Package ‘pim’

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Description Fit a probabilistic index model as described in
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modeling function has changed in this new version. The old version is
still available at R-Forge.
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  'pim.formula-class.R' 'pim-class.R' 'pim.summary-class.R'
  'Extract.pim.summary.R' 'FEVData.R' 'Getters.R' 'Getters_pim.R'
  'Getters_pim.formula.R' 'InternalFunctions.R'
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  'create.poset.R' 'formula.R' 'has.intercept.R' 'is.complete.R'
  'make.posfun.R' 'model.matrix.pim.R' 'new.pim.R'
  'new.pim.env.R' 'new.pim.formula.R' 'new.pim.poset.R' 'nobs.R'
  'penv.R' 'pim.R' 'pim.fit.R' 'pimdata.R' 'poset.R' 'print.R'
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Description

Fit a probabilistic index model. Note that this version is NOT compatible with the previous version used in the original publications on probabilistic index models. If you want to try out the original code, please install the package pimold from R-Forge. You can install the old package using:

Details

install.packages('pimold',repos = 'http://R-Forge.R-project.org')

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References

http://r-forge.r-project.org/projects/pim/

Description

This function creates a poset function from a poset. The function is not exported and shouldn’t be called by the user.

Usage

.make.posfun(poset)
Arguments

- `poset` a vector with the columns as indices

Value

A function that takes a single vector as argument, and that returns the vector with the poset vector applied to it.

Description

This function adds a poset to a `pim.environment` object.

Usage

```
add.poset(x, ...)
```

## S4 method for signature 'pim.environment'
add.poset(x, overwrite = FALSE, ...)

Arguments

- `x` a `pim.environment` object
- `...` further parameters passed to `new.pim.poset`
- `overwrite` a logical value indicating whether the poset should be overwritten if it’s already present. Defaults to `FALSE` to avoid problems.

Value

The object with a (new) poset attached.

Warning

Although it might be tempting to pass the argument `nobs` to `new.pim.poset`, you shouldn’t. The necessary information is taken from the respective slot in the `pim.environment` object.

If you provide a matrix or a list as value for the argument `compare`, note that you can easily create a poset that doesn’t use all the observations. This might or might not be your intention. If the poset you try to create contains indices that go beyond the number of observations, you will get errors.

See Also

`new.pim.poset` for the possible values of the arguments `compare` and `nobs`.
Examples

```r
data(DysData)
Dysenv <- new.pim.env(DysData)
Dysenv
DysenvAll <- add.poset(Dysenv, overwrite = TRUE,
                        compare = 'all', nobs = nobs(DysData))
compare(Dysenv)
compare(DysenvAll)
```

---

**as.data.frame**

Convert a `pim.environment` to a data frame

Description

This function extracts all data from a `pim.environment` and returns it as a data frame. Note that this is the original data frame, not the one with pseudo observations.

Usage

```r
as.data.frame(x, row.names = NULL, optional = FALSE, ...)
```

## S4 method for signature 'pim.environment'

```r
as.data.frame(x, row.names = NULL, optional = FALSE, ...)
```

Arguments

- **x**
  - a `pim.environment` object
- **row.names**
  - NULL or a character vector giving the row names for the data frame. Missing values are not allowed.
- **optional**
  - logical. if TRUE, setting row names and converting column names (to syntactic names: see `make.names`) is optional
- **...**
  - additional arguments to be passed to or from methods, including `stringsAsFactors`.

Details

TO DO: Insert link to how to get pseudo observations out.

Value

a data frame.
Examples

# Create a pim environment
data("DysData")
Dys <- new.pim.env(DysData)
str(as.data.frame(Dys))

as.matrix.pim.summary  Convert a pim.summary object to a matrix

Description

This function converts a summary object to a matrix so values can be extracted from it.

Usage

as.matrix(x, ...)

## S4 method for signature 'pim.summary'
as.matrix(x, ...)

## S4 method for signature 'pim'
as.matrix(x, ...)

Arguments

x  a pim.summary object
...

additional arguments to be passed to or from methods. This one is ignored.

Value

a matrix with the estimate, standard error, Z value and probability for every coefficient.

classes  Extract information from pim.environment and pim.poset objects

Description

These functions serve to extract the information contained in the objects of class pim.environment and pim.poset.
Usage

classes(x)

# S4 method for signature 'pim.environment'
classes(x)

# S4 method for signature 'pim.environment'
names(x)

# S4 method for signature 'pim.poset'
names(x)

compare(x)

# S4 method for signature 'pim.environment'
compare(x)

# S4 method for signature 'pim.poset'
compare(x)

model(object, ...)

# S4 method for signature 'pim'
model(object)

# S4 method for signature 'pim.summary'
model(object)

link(object, ...)

# S4 method for signature 'pim'
link(object)

# S4 method for signature 'pim.summary'
link(object)

Arguments

x an object of class pim.environment or pim.poset
object an object of class pim or pim.summary
... arguments passed to and from other methods.

Value

classes(): A named vector with the classes of the data contained in the pim.environment
names(): For an object of class pim.environment the names of the variables in the object. For an
object of class pim.poset, the name of the poset functions inside the environment
compare(): A character value indicating how the comparison is defined in a pim.poset object, or the poset-slot of a pim.environment object respectively.

model(): a character value that displays the type of model (difference, marginal, regular or customized)

link(): a character value that displays the type of link (difference, marginal, regular or customized)

See Also

nobs, poset, is.complete, pim.environment-class, pim.poset-class, pim-class, pim.summary-class

Examples

data(DysData)
DysPimEnv <- new.pim.env(DysData, poset=TRUE)
classes(DysPimEnv)
names(DysPimEnv)
compare(DysPimEnv)

themodel <- pim(SPC_D2 ~ Chemo, data = DysData, model = 'difference')
model(themodel)
thesummary <- summary(themodel)
model(thesummary)

coef

Extract the coefficients from a pim or pim.summary object

Description

This function works like coef from the stats package. It extracts the coefficients from the objects.

Usage

c coef(object, ...)

# S4 method for signature 'pim'
c coef(object, ...)

# S4 method for signature 'pim.summary'
c coef(object, ...)

Arguments

object a pim or pim.summary object
... currently ignored.

Value

a named vector with the coefficients.
Examples

```r
data("FEVData")
Model <- pim(FEV~ Age + Smoke*Sex , data=FEVData)
coef(Model)
summ <- summary(Model)
coef(summ)
```

confint.pim

*Calculate Wald confidence intervals around the coefficients of a PIM*

Description

This function returns Wald confidence intervals around the coefficients of a fitted \texttt{pim} object.

Usage

```r
confint(object, parm, level = 0.95, ...)
```

## S4 method for signature 'pim'

```r
confint(object, parm, level = 0.95, ...)
```

## S4 method for signature 'pim.summary'

```r
confint(object, parm, level = 0.95, ...)
```

Arguments

- **object**: a \texttt{pim} or \texttt{pim.summary} object
- **parm**: a specification of which parameters are to be given confidence intervals. Either a vector of numbers or a vector of names. If missing, all parameters are considered.
- **level**: The confidence level required.
- **...**: extra arguments to methods

create.poset

*Create a poset*

Description

This function creates a poset for use in a pim model based on a number of observations and a comparison type. This function is called from \texttt{new.pim.poset} and returns a list that can be used as a value for its argument compare.

Usage

```r
create.poset(compare = c("unique", "all"), n)
```
CreateScoreFun

Create a score function for use in a pim.

Description

This function creates a suitable score function for the fitting process of a probabilistic index model.

Usage

CreateScoreFun(Z, Y, link = c("probit", "logit", "identity"), W = NULL)

Arguments

- **Z**: the model matrix of pseudo-observations
- **Y**: a vector with the response of the pseudo-observations
- **link**: a character vector indicating the link function to be used.
- **W**: a vector with weights.

Value

- a function used for estimating the coefficients by the estimator functions.

NOTE

This function is not exported.
DysData

This is the Dysphagia data

Description

This is the Dysphagia data

Details

These are the columns and their meanings

- out  Outcome: a factor with values 1 to 4, indicating the outcome
- Chemo  Whether the patient underwent chemotherapy ("ja" is yes, "nee" is no)
- SNP.XRCC1__77  Genotype of this SNP. A factor with three levels: "TT", "TC" and "CC"
- SPC_D2  Dose of radiation that reached 2
- SNP.XRCC1__77TC  1 if SNP.XRCC1__77 is "TC", 0 otherwise

EngelData

This is the engel data

Description

This is the engel data

Details

These are the columns and their meanings

- foodexp  Food expenditure (FE)
- income  Household income (HI)
estimators  

Estimator functions for probabilistic index models

Description

This page documents different possibilities for solving the score function of a probabilistic index model or pim. All functions mentioned on this page, are essentially wrappers around different solver functions.

Usage

estimator.nleqslv(
  x,
  y,
  start = rep(0, ncol(x)),
  link = "logit",
  construct = NULL,
  ...
)

estimator.glm(x, y, start = rep(0, ncol(x)), link = "logit", ...)

estimator.BB(
  x,
  y,
  start = rep(0, ncol(x)),
  link = "logit",
  construct = NULL,
  method = c(1, 2, 3),
  control = list(NM = c(FALSE, TRUE)),
  ...
)

Arguments

- **x**  a model matrix for the respective pim model. See also model.matrix.
- **y**  a vector with the response for the respective pim model.
- **start**  a vector as long as there are columns in x, containing the starting values for the algorithm
- **link**  a character vector describing the link function. This link function is used to adapt the calculation depending on the link used in the fitting process.
- **construct**  a function that creates the score function used by either nleqslv or BBsolve for numerical optimization. See Details. The estimator estimator.glm doesn’t allow for specification of your own score function.
- ...  extra arguments passed down to the actual solver function. See details.
method  A vector of integers specifying which Barzilai-Borwein steplengths should be used in a consecutive manner. The methods will be used in the order specified. More information on the help page of BBsolve.

control  a list with extra controlling parameters for BBsolve. See the help page of BBsolve for more information.

Details

All functions share the same three arguments, being the design matrix \( x \), the response vector \( y \) and the start values for the estimating function. If you follow the same principles, you can write your own wrapper function for any solver function of your choice.

The solvers estimator.nleqslv and estimator.BBsolve allow for specification of your own score function as well. For this, you have the possibility to provide a constructor function that takes three arguments

\[ x \]  The model matrix
\[ y \]  the vector with pseudo-observations
\[ \text{link} \]  a character vector specifying the link

The function should return a function that can be used in either nleqslv or BBsolve. If you don’t specify this constructor function, the package will use the constructor function CreateScoreFun to provide the score function.

Value

a list with following elements:

\[ \text{coef} \]  the estimated coefficients

WARNING

If you specify your own score function without changing the estimators for the variance-covariance matrix, this vcov matrix will be blatantly wrong!!!!!!

See Also

nleqslv, glm.fit, BBsolve for more information on the fitting algorithms.

vcov.estimators, pim.fit and pim for more information on the fitting process

Examples

# This is a reimplementaiton of the identity link
myconstruct <- function(x,y,link){
  # this function is returned
  function(beta){
    xb <- as.vector(x %% beta)
    colSums(x * (y - xb))
  }
}

# This is a reimplementation of the identity link
data(ChickWeight)
themodel <- pim(weight ~ Diet, data = ChickWeight,
construct = myconstruct)

# compare coefficients to
themodel2 <- pim(weight ~ Diet, data = ChickWeight,
link = "identity")
coef(themodel)
coef(themodel2)

# Note that this example uses a wrong estimate for the variance-covariance matrix
# You have to specify the correct vcov estimator as well

---

Extract.pim.summary  Extract method for pim.summary objects

**Description**

This method allows to extract data directly from a `pim.summary` object. It’s exactly the same as extracting from `as.matrix(thesummary)`.

**Usage**

```r
## S4 method for signature 'pim.summary'
X[i, j, drop = TRUE]
```

**Arguments**

- `x`  
  object from which to extract element(s) or in which to replace element(s).
- `i`  
  indices specifying elements to extract or replace. Indices are numeric or character vectors or empty (missing) or NULL. Numeric values are coerced to integer as by `as.integer` (and hence truncated towards zero). Character vectors will be matched to the `names` of the object (or for matrices/arrays, the `dimnames`): see ‘Character indices’ below for further details.
  For `[.-indexing only: `i`, `j`, ...` can be logical vectors, indicating elements/slices to select. Such vectors are recycled if necessary to match the corresponding extent. `i`, `j`, ... can also be negative integers, indicating elements/slices to leave out of the selection.
  When indexing arrays by `[ a single argument `i` can be a matrix with as many columns as there are dimensions of `x`; the result is then a vector with elements corresponding to the sets of indices in each row of `i`.
  An index value of NULL is treated as if it were `integer(0)`.
- `j`  
  see `i`
- `drop`  
  For matrices and arrays. If TRUE the result is coerced to the lowest possible dimension (see the examples). This only works for extracting elements, not for the replacement. See `drop` for further details.
Value

the selected matrix

Examples

data(FEVData)
Model <- pim(FEV~ Smoke*Sex , data=FEVData)

thesummary <- summary(Model)
thesummary[,2:3]
thesummary["Sex"]

FEVData

This is the Childhood respiratory disease data

Description

This is the Childhood respiratory disease data

Details

These are the columns and their meanings

- FEV Forced Expiratory Volme (FE)
- Age Age of the child
- Height Height of the child
- Sex Gender of the child (1 for boys, 0 for girls)
- Smoke 1 if the child smokes, 0 otherwise

formula

Extract the formula from a pim or pim.formula object

Description

This function allows you to extract a formula from a pim or a pim.formula object. In the latter case, you extract the original formula.

Usage

formula(x, ...)

## S4 method for signature 'pim'
formula(x, orig = FALSE, ...)

## S4 method for signature 'pim.formula'
formula(x, ...)

Arguments

x 
a pim or pim.formula object

... 
arguments passed to other methods

orig 
a logical value indicating whether the original formula (TRUE) or the pim.formula object (FALSE) should be returned. Defaults to FALSE

Details

This function is based on formula from the stats package. It creates a generic and can hence be used more or less in the same way. Yet, as the pim package is dependent on the correct binding between the formula objects and different environments, it is advised not to change the environments tied to the formulas and to use this function only to extract the desired information.

Value

a pim.formula if x is a pim object and orig = TRUE. Otherwise a formula object.

See Also

pim.formula-class and pim-class for more information on the classes.

Examples

data("DysData")
themodel <- pim(SPC_D2 ~ Chemo, data = DysData)

thepimform <- formula(themodel)
formula(thepimform)
formula(themodel, orig = TRUE)

---

has.intercept 

Check whether formula has an explicit intercept

Description

This function checks whether an intercept is present in a formula of some form. It works for a formula, a terms.object a pim.formula object or a character vector representing a formula.

Usage

has.intercept(x)

## S4 method for signature 'character'
has.intercept(x)

## S4 method for signature 'formula'
has.intercept

has.intercept(x)

## S4 method for signature 'terms'
has.intercept(x)

## S4 method for signature 'pim.formula'
has.intercept(x)

## S4 method for signature 'pim'
has.intercept(x)

Arguments

x either a formula, pim.formula, terms.object or a character vector representing a formula.

Details

In case of a terms.object, this function only checks whether the intercept attribute is larger than 0. In all other cases, the function checks whether it can find a + 1 somewhere in the formula, indicating that an intercept has to be fit in a pim.

Value

a single logical value

WARNING

This function will return FALSE for a standard formula that is used in the context of a marginal model. Keep in mind that when specifying model = 'marginal' in a call to pim, the model will contain an intercept regardless of the outcome of has.intercept.

Note

This function is meant to be used in the context of a pim call. Although the function should work for standard formulas as well, correct results are not guaranteed when used outside a pim context.

Examples

data("FEVData")
# Create the "model frame"
FEVenv <- new.pim.env(FEVData, compare="unique")
# create the formula and bind it to the pim.environment.
FEVform <- new.pim.formula(
  Age ~ I(L(Height) - R(Height)) ,
  FEVenv
)
has.intercept(FEVform)
FEVform2 <- new.pim.formula(Age ~ Height + 1, FEVData)
has.intercept(FEVform2)
has.specials  

Extract information from a pim.formula object

**Description**

This group of functions provides an easy way to extract the extra information saved in a `pim.formula` object. Take a look at the help page of `pim.formula` for more information.

**Usage**

```r
has.specials(x)

## S4 method for signature 'pim.formula'
has.specials(x)

terms(x, ...)

## S4 method for signature 'pim.formula'
terms(x)

lhs(x)

## S4 method for signature 'pim.formula'
lhs(x)
```

**Arguments**

- `x` an object of the class `pim.formula`
- `...` arguments passed to other methods

**Value**

- `has.specials()`: a single TRUE or FALSE value indicating whether the formula right-hand side contains any special functions.
- `terms()`: the `terms` object of the `pim.formula` object
- `lhs()`: an object of class `call` containing the left hand side of the formula as used in the `pim`

**See Also**

- the class `pim.formula-class`
- `response` for extracting the pseudoresponse variable, `model.matrix` for extracting the design matrix of pseudo-observations, `formula` for extracting the `pim.formula` and `penv` for extracting the `pim` environment.
is.complete

Examples

data("FEVData")
# Create the "model frame"
FEVenv <- new.pim.env(FEVData, compare="unique")

# create the formula and bind it to the pim.environment.
FEVform <- new.pim.formula(
  Age ~ I(L(Height) - R(Height)) ,
  FEVenv
)
lhs(FEVform)
has.specials(FEVform)
penv(FEVform)

FEVform2 <- new.pim.formula(
  FEV ~ Height*Sex,
  FEVenv
)

has.specials(FEVform2)
terms(FEVform2)

is.complete

Check whether a pim environment is complete

Description

Objects of class pim.environment can be created with or without a poset. To check whether an object has a poset included, you use the function is.complete

Usage

is.complete(x)

Arguments

x an object of class pim.environment

Value

a single value TRUE or FALSE

Note

This function is not written as an S4 method. Might be rewritten to S4 later on.
Examples

# the constructor returns an empty environment without poset
is.complete(new.pim.env())

# Constructing a pim environment with a poset
data("FEVData")
FEVenv <- new.pim.env(FEVData, compare="unique")
is.complete(FEVenv)

L

Specify the left hand and right hand side of an expression used in pims

Description

These functions allow you to specify the left hand side and right hand side of a term in a pim model. The user should only use this functions within a formula using the `pim` function. Use in a different context will return an error.

Usage

L(x)

R(x)

PP(x)

Arguments

x any vector specified in a formula

Details

These specific functions are actually not used by the function `pim`. `pim` calls the internal function `.make.posfun` to create the actual functions L and R to work with the specified posets of the model of interest.

The actual functions used by `pim` are saved in a specific environment, a `pim.environment`, which resides in the `pim-class` object returned by `pim`. This way of working is chosen in order to avoid unnecessary copying of data.

The function PP serves simply as short for R(x) - L(x). If used outside the context of a pim model, it will generate multiple warnings (see section warning).

Value

a vector with the pseudo-observations for x, based on the poset used to create the function. If used in a wrong context (i.e. not in a call to pim), it returns x unchanged and throws a warning.
These functions serve only as placeholder. During the fitting process of a pim, they get updated to include the posets (the indices that determine which observations are compared) Note that this makes the functions behave fundamentally different from what you would expect R. The result of these functions depends on the context in which they are called.

Examples

```r
## Not run:
pim(income~L(foodexp) - R(foodexp)), data=Engeldata)
L(1:10) # Gives a warning
## End(Not run)
```

---

**MHDdata**

*This is the Mental health data*

---

**Description**

This is the Mental health data

**Details**

These are the columns and their meanings

- `mental` Mental impairment (MI)
- `ses` Socioeconomic status
- `life` Life index (LI)

---

**model.matrix.pim**

*Create a model matrix for a probabilistic index model*

---

**Description**

This function creates a model matrix for use in a probabilistic index model. This model matrix can be passed to `pim.fit`.
Usage

model.matrix(object, ...)  
## S4 method for signature 'pim'
model.matrix(object, data, ...)  
## S4 method for signature 'pim.formula'
model.matrix(  
  object,  
  data,  
  model = c("difference", "marginal", "regular", "customized"),  
  ...  
)

Arguments

object a pim.formula object that contains the formula necessary for constructing the model matrix.

... extra arguments passed to or from other methods. This is currently only implemented in concordance with the generic model.matrix function.

data an optional argument specifying the data frame for which the model matrix should be constructed. See also model.matrix in the stats package.

model a single character value with possible values "difference" (the default), "marginal", "regular" or "customized". See also pim.

Value

a design matrix for a pim model

Examples

data("FEVData")  
# Create the "model frame"  
FEVenv <- new.pim.env(FEVData, compare="unique")  
# This includes the poset  
pos <- poset(FEVenv, as.list=TRUE)

# create the formula and bind it to the pim.environment.  
FEVform <- new.pim.formula(  
  Age ~ I(L(Height) - R(Height)) ,  
  FEVenv  
)

# Use this formula object to construct the model matrix  
# use the default model ( difference )  
MM <- model.matrix(FEVform)

# Use this formula object to construct the pseudo response  
Y <- response(FEVform)
new.pim

Create an object of class pim

Description

This function is the constructor for an object of class pim. It is nothing but a placeholder for new("pim",...). This function is not exported.

Usage

new.pim(...)

Arguments

... Data to include in the new object. See new

Value

an object of class pim. See pim-class

new.pim.env

Constructor for a pim.environment

Description

This functions serves as a constructor for an object of the class pim.environment. In most cases, calling this function directly is not necessary.

Usage

new.pim.env(data, ...)

## S4 method for signature 'missing'
new.pim.env(data, ...)

## S4 method for signature 'environment'
new.pim.env(
  data,
  compare = "unique",
  env = parent.frame(),
  vars = NULL,
new.pim.env

classes = NULL,
...
)

## S4 method for signature 'list'
new.pim.env(data, compare = "unique", vars = NULL, ...)

## S4 method for signature 'data.frame'
new.pim.env(data, compare = "unique", vars = NULL, ...)

## S4 method for signature 'ANY'
new.pim.env(data, ...)

Arguments

data a data frame, a list or an environment containing the data for a probabilistic
index model.
...
extra parameters for construction of the poset, like the argument compare from
new.pim.poset.
compare a character vector, matrix or list that defines how the set of pseudo observations
(poset) should be constructed. if set to NULL, no poset is constructed. See also
new.pim.poset for more information on how to specify a custom poset.
env an environment that is the parent environment of the object.
vars An optional character vector with the names of the variables that should be in-
cluded in the pim environment. Note that the variable names should be found in
the object passed to argument data.
classes An optional character vector with the classes of the variables in the environment,
given in the same order as the argument data.names.

Details

This function is called during the preparation of the model matrix for a pim. The resulting object is
used to evaluate the formula of a pim, and stores information on how this is done.
Note that the parent of the environment is actually the pim.poset object in the poset slot. The
parent you set using the env argument, is the parent of the pim.poset object. This ensures that
when a formula is evaluated in the pim.environment it will use a suitable search path to find all
functions and objects.

Value

an object of the class pim.environment

Examples

new.pim.env() # Creates an empty object

# Starting from a data frame
data(DysData)
env1 <- new.pim.env(DysData)
env2 <- new.pim.env(DysData, compare=NULL)
poset(env2)
env3 <- new.pim.env(DysData, compare="all")
poset(env3)
data(FEVData)
env4 <- new.pim.env(FEVData, vars=c('Age','Sex'))
ls(env4)

---

**new.pim.formula**  
*Constructor for pim.formula*

**Description**

This function reworks a formula to a pim.formula for use in a probabilistic index model. This function is only meant to be used internally, but is exported. It should be used only in concordance with `model.matrix.pim`.

**Usage**

```r
new.pim.formula(formula, data, ...)
```

### S4 method for signature 'formula,pim.environment'
```r
new.pim.formula(formula, data, ...)
```

### S4 method for signature 'formula,ANY'
```r
new.pim.formula(formula, data, ...)
```

**Arguments**

- `formula` a formula object
- `data` either a `pim.environment` object containing the data for the pim, or an object that can be converted to a `pim.environment` by `new.pim.env`
- `...` extra arguments to `new.pim.env`

**Details**

It is the constructor to be used for a `pim.formula` object, and should only be used in conjunction with `model.matrix.pim` and `pim.fit` as shown in the examples.

**Value**

A `pim.formula` object.
See Also

`pim.formula-class` for more information on the class itself. P0, L and R for some functions that can be used in a `pim.formula`

# @examples data("FEVData") # Create the "model frame" FEVenv <- new.pim.env(FEVData, compare="unique") # This includes the poset pos <- poset(FEVenv, as.list=TRUE)

# create the formula and bind it to the pim.environment. FEVform <- new.pim.formula( Age ~ I(L(Height)) - R(Height)), FEVenv )

# Use this formula object to construct the model matrix # use the default model ( difference ) MM <- model.matrix(FEVform)

# Use this formula object to construct the pseudo response Y <- response(FEVform)

# Now pim.fit can do what it does res <- pim.fit(MM,Y, estim = "estimator.glm", penv=FEVenv)

---

new.pim.poset

Create a pim.poset environment

Description

This function allows you to create a `pim.poset` environment that can be added to a `pim.environment` object. You can use this function to create a custom poset, but in general it’s safer to use the relevant arguments of the `pim` function. That way more safety checks are carried out.

Usage

new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'character,numeric'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'matrix,numeric'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'list,numeric'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'matrix,missing'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'list,missing'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'missing,numeric'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'missing,number'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'list,number'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)

## S4 method for signature 'matrix,number'
new.pim.poset(compare, nobs, parent = parent.frame(), ...)
**Arguments**

- **compare**: A character value, matrix or list indicating how the poset should be constructed. Defaults to the default value of `create.poset`. See Details section for more information.
- **nobs**: An integer value determining the number of observations this poset is created for. If compare is not a character value, the number of observations.
- **parent**: An optional environment that serves as the parent for the `pim.poset` environment. By default this is the environment from which the function is called. Note that for a correct functioning, the parent environment should be set to the `pim.environment` this object is part of. This is done automatically by the function `add.poset`.
- **...**: arguments passed to other methods.
- **comp.value**: a character value to be used as value for the compare slot of the object. Defaults to 'custom' and should be left at the default without a very good reason to change it.

**Details**

A poset (or pseudo observation set) in the context of probabilistic index models is a set of indices that determines which observations are compared with one another. It is used to construct the pseudo-observations on which the model is fitted. You can think of a poset as a "pseudo-observation set".

The most convenient way to use this function, is by specifying a character value for the argument `compare`. The value "unique" creates a poset in such a way that only unique combinations of two observations are used in the model. The value "all" creates all possible L-R combinations between the observations.

If you want to define the poset yourself, you can pass either a matrix or a list with 2 elements as value for the argument `compare`. Columns of the matrix or elements of the list should either be named "L" and "R", or be unnamed. When unnamed, the function takes the first column/element as the left poset, and the second column/element as the right poset. If the (col)names are anything else but "L" and "R", these names are ignored and the first column is seen as "L".

**Value**

an `pim.poset` object that can be used to replace the poset in a pim environment.

**Note**

You can omit the argument `compare` if you supply a value for `nobs`. You can also omit the argument `nobs` if you provide a matrix or list as value for `compare`. The function will try to deduct the number of observations from the highest index value present in the matrix/list.

You can’t omit both arguments together though, as the function needs at least some information on the number of observations the poset is designed for.

**Warning**

Changing the value of `comp.value` by hand might result in errors or a wrongly fitted model. The argument exists for internal purposes and possible extensions later on, but should not be used.
nobs.pim.environment-method

See Also

add.poset for more information on how to adapt the poset of a pim.environment object.

Examples

```r
mypos <- new.pim.poset('unique', n=10) # creates empty environment
ls(mypos)
# Using the created poset functions L and R
# Note this is purely as illustration, this makes no sense
# in the context of a pim analysis.
mypos$L(1:10)
mypos$R(1:10)
```

Description

This function extracts the number of observations in an object of class pim.environment, or the number of observations for which a pim.poset is constructed. If applied to a matrix or data.frame, it returns the number of rows. For any other object it does the same as length.

Usage

```r
## S4 method for signature 'pim.environment'
nobs(object)

## S4 method for signature 'pim.poset'
nobs(object)

## S4 method for signature 'matrix'
nobs(object)

## S4 method for signature 'data.frame'
nobs(object)
```

Arguments

- `object` an object of the class pim.environment or pim.poset

Details

This package imports the generic nobs from the package stats4.
Value

In case the function is called on a `pim.environment` or a `pim.poset` object, an integer with the number of (foreseen) observations. If the `pim.environment` is empty, it returns 0.

In all other cases, it returns the output of either `nrow` (for matrices and data.frames) or `length`.

---

**P**  
*Probability function*

---

Description

This function transforms a comparison or otherwise logical value to a numeric value for use in a `pim`.

Usage

```r
P(x)
PO(x, y = NULL)
```

Arguments

- `x` for `P`, a logical value. For `PO` a numeric value.
- `y` a numeric value or `NULL`. If `NULL`, the function will try to calculate `PO(L(x), R(x))`, provided the functions `L` and `R` are defined correctly. This is the case when `PO` is used in the context of a probabilistic index model fitted with `pim`.

Details

These functions are constructed purely for notation. `P` is completely equivalent to `as.numeric`, apart from an extra control to check whether it actually makes sense to do so. The function `PO` is just short for `P(x < y) + 0.5*P(x == y)`.

Value

A numeric value of 0, 0.5 or 1. 1 if `x < y`, 0.5 if `x == y` and 0 if `x > y`.

See Also

`pim` and `pim.formula` for more information on how this is used inside a `pim` context.

Examples

```r
# Check in pim
```
Extract a pim environment from a model or formula

Description

This function allows you to extract the `pim.environment` object from either a pim object or a pim.formula object.

Usage

```r
penv(x)
```

## S4 method for signature 'pim.formula'
```r
penv(x)
```

## S4 method for signature 'pim'
```r
penv(x)
```

Arguments

- `x` either a pim or a pim.formula object

Value

In case of a pim object, the `pim.environment` contained therein. In case of a pim.formula object, the environment itself. See the help page `pim.formula-class`.

Examples

```r
data("FEVData")
# Create the "model frame"
FEVenv <- new.pim.env(FEVData, compare="unique")

# Create the formula and bind it to the pim.environment.
FEVform <- new.pim.formula(
  Age ~ I(L(Height) - R(Height)) ,
  FEVenv
)
theEnv <- penv(FEVform)
ls(theEnv)

themodel <- pim(Age ~ Height, FEVenv)
thePEnv <- penv(themodel)
thePEnv

ls(thePEnv)
# Note that this is a different environment, and that it only contains
# the variables in the formula, contrary to the environment created
# by new.pim.formula
```
Fitting a Probabilistic Index Model

Description

This function fits a probabilistic index model, also known as PIM. It can be used to fit standard
PIMs, as well as many different flavours of models that can be reformulated as a pim. The most
general models are implemented, but the flexible formula interface allows you to specify a wide
variety of different models.

Usage

pim(
  formula,
  data,
  link = c("logit", "probit", "identity"),
  compare = if (model == "marginal") "all" else "unique",
  model = c("difference", "marginal", "regular", "customized"),
  na.action = getOption("na.action"),
  weights = NULL,
  keep.data = FALSE,
  ...
)

Arguments

formula An object of class formula (or one that can be coerced to that class): A symbolic
description of the model to be fitted. The details of model specification are given
under 'Details'.
data an optional data frame, list or environment that contains the variables in the
model. Objects that can be coerced by as.data.frame can be used too.
link a character vector with a single value that determines the used link function.
Possible values are "logit", "probit" and "identity". The default is "logit".
compare a character vector with a single value that describes how the model compares
observations. It can take the values "unique" or "all". Alternatively you can pass
a matrix with two columns. Each row represents the rownumbers in the original
data frame that should be compared to eachother. See Details.
model a single character value with possible values "difference" (the default), "marginal",
"regular" or "customized". If the formula indicates a customized model (by the
use of L() or R()), this parameter is set automatically to "customized". Cur-
rently, only the options "difference", "marginal" and "customized" are imple-
mented.
na.action the name of a function which indicates what should happen when the data con-
tains NAs. The default is set by the na.action setting of options, and is
na.fail when unset.
weights Currently not implemented.
keep.data a logical value indicating whether the model matrix should be saved in the object. Defaults to FALSE. See Details.
... extra parameters sent to pim.fit

Details

PIMs are based on a set of pseudo-observations constructed from the comparison between a range of possible combinations of 2 observations. We call the set of pseudo observations poset in the context of this package.

By default, this poset takes every unique combination of 2 observations (compare = "unique"). You can either use a character value, or use a matrix or list to identify the set of observation pairs that have to be used as pseudo-observations. Note that the matrix and list should be either nameless, or have the (col)names 'L' and 'R'. If any other names are used, these are ignored and the first column/element is considered to be 'L'. See also new.pim.poset.

It's possible to store the model matrix and pseudo responses in the resulting object. By default this is not done (keep.data = FALSE) as this is less burden on the memory and the pim.formula object contains all information to reconstruct both the model matrix and the pseudo responses. If either the model matrix or the pseudo responses are needed for further calculations, setting keep.data to TRUE might reduce calculation time for these further calculations.

Value

An object of class pim. See pim-class for more information.

The enhanced formula interface

In case you want to fit a standard PIM, you can specify the model in mostly the same way as for lm. There's one important difference: a PIM has by default no intercept. To add an intercept, use + 1 in the formula.

Next to this, you can use the functions L and R in a formula to indicate which part of the poset you refer to. Remember a poset is essentially a matrix-like object with indices refering to the pseudo-observations. Using L() and R() you can define exactly how the pseudo-observations fit in the model. Keep in mind that any calculation done with these functions, has to be wrapped in a call to I(), just like you would do in any other formula interface.

You don't have to specify the model though. If you choose the option model = 'difference', every variable in the formula will be interpreted as I(R(x) - L(x)). If you use the option model = 'marginal', every variable will be interpreted as R(X).

If you don't specify any special function (i.e. L, R, P or PO), the lefthand side of the formula is defined as PO(y). The function PO calculates pseudo observations; it is 1 if the value of the dependent variable for the observation from the L-poset is smaller than, 0 if it is larger than and 0.5 if it is equal to the value for value from the R-poset (see also PO)

See Also

pim-class for more information on the returned object, pim.fit for more information on the fitting itself, pim-getters, coef, confint, vcov etc for how to extract information like coefficients, variance-covariance matrix, ..., summary for some tests on the coefficients.
Examples

data('FEVData')
# The most basic way to use the function
Model <- pim(FEV~ Smoke*Sex, data=FEVData)

# A model with intercept
# The argument xscalm is passed to nleqslv via pim.fit and estimator.nleqslv
# By constructing the estimator functions wisely, you can control most of
# the fitting process from the pim() function.
data('EngelData')
Model2 <- pim(foodexp ~ income + 1, data=EngelData, 
  compare="all",
  xscalm = 'auto')

# A marginal model
# It makes sense to use the identity link in combination with the
# score estimator for the variance-covariance matrix
data('DysData')
Model3 <- pim(SPC_D2 ~ out, data = DysData, 
  model = 'marginal', link = 'identity',
  vcov.estim = score.vcov)

# A Model using logical comparisons, this is also possible!
# Model the chance that both observations have a different
# outcome in function of whether they had a different Chemo treatment
Model6 <- pim(P(L(out) != R(out)) ~ I(L(Chemo) != R(Chemo)),
  data=DysData, 
  compare="all")

# Implementation of the friedman test in the context of a pim
# warpbreaks data where we consider tension as a block
# To do so, you provide the argument compare with a custom
# set of comparisons
data(warpbreaks)
w <- aggregate(warpbreaks$breaks, 
  by = list(w = warpbreaks$wool, 
    t = warpbreaks$tension),
    FUN = mean)
comp <- expand.grid(1:nrow(w), 1:nrow(w))
comp <- comp[wb$t[comp[,1]] == wb$t[comp[,2]],] # only compare within blocks
m <- pim(x ~ w, data = wb, compare = comp, link = "identity", 
  vcov.estim = score.vcov)
summary(m)
friedman.test(x ~ w | t, data = wb)
## Not run:
# This illustrates how a standard model is actually built in a pim context
Model4 <- pim(PO(L(Height),R(Height)) ~ I(R(Age) - L(Age)) + I(R(Sex) - L(Sex)),
  data=FEVData, 
  estim = "estimator.BB")
# is the same as
Model5 <- pim(Height ~ Age + Sex, data = FEVData, estim = "estimator.BB")
summary(Model4)
summary(Model5)
pim-class

## Description

This class contains the fitting information resulting from a call to \texttt{pim}.

## Slots

- \texttt{formula} \hspace{1em} The \texttt{pim.formula} object used in the fit
- \texttt{coef} \hspace{1em} a numeric vector with the fitted coefficients
- \texttt{vcov} \hspace{1em} a numeric matrix containing the variance-covariance matrix of the fitted coefficients
- \texttt{penv} \hspace{1em} a \texttt{pim.environment} object containing the data used to fit this
- \texttt{fitted} \hspace{1em} a numeric vector containing the raw fitted
- \texttt{link} \hspace{1em} a character vector describing the used link function
- \texttt{estimators} \hspace{1em} a list with the elements \texttt{coef} and \texttt{vcov}, containing either a character value with the name of the used estimator, or the function itself.
- \texttt{model.matrix} \hspace{1em} If \texttt{keep.data} is set to \texttt{TRUE} while calling \texttt{pim} the original model matrix. Otherwise an empty matrix with 0 rows and columns.
- \texttt{response} \hspace{1em} If \texttt{keep.data} is set to \texttt{TRUE} while calling \texttt{pim} the original response vector. Otherwise an empty numeric vector.
- \texttt{keep.data} \hspace{1em} a logical value indicating whether the original data is kept in the object. This is set using the argument \texttt{keep.data} of the function \texttt{pim}.
- \texttt{model} \hspace{1em} a character value with the value "difference", "marginal", "regular" or "customized", indicating which type of \texttt{pim} model has been fitted.

pim-getters

## Description

Getters for slots of a \texttt{pim} object

## Usage

- \texttt{keep.data(x)}

- \texttt{fitted(object, \ldots)}

## S4 method for signature 'pim'

- \texttt{fitted(object, \ldots)}
Arguments

- `x`: a `pim` object
- `object`: a `pim` object
- `...`: arguments passed to other methods. Currently ignored.

Value

- `keep.data()`: a single logical value indicating whether the model matrix and pseudo responses were stored in the `pim` object.
- `fitted()`: a numeric vector with the fitted values for the pseudo-observations.

Examples

```r
data('FEVData')
themodel <- pim(FEV ~ Age + Height, data = FEVData)
keep.data(themodel)
fitted(themodel)
```

---

**pim.environment-class**  The `pim.environment` class

**Description**

This S4 class inherits from the S3 class `environment`. The environment serves as a container to hold the data, poset and the poset related functions of a probabilistic index model generated by the function `pim`. The objects of this class behave much like an environment, but contain some extra slots with information on the objects inside the environment.

**Slots**

- `poset`: an environment of class `pim.poset` containing the poset-related functions (normally these are `L` and `R`). This environment has the object itself as parent.
- `data.names`: a character vector containing the names of the vectors that represent the data
- `nobs`: integer value indicating the number of observations in the environment
- `classes`: a named list containing the classes of the objects inside the environment. Note that the value should be the one given by `class`.
- `is.complete`: a logical value indicating whether or not the poset was added before.

**Note**

This class is not exported, so it can’t be extended as for now. Although it is possible to use the function `new` for creation of new instances, users are strongly advised to use the function `new.pim.env` in case they need to manually create a new instance of the class `pim.environment`. 
pim.fit  

Fitter function for a probabilistic index model

Description

This is the basic computing engine called by pim to get the estimates for the coefficients and the variance-covariance matrices. This function currently only spits out these components using the sandwich estimators.

Usage

pim.fit(
  x, y,
  link = "logit",
  estim = "estimator.nleqslv",
  start = rep(0, ncol(x)),
  vcov.estim = "sandwich.vcov",
  weights = NULL,
  penv,
  ...
)

Arguments

x  a model matrix with as many rows as y.
y  a vector with the pseudo-responses
link  a character vector with a link function
estim  a character vector or a function indicating the solver to be used for estimating the coefficients. By default this is the function nleqslv. Other possibilities are given in the help page on estimators.
start  A numeric vector with the starting values for the fitting algorithm, if required.
vcov.estim  a function to determine the variance-covariance matrix. Possibilities are sandwich.vcov and link(score.vcov). Defaults to sandwich.vcov
weights  currently not implemented
penv  An environment, pim.environment or pim.poset object containing the poset functions. Alternatively this can be a list of two numeric vectors, containing the poset indices for the left and right side of the pim.
...  Further arguments that need to be passed to the estimation function. The most relevant is construct, allowing you to write your own score function for the numerical optimization. See also estimators
Value

A list with the following elements

- **coefficients** a numeric vector with the coefficients
- **vcov** a numeric matrix with the variance-covariance matrix for the coefficients
- **fitted** a numeric vector with the raw fitted values
- **estim** a list with two components named coef and vcov containing information on the used estimators for both.

See Also

- `model.matrix` for how to construct a valid model matrix for a pim
- `pim` for the general user interface

### pim.formula-class

**Class pim.formula**

**Description**

This class contains information on the formula passed in a call to `pim`. The object is used to create the model matrix of a pim (see `model.matrix`)

**Details**

Although a future version of this package will include the possibility to fit survival models, this is currently not implemented. If the `pim` function encounters special functions on the left-hand side (i.e. when `has.lhs.fun` is `TRUE`), the model won’t be calculated.

The slot `penv` contains a reference to an environment. In most cases, this will be the environment contained in a `pim.environment` object. Note though that the `pim.formula` object only contains a link to the environment. The extra slots contained in the `pim.environment` object are NOT copied to the `pim.formula`. Also keep in mind that the environment linked to the `pim.environment` object will continue to exist even after deleting the `pim.environment` itself, and this for as long as the `pim.formula` object exists.

This class is not exported and hence cannot be extended. It serves internal use in the pim package only.

**Slots**

- **terms** a `terms.object` derived from the formula
- **has.specials** a logical value indicating whether the right-hand side of the original formula contains special functions like `L` and `R`
- **has.lhs.fun** a logical value indicating whether the left-hand side of the original formula contains special functions. These exclude the functions `P` and `PO` but include functions like `Surv`. See Details
- **predictors** a character vector with the names of all the variables mentioned in the right-hand side of the formula.
response  an character vector with the name of the response variable.

lhs  a call with the processed left-hand side of the formula

orig  a formula object with the original formula

penv  an environment object to which the formula is related (i.e. the environment containing possible L and R function definitions.) See Details.

has.intercept  a logical value indicating whether the formula has an explicit intercept (indicated by + 1)

Note

This class is not exported, so it can’t be extended as for now. Although it is possible to use the function new for creation of new instances, users are strongly advised to use the function new.pim.formula in case they need to manually create a new instance of the class pim.formula.

---

pim.poset-class  The pim.poset class

Description

The pim.poset class is an S4 class that inherits from environment and contains the poset functions for a pim. It’s a class used internally and should not be adapted by the user. The correct interpretation of the formula is dependent on this object. The object mainly functions as a slot in object of class pim.environment.

Slots

compare  a character value with the type of poset. This can take the values "unique", "all" and "custom".
	nobs  an integer value describing the number of observations for which this poset is meant to be used.

Note

The pim.poset class doesn’t really make sense to be used on itself. It is part of the pim.environment class and shouldn’t be used outside this context.
pim.summary-class

Class pim.summary

Description

This class contains the summary information from a probabilistic index model, and is created by using the function `summary` on an object of the pim-class.

Details

The class pim.summary can be treated like a matrix to get out the coefficients, standard errors, Z values and/or p values.

Slots

- `formula` contains an object of the class pim.formula containing the model fitted.
- `model` a character vector describing the type of model. See also the argument `model` of the function `pim`.
- `link` a character value that contains the link. See also the argument `link` of the function `pim`.
- `coef` a numeric vector with the coefficients
- `se` a numeric vector with the standard errors for the coefficients
- `zval` a numeric vector containing the Z values for the coefficients, testing whether the coefficient differs significantly from 0.
- `pr` a numeric vector containing the related p-values for the coefficients.
- `h0` a numeric value or a numeric vector containing the null hypothesis. See the argument at summary.pim

See Also

pim for more info on how to construct the model and summary.pim for the constructor.

pimdata

The data contained in the pim package

Description

The pim package contains different datasets for use in examples and tests. Currently, you find the datasets DysData, EngelData and FEVData. More information can be found on the respective help pages.
Details

The data contained in the package has following structures

- **EngelData**: A single numeric predictor variable and a response
- **FEVData**: A data frame with a numeric response variable and 4 additional numeric predictor values.
- **DysData**: A dataframe with 3 factors and a numeric variable as predictors. The outcome is a factor with 4 levels.
- **SNP_XRCC1__77**: Genotype of this SNP. A factor with three levels: "TT", "TC" and "CC"
- **SPC_D2**: Dose of radiation that reached 2
- **SNP_XRCC1__77TC**: 1 if SNP_XRCC1__77 is "TC", 0 otherwise

---

poset

Extract the poset as a matrix or list

Description

This function allows you to extract the poset from either a `pim.environment` or a `pim.poset` object. The poset can be extracted as a matrix or a list.

Usage

```r
poset(x, ...)  
```

```r
## S4 method for signature 'pim.environment'
poset(x, ...)

## S4 method for signature 'pim.poset'
poset(x, as.list = FALSE)

## S4 method for signature 'environment'
poset(x, as.list = FALSE)

## S4 method for signature 'pim'
poset(x, ...)

## S4 method for signature 'pim.formula'
poset(x, ...)
```

Arguments

- **x**
  
an object of class `pim.environment`, `pim.formula`, `pim` or `pim.poset`, or an environment derived from either object.

- **...**
  
arguments passed to other methods. Currently ignored.

- **as.list**
  
a logical value indicating whether the poset should be returned as list or as a matrix. Defaults to FALSE, which returns a matrix
Value

When x contains a poset, either a matrix or a list (when as.list is TRUE) with the indices that make up the poset. If there’s no poset, the function returns a missing value.

The returned matrix has 2 columns, each named after the respective poset function. In case a list is requested, the function returns a named list with 2 elements, each element containing the indices related to the poset function of the same name (either L or R).

Examples

data(DysData)
DysPimEnv <- new.pim.env(DysData)
poset(DysPimEnv)

print

Print methods for the different object types

Description

Printing pim, pim.environment, pim.formula and pim.poset objects.

Usage

print(x, ...)

## S4 method for signature 'pim'
print(x, digits = max(3L, getOption("digits") - 3L), show.vcov = FALSE, ...)

## S4 method for signature 'pim.environment'
print(x, digits = max(3L, getOption("digits") - 3L), n = 6L, ...)

## S4 method for signature 'pim.poset'
print(x, digits = max(3L, getOption("digits") - 3L), n = 6L, ...)

## S4 method for signature 'pim.formula'
print(x, digits = max(3L, getOption("digits") - 3L), ...)

Arguments

x
the object

... arguments passed to other methods. Currently ignored
digits an integer that defines the number of digits printed

show.vcov a logical value indicating whether the variance-covariance matrix should be shown or not. Defaults to FALSE

n number of observations shown by print
Value

 invisible NULL

Examples

data(FEVData)
Model <- pim(FEV~ Smoke*Sex , data=FEVData)
print(Model)
print(penv(Model))
# You get the drift

response Extract response from a pim.formula or a pim object

Description

This function extracts the response from a pim.formula for use in pim.fit.

Usage

response(object)

## S4 method for signature 'pim.formula'
response(object)

## S4 method for signature 'pim'
response(object)

Arguments

object an object of class pim or pim.formula.

Value

The response variable with pseudo-observations for a pim.

See Also

pim-class and pim.formula-class for more information on the classes, and pim, pim.fit and pim.formula for more information on related functions.
Examples

```r
data('FEVData')
Model <- pim(FEV~ Smoke*Sex , data=FEVData)
response(Model)

# In pieces
FEVenv <- new.pim.env(FEVData, compare="unique")
FEVform <- new.pim.formula(
  Age ~ I(L(Height) - R(Height)) ,
  FEVenv
)
response(FEVform)
```

sandwich.estimator  

Pseudo-observation variance sandwich estimator

Description

The functions described here all implement an estimator for the variance of the coefficients. This function is not exported.

Usage

```r
sandwich.estimator(
  U,
  U.diff,
  g1,
  g2,
  shared.factor = 1,
  switched.factor = 1,
  self.factor = 1
)
```

Arguments

- `U`: See the formula for sandwich estimator: holds $U_{ij}$
- `U.diff`: See the formula for sandwich estimator: holds the partial derivatives of $U$.
- `g1, g2`: Index in the original observations of the "left" and "right" part of the pseudo-observations.
- `shared.factor`: Factor by which all $U_{ijk}$ or $U_{ijl}$ will be multiplied
- `switched.factor`: Factor by which all $U_{ijk}$ or $U_{ijl}$ will be multiplied
- `self.factor`: Factor by which all $U_{ijj}$ or $-U_{jjj}$ will be multiplied

Value

The matrix of the sandwich estimator
SUData

*This is the Surgical unit data*

**Description**

This is the Surgical unit data

**Details**

These are the columns and their meanings

- `EnT` Enzyme function test score
- `Gender` Gender of the patient (0: male, 1: female)
- `Alcohol` History of alcohol use (0: none, 1: moderate, 2: severe)
- `SurvivalTime` Survival time of each patient (the outcome of interest)

**summary.pim**

*The summary function for the pim class*

**Description**

The function `summary` is a generic function. We provide a method for objects of the `pim-class`.

**Usage**

```r
summary(object, ...)  
## S4 method for signature 'pim'  
summary(object, h0 = 0, ...)  
```

**Arguments**

- `object` an object of the class `pim`
- `...` arguments passed to other methods. Currently ignored.
- `h0` a numeric value or a vector as long as the number of coefficients with the value that defines the null hypothesis to test against

**Value**

A `pim.summary` object

**Examples**

```r
data(FEVData)  
Model <- pim(FEV~ Age + Smoke*Sex , data=FEVData)  
summary(Model)  
```
Description
This package defines an S4 generic for `vcov` and methods for list and pim classes.

Usage

```r
cov(object, ...)  
## S4 method for signature 'pim'  
cov(object, ...)  
## S4 method for signature 'list'  
cov(object, ...)
```

Arguments

- `object` any object.
- `...` arguments passed to other methods. Currently ignored.

Value

the variance-covariance matrix

See Also

`vcov` in the stats package.

Examples

```r
data(FEVData)  
Model <- pim(FEV~ Age + Smoke*Sex, data=FEVData)  
cov(Model)
```
Usage

sandwich.vcov(fitted, X, Y, W, link, poset, ...)

score.vcov(fitted, X, Y, W, link, poset, ...)

Arguments

- `fitted`: The fitted values (calculated as `X %*% coef` with `X` the design matrix and `coef` the coefficients)
- `X`: the design matrix
- `Y`: a numeric vector with pseudoresponses
- `W`: a numeric vector with weights. If weights are not applicable, set to `NULL` (the default)
- `link`: a character vector with the link function
- `poset`: a list with the left and right indices. See `poset` for more information.
- `...`: arguments passed to downstream methods.

Details

You can create your own estimating functions for the variance-covariance matrix. To do so, you have to make sure that your function allows for the exact same arguments. As the function `pim.fit` calculates the fitted values already, there’s no need to incorporate the calculation of these inside the function.

Value

the variance-covariance matrix

Note

You should only use `score.vcov` in combination with an identity link

See Also

`sandwich.estimator` for more information on the actual fitting process. `pim` for a few examples in how these are used
Description

These functions serve as preparation functions to calculate the variance-covariance matrix of a pim using any of the `vcov.estimators` provided in this package. The result of these preparation functions is used by the `sandwich.estimator` and `score.estimator` functions respectively.

Usage

\[
\text{U.sandwich}(Z\beta, Z, Y, \text{link}, W = \text{NULL})
\]

\[
\text{U.score}(Z\beta, Z, Y, \text{link}, W = \text{NULL})
\]

Arguments

- **Zbeta**: fitted values
- **Z**: design matrix
- **Y**: pseudo responses
- **link**: character vector with link function
- **W**: vector with weights

Note

These functions should NOT be called by the user.
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