Package 'ILSE'

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Type Package

Title Linear Regression Based on 'ILSE' for Missing Data

Version 1.1.7

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Author Wei Liu [aut, cre],
Huazhen Lin [aut],
Wei Lan [aut]

Maintainer Wei Liu <weiliu@smail.swufe.edu.cn>

Description Linear regression when covariates include missing values by embedding the correlation information between covariates. Especially for block missing data, it works well. 'ILSE' conducts imputation and regression simultaneously and iteratively. More details can be referred to Huazhen Lin, Wei Liu and Wei Lan. (2021) <doi:10.1080/07350015.2019.1635486>.

URL https://github.com/feiyoung/ILSE

BugReports https://github.com/feiyoung/ILSE/issues

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Depends R (>= 3.0.1)

Imports stats, Rcpp, pbapply

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VignetteBuilder knitr

NeedsCompilation yes

RoxygenNote 7.1.1

Repository CRAN

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R topics documented:

`Coef` *Extracts Regression Coefficients*

Description

extracts model coefficients from object of class "ilse".

Usage

```
Coef(object)
```

Arguments

`object`	an object of class "ilse".

Value

Coefficients extracted from object.

See Also

coef, coefficient

Examples

```
# example one
data(nhanes)
NAlm2 <- ilse(age~., data=nhanes)
Coef(NAlm2)
```

`cor.mat` *Generate Two Type of Correlation Matrix*

Description

Generate two type of correlation matrix

Usage

```
cor.mat(p, rho, type='toeplitz')
```

Arguments

`p`	a positive integer, the dimension of correlation matrix.
`rho`	a value between 0 and 1, a baseline vlaue of correlation coefficient.
`type`	a character, specify the type of correlation matrix and only include 'toeplitz' and 'identity' in current version.

Details

The argument rho specify the size of correlation coeffient. As for argument type, if type='toeplitz', sigma_ij=rho^|i-j|; if type ='identity', sigma_ij=rho when i!=j and sigma_ij=1 when i=j.

Value

return a correlation matrix with a type of specified structure.

Note

nothing

Author(s)

Liu Wei

References

nothing.

See Also

cov2cor

Examples

```
cor.mat(5, 0.5)
cor.mat(5, 0.5, type='identity')
```

`cov.mat` *Generate Two Type of Covariance Matrix*

Description

Generate two type of covariance matrix

Usage

```
cov.mat(sdvec,rho, type='toeplitz')
```

Arguments

`sdvec`	a positive vector, standard deviation of each random variable.
`rho`	a value between 0 and 1, a baseline vlaue of correlation coefficient.
`type`	a character, specify the type of correlation matrix and only include 'toeplitz' and 'identity' in current version.

Details

The argument rho specify the size of correlation coeffient. As for argument type, if type='toeplitz', sigma_ij=rho^|i-j|; if type ='identity', sigma_ij=rho when i!=j and sigma_ij=1 when i=j.

Value

return a covariance matrix with a type of specified structure.

Note

nothing

Author(s)

Liu Wei

References

nothing.

See Also

cov2cor

Examples

```
cov.mat(rep(5,5), 0.5)
cov.mat(c(2,4,3), 0.5, type='identity')
```

fimlreg *Full Information Maximum Likelihood Linear Regression*

Description

Estimate regression coefficients based on Full Information Maximum Likelihood Estimation, which can couple missing data, including response missing or covariates missing.

Usage

```
  fimlreg(...)

  ## S3 method for class 'formula'
fimlreg(formula, data=NULL, ...)
  ## S3 method for class 'numeric'
fimlreg(Y, X, ...)
```

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'.
Y	a numeric vector, the reponse variable.
X	a numeric matrix that may include NAs, the covariate matrix.
data	an optional data frame, list or environment (or object coercible by as.data.frame to a data frame) containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which clse is called.
...	Optional arguments.

Details

Note that arguments ... of stats::nlm are the parameters of algorithm, see the details in help file of "nlm". "fimlreg" can cople with any type of missing data.

Value

Return a list including following components:

beta	A named vector of coefficients
formula	The formula used
data	The raw data

Author(s)

Liu Wei

See Also

ilse

Examples

```
data(nhanes)
## example one: include missing value
fiml1 <- fimlreg(age~., data=nhanes)
print(fiml1)
# example two: No missing vlaue
## example two: No missing value
n <- 100
group <- rnorm(n, sd=4)
weight <- 3.2*group + 1.5 + rnorm(n, sd=0.1)
fimllm <- fimlreg(weight~group, data=data.frame(weight=weight, group=group))
print(fimllm)
```

`ilse` *Linear Regression by Iterative Least Square Estimation*

Description

Linear regression when covariates include missing values embedding the correlation information between covariates by Iterative Least Square Estimation.

Usage

```
  ilse(...)
  ## S3 method for class 'formula'
ilse(formula, data=NULL, bw=NULL,  k.type=NULL,  method="Par.cond", ...)
  ## S3 method for class 'numeric'
ilse(Y, X,bw=NULL, k.type=NULL, method="Par.cond", max.iter=20,
  peps=1e-5, feps = 1e-7, arma=TRUE, verbose=FALSE, ...)
```

Arguments

`...`	Arguments passed to other methods.
`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'.
`Y`	a numeric vector, the reponse variable.
`X`	a numeric matrix that may include NAs, the covariate matrix.
`data`	an optional data frame, list or environment (or object coercible by as.data.frame to a data frame) containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which ilse is called.

bw	a positive value, specify the bandwidth in estimating missing values, default as NULL. When bw=NULL, it is automatically selected by empirical method.
k.type	an optional character string, specify the type of kernel used in iterative estimating algorithm and support 'epk', 'biweight', 'triangle', 'gaussian', 'triweight', 'tricube', 'cosine', 'uniform' in current version, defualt as 'gaussian'.
method	an optional character string, specify the iterative algorithm, support 'Par.cond' and 'Full.cond' in current version.
max.iter	an optional positive integer, the maximum iterative times, defualt as '20'.
peps	an optional positive value, tolerance vlaue of relative variation rate of estimated parametric vector, default as '1e-7'.
feps	an optional positive vlaue, tolerance vlaue of relative variation rate of objective function value, default as '1e-7'.
arma	an optional logical value, whether use armadillo and Rcpp to speed computation, default as TRUE
verbose	an optional logical value, indicate whether output the iterative information, default as 'TRUE'.

Details

Models for ilse are specified symbolically. A typical model has the form response ~ terms where response is the (numeric) response vector and terms is a series of terms which specifies a linear predictor for response. A terms specification of the form first + second indicates all the terms in first together with all the terms in second with duplicates removed. A specification of the form first:second indicates the set of terms obtained by taking the interactions of all terms in first with all terms in second. The specification first*second indicates the cross of first and second. This is the same as first + second + first:second.

Value

ilse returns an object of class "ilse".

The functions summary and anova are used to obtain and print a summary and analysis of variance table of the results. The generic accessor functions coefficients, effects, fitted.values and residuals extract various useful features of the value returned by lm.

An object of class "ilse" is a list containing at least the following components:

beta	a named vector of coefficients
hX	a imputed design matrix
d.fn	a nonnegative value, vlaue of relative variation rate of objective function value
d.par	a nonnegative value, relative variation rate of estimated parametric vector when algorithm stopped.
iterations	a positive integer, iterative times in total.
residuals	the residuals, that is response minus fitted values.
fitted.values	the fitted mean values.
inargs	a list including all input arguments.

Note

nothing

Author(s)

Wei Liu

References

Huazhen Lin, Wei Liu, & Wei Lan (2021). Regression Analysis with individual-specific patterns of missing covariates. Journal of Business & Economic Statistics, 39(1), 179-188.

See Also

lm

Examples

```
## exmaple one: include missing value
data(nhanes)
NAlm1 <- ilse(age~., data=nhanes,bw=1,
   method = 'Par.cond', k.type='gaussian', verbose = TRUE)
print(NAlm1)
NAlm2 <- ilse(age~., data=nhanes, method = 'Full.cond')
print(NAlm2)
## example two: No missing value
n <- 100
group <- rnorm(n, sd=4)
weight <- 3.2*group + 1.5 + rnorm(n, sd=0.1)
NAlm3 <- ilse(weight~group, data=data.frame(weight=weight, group=group),
   intercept = FALSE)
print(NAlm3)
```

---

kern *Kernel Function*

Description

Different type of kernel functions.

Usage

```
kern(u, type='epk')
```

Arguments

u	a numeric vector, evluated points in kernel funciton.
type	a optional character string, specify the type of used kernel functionand support 'epk', 'biweight', 'triangle', 'guassian', 'triweight', 'tricube', 'cosine', 'uniform' in current version, defualt as 'epk'.

Details

Note that K(u_i)=K(X_i-x_0) where u = (X_1-x_0, ..., X_n-x_0) and K_h(u_i)=1/h*K((X_i-x_0)/h) where h is bandwidth.

Value

Return a numeric vector with length equal to 'u'.

Author(s)

Liu Wei

See Also

KernSmooth package

Examples

```
library(graphics)
u <- seq(-1,1,by=0.01)
(Ku <- kern(u))
plot(u, Ku, type='l')
# guassian kernel
plot(u, kern(u, type='gaussian'), type ='l')
# cosine kernel
plot(u, Ku <- kern(u, type='cosine'), type ='l')
```

---

nhanes *NHANES example - all variables numerical*

Description

A small data set with missing values.

Format

A data frame with 25 observations on the following 4 variables. age: Age group (1=20-39, 2=40-59, 3=60+).

bmi: Body mass index (kg/m**2).

hyp: Hypertensive (1=no,2=yes).

chl: Total serum cholesterol (mg/dL).

Details

A small data set with all numerical variables. The data set nhanes2 is the same data set, but with age and hyp treated as factors.

Source

Schafer, J.L. (1997). Analysis of Incomplete Multivariate Data. London: Chapman & Hall. Table 6.14.

Examples

```
# example one
data(nhanes)
bw <- 1
ilse(age~., data=nhanes,bw=bw)
```

---

print *Print the Information of FIML or ILSE methods*

Description

print method for class "ilse" or class "fiml".

Usage

```
  print(object)
  ## S3 method for class 'ilse'
print(object)

  ## S3 method for class 'fiml'
print(object)
```

Arguments

object	an object of class "ilse" or "fiml".

Value

For "ilse", print the basic information of ilse estimation and algorithm and return a list including

beta	a named vector of coefficients
Bmat	a named matrix that summary the estimated beta in every iteration.
residuals	the residuals, that is response minus fitted values.
fitted.values	the fitted mean values.
d.fn	a nonnegative value, vlaue of relative variation rate of objective function value

d.par	a nonnegative value, relative variation rate of estimated parametric vector when algorithm stopped.
K	a positive integer, iterative times in total.

For "fiml", print the basic information of fiml estimation and return a list including

beta	A named vector of coefficients
iterations	A positive integer, iterative times in total.
stop.code	The stop code returned by nlm.

See Also

print.lm

Examples

```
data(nhanes)
NAlm1 <- ilse(age~., data=nhanes)
a <- print(NAlm1)
a

fimllm <- fimlreg(age~., data=nhanes, iterlim= 40)
b <- print(fimllm)
b
```

`summary` *Summarizing the inference information for ILSE or FIML methods*

Description

summary method for class "ilse" or "fiml".

Usage

```
  summary(object, Nbt=20)

  ## S3 method for class 'ilse'
summary(object, Nbt=20)

  ## S3 method for class 'fiml'
summary(object, Nbt=20)

  ##
  Fitted.values(object)
  ##
  Residuals(object)
```

Arguments

object	an object of class "ilse".
Nbt	an positive integer, the repeated times of bootstrap to eatimate covariance matrix of regression coefficient.

Value

The function summary.ilse computes and returns a named matrix of summary statistics of the fitted linear model given in object by ILSE or FIML methods. The function Fitted.values return a vector, fitted repsonse vlaues. The function Residuals return a vector, residuals.

See Also

summary.lm fitted.vlaues residuals

Examples

```
# example one
data(nhanes)
NAlm <- ilse(age~., data=nhanes)
summary(NAlm, Nbt=5)

fimllm <- fimlreg(age~., data=nhanes)
summary(fimllm, Nbt = 5)
```

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