrix is the inverse of the outer-product of the gradient (i.e. the bhhh estimator of the hessian).
The initial step is 1 and, if the new value of the function is less than the previous value, it is divided by two, until a higher value is obtained.

The routine stops when the gradient is sufficiently close to 0. The criteria is \( g \times H^{-1} \times g \) which is compared to the tol argument. It also may stops if the number of iterations equals iterlim.

The function \( f \) has a initial.value argument which is the initial value of the likelihood. The function is then evaluated a first time with a step equals to one. If the value is lower than the initial value, the step is divided by two until the likelihood increases. The gradient is then computed and the function returns as attributes the gradient is the step. This method is more efficient than other functions available for R:

For the optim and the maxLik functions, the function and the gradient should be provided as separate functions. But, for multinomial logit models, both depends on the probabilities which are the most time-consuming elements of the model to compute.

For the nlm function, the function returns the gradient as an attribute. The gradient is therefore computed at each iteration, even when the function is computed with a step that is unable to increase the value of the likelihood.

Previous versions of mlogit depended on the 'maxLik' package. We kept the same interface, namely the start, method, iterlim, tol, print.level and constPar arguments.

The default method is 'bfgs', which is known to perform well, even if the likelihood function is not well behaved and the default value for print.level = 1, which means moderate printing.

A special default behavior is performed if a simple multinomial logit model is estimated. Indeed, for this model, the likelihood function is concave, the analytical hessian is simple to write and the optimization is straightforward. Therefore, in this case, the default method is 'nr' and print.level = 0.

Value

a list that contains the followings elements :

- optimum: the value of the function at the optimum, with attributes: gradi a matrix that contains the contribution of each individual to the gradient, gradient the gradient and, if method = 'nr', hessian' the hessian,
- coefficients: the vector of the parameters at the optimum,
- est.stat: a list that contains some information about the optimization : 'nb.iter' the number of iterations, 'eps' the value of the stoping criteria, 'method' the method of optimization method used, 'message'

Author(s)

Yves Croissant
<table>
<thead>
<tr>
<th>Mode</th>
<th>Mode Choice</th>
</tr>
</thead>
</table>

**Description**

A sample of 453 individuals for 4 transport modes.

**Format**

A dataframe containing:

- choice: one of car, carpool, bus or rail,
- cost.z: cost of mode z,
- time.z: time of mode z.

**Source**

Kenneth Train’s home page.

<table>
<thead>
<tr>
<th>ModeCanada</th>
<th>Mode Choice for the Montreal-Toronto Corridor</th>
</tr>
</thead>
</table>

**Description**

A sample of 3880 travellers for the Montreal-Toronto corridor.

**Format**

A dataframe containing:

- case: the individual index,
- alt: the alternative, one of train, car, bus and air,
- choice: one if the mode is chosen, zero otherwise,
- cost: monetary cost,
- ivt: in vehicule time,
- ovt: out vehicule time,
- frequency: frequency,
- income: income,
- urban: urban,
- noalt: the number of alternatives available.

**Source**

kindly provided by S. Koppelman
References


Examples

data("ModeCanada", package = "mlogit")
bususers <- with(ModeCanada, case[choice == 1 & alt == "bus"])
ModeCanada <- subset(ModeCanada, ! case %in% bususers)
ModeCanada <- subset(ModeCanada, noalt == 4)
ModeCanada <- subset(ModeCanada, alt != "bus")
ModeCanada$alt <- ModeCanada$alt[drop = TRUE]
KoppWen00 <- mlogit.data(ModeCanada, shape='long', chid.var = 'case',
alt.var = 'alt', choice='choice',
drop.index=TRUE)
pcl <- mlogit(choice~freq+cost+ivt+ovt, KoppWen00, reflevel='car',
nests='pcl', constPar=c('iv:train.air'))

---

**NOx**

*Technologies to reduce NOx emissions*

Description

A sample of 632 American production units

Format

A dataframe containing:

- chid: the plant id,
- alt: the alternative,
- id: the owner id,
- choice: the chosen alternative,
- available: a dummy indicating that the alternative is available,
- env: the regulatory environment, one of 'regulated', 'deregulated' and 'public',
- post: dummy for post-combustion pollution control technology,
- cm: dummy for combustion modification technology,
• lnb: dummy for low NOx burners technology,
• age: age of the plant (in deviation from the mean age),
• vcost: variable cost,
• kcost: capital cost.

Source
American Economic Association data archive.

References

plot.mlogit

Plot of the distribution of estimated random parameters

Description
Methods for rpar and mlogit objects which provide a plot of the distribution of one or all of the estimated random parameters

Usage
## S3 method for class 'mlogit'
plot(x, par = NULL, norm = NULL, type = c("density", "probability"), ...)

## S3 method for class 'rpar'
plot(x, norm = NULL, type = c("density", "probability"), ...)

Arguments
x a mlogit or a rpar object,
par a subset of the random parameters; if NULL, all the parameters are selected,
norm the coefficient's name for the mlogit method or the coefficient's value for the rpar method used for normalization,
type the function to be plotted, whether the density or the probability density function,
... further arguments, passed to plot.rpar for the mlogit method and to plot for the rpar method.

Details
For the rpar method, one plot is drawn. For the mlogit method, one plot for each selected random parameter is drawn.
RiskyTransport

Author(s)
Yves Croissant

See Also
mlogit() the estimation of random parameters logit models and rpar() for the description of rpar objects and distribution for functions which return informations about the distribution of random parameters.

Description
1793 choices by 561 individuals of a transport mode at Freetwon airport

Format
A dataframe containing:
- id: individual id,
- choice: 1 for the chosen mode,
- mode: one of Helicopter, WaterTaxi, Ferry, and Hovercraft,
- cost: the generalised cost of the transport mode,
- risk: the fatality rate, numbers of death per 100,000 trips,
- weight: weights,
- seats: ,
- noise: ,
- crowdness: ,
- convloc: ,
- clientele: ,
- chid: choice situation id,
- african: yes if born in Africa, no otherwise,
- lifeExp: declared life expectancy,
- dwage: declared hourly wage,
- iwage: imputed hourly wage,
- educ: level of education, one of low and high,
- fatalism: self-ranking of the degree of fatalism,
- gender: gender, one of female and male,
- age: age,
- haveChildren: yes if the traveler has children, no otherwise,
- swim: yes if the traveler knows how to swim, 'no, otherwise.
Source
American Economic Association data archive.

References

rpar
random parameter objects

Description
rpar objects contain the relevant information about estimated random parameters. The homonymous function extract on rpar object from a mlogit object.

Usage
rpar(x, par = NULL, norm = NULL, ...)

## S3 method for class 'rpar'
print(
x,
digits = max(3,getOption("digits") - 2),
width = getOption("width"),
...
)

## S3 method for class 'rpar'
summary(object, ...)

Arguments
x, object a mlogit object,
par the name or the index of the parameters to be extracted; if NULL, all the parameters are selected,
norm the coefficient used for normalization if any,
... further arguments.
digits the number of digits
width the width of the printed output

Details
mlogit objects contain an element called rpar which contain a list of rpar objects, one for each estimated random parameter. The print method prints the name of the distribution and the parameter, the summary behave like the one for numeric vectors.
Scoretest

Value

A `rpar` object, which contains:

- `dist`: the name of the distribution,
- `mean`: the first parameter of the distribution,
- `sigma`: the second parameter of the distribution,
- `name`: the name of the parameter.

Author(s)

Yves Croissant

See Also

`mlogit()` for the estimation of a random parameters logit model.

Description

Three tests for mlogit models: specific methods for the Wald test and the likelihood ration test and a new function for the score test

Usage

```r
scoretest(object, ...)
```

## S3 method for class `mlogit`
```r
scoretest(object, ...)
```

## Default S3 method:
```r
scoretest(object, ...)
```

## S3 method for class `mlogit`
```r
waldtest(object, ...)
```

## S3 method for class `mlogit`
```r
lrtest(object, ...)
```

Arguments

- `object` an object of class `mlogit` or a formula.
- `...` two kinds of arguments can be used. If `mlogit` arguments are introduced, initial model is updated using these arguments. If formula or other `mlogit` models are introduced, the standard behavior of `lmtest::waldtest()` and `lmtest::lrtest()` is followed.
Details

The `scoretest` function and `mlogit` method for `waldtest` and `lrtest` from the `lmtest` package provides the infrastructure to compute the three tests of hypothesis for `mlogit` objects.

The first argument must be a `mlogit` object. If the second one is a fitted model or a formula, the behaviour of the three functions is the one of the default methods of `waldtest` and `lrtest`: the two models provided should be nested and the hypothesis tested is that the constrained model is the ‘right’ model.

If no second model is provided and if the model provided is the constrained model, some specific arguments of `mlogit` should be provided to describe how the initial model should be updated. If the first model is the unconstrained model, it is tested versus the ‘natural’ constrained model; for example, if the model is a heteroscedastic logit model, the constrained one is the multinomial logit model.

Value

an object of class `htest`.

Author(s)

Yves Croissant

Examples

```r
library("mlogit")
library("lmtest")
data("TravelMode", package = "AER")
ml <- mlogit(choice ~ wait + travel + vcost, TravelMode,
              shape = "long", chid.var = "individual", alt.var = "mode")
hl <- mlogit(choice ~ wait + travel + vcost, TravelMode,
              shape = "long", chid.var = "individual", alt.var = "mode",
              method = "bfgs", heterosc = TRUE)
lrtest(ml, hl)
waldtest(hl)
scoretest(ml, heterosc = TRUE)
```

Train Stated Preferences for Train Traveling

Description

A sample of 235 Dutch individuals facing 2929 choice situations
Format

A dataframe containing:

- id: individual identifier,
- choiceid: choice identifier,
- choice: one of 'A' or 'B',
- price_z: price of proposition z (z = 'A', 'B') in cents of guilders,
- time_z: travel time of proposition z (z = 'A', 'B') in minutes,
- comfort_z: comfort of proposition z (z = 'A', 'B'), 0, 1 or 2 in decreasing comfort order,
- change_z: number of changes for proposition z (z = 'A', 'B').

Source

Journal of Applied Econometrics data archive.

References


vcov.mlogit  vcov method for mlogit objects

Description

The vcov method for mlogit objects extract the covariance matrix of the coefficients, the errors or the random parameters.

Usage

```
## S3 method for class 'mlogit'
vcov(
  object,
  what = c("coefficient", "errors", "rpar"),
  subset = c("all", "iv", "sig", "sd", "sp", "chol"),
  type = c("cov", "cor", "sd"),
  reflevel = NULL,
  ...
)
```

```
## S3 method for class 'vcov.mlogit'
```
print(x, ...)  

## S3 method for class 'vcov.mlogit'
summary(object, ...)  

## S3 method for class 'summary.vcov.mlogit'
print(
  x,
  digits = max(3, getOption("digits") - 2),
  width = getOption("width"),
  ...  
)

Arguments

object       a mlogit object (and a vcov.mlogit for the summary method),
what         indicates which covariance matrix has to be extracted: the default value is
              coefficients, in this case, vcov behaves as usual. If what equals errors the
              covariance matrix of the errors of the model is returned. Finally, if what equals
              rpar, the covariance matrix of the random parameters are extracted,
subset       the subset of the coefficients that have to be extracted (only relevant if what
              = "coefficients"),
type         with this argument, the covariance matrix may be returned (the default) ; the
              correlation matrix with the standard deviation on the diagonal may also be ex-
              tracted,
reflevel     relevant for the extraction of the errors of a multinomial probit model ; in this
              case the covariance matrix is of error differences is returned and, with this argu-
              ment, the alternative used for differentiation is indicated,
...          further arguments.
x           a vcov.mlogit or a summary.vcov.mlogit object,
digits      the number of digits,
width       the width of the printing,

Details

This new interface replaces the cor.mlogit and cov.mlogit functions which are deprecated.

Author(s)

Yves Croissant

See Also

mlogit() for the estimation of multinomial logit models.
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