Package 'FEprovideR'

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Title Fixed Effects Logistic Model with High-Dimensional Parameters

Version 1.1

Description A structured profile likelihood algorithm for the logistic fixed effects model and an approximate expectation maximization (EM) algorithm for the logistic mixed effects model. Based on He, K., Kalbfleisch, J.D., Li, Y. and Li, Y. (2013) <doi:10.1007/s10985-013-9264-6>.

License GPL-2

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LazyData true

BugReports https://github.com/umich-biostatistics/FEprovideR/issues

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Repository CRAN

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Contents

confint.fe.prov *Compute confidence intervals for fitted model*

Description

confint.fe.prov computes the (1-alpha)% confidence intervals for the fixed effect parameter estimates. Go to Github for a tutorial.

Usage

```
## S3 method for class 'fe.prov'
confint(object, parm = "all", level = 0.95, data,
  Y.char, Z.char, prov.char, ...)
```

Arguments

object	fitted model object (fit using fe.prov)
parm	provider IDs for which confidence intervals are desired. The default is "all". Specify a subset of privider effects with a numeric vector of provider IDs. For example, parm=c(1,20) for providers 1 and 20.
level	confidence level (default is 0.95)
data	prepared data.frame. Use fe.data.prep to prepare the raw data
Y.char	Y.char name of the response variable from data as a character string
Z.char	Z.char names of covariates from data as vector of character strings
prov.char	name of provider IDs variable as a character string
...	extra arguments to be passed to confint

Value

Returns a data.frame of gamma and SRR lower and upper CI bounds. Each row is a parameter, each column gives a different bound.

References

He, K., Kalbfleisch, J.D., Li, Y. and Li, Y., 2013. Evaluating hospital readmission rates in dialysis facilities; adjusting for hospital effects. Lifetime data analysis, 19(4), pp.490-512.

See Also

fe.data.prep, fe.prov, test.fe.prov, funnel.SRR

Examples

```
# Name input variables and other parameters
# a small positive number specifying stopping
# criterion of Newton-Raphson algorithm
tol <- 1e-5
Y.char <- 'Y'
prov.char <- 'prov.ID'
Z.char <- paste0('z', 1:3)
data(hospital_prepared) # build in data set
fe.ls <- fe.prov(hospital_prepared, Y.char, Z.char, prov.char, tol) # model fitting

# confidence intervals
confint.fe.prov(fe.ls, parm = "all", level = 0.95,
                            hospital_prepared, Y.char, Z.char, prov.char)
```

`fe.data.prep` *Prepares data for model fitting (fe.prov)*

Description

`fe.data.prep` prepares the data for model fitting with `fe.prov` by taking the data with missing values imputed. Go to Github for a tutorial.

Usage

```
fe.data.prep(data, Y.char, Z.char, prov.char, cutoff = 10)
```

Arguments

`data`	a `data.frame` including response, provider ID, and covariates, with missing values imputed
`Y.char`	name of the response variable from `data` as a character string
`Z.char`	names of covariates from `data` as vector of character strings
`prov.char`	name of provider IDs variable as a character string
`cutoff`	cutoff of provider size as an interger, default value is 10

Value

`data.frame`: a data frame sorted by provider IDs with additional variables 'included', 'no.readm', 'all.readm' and missing values imputed.

References

He, K., Kalbfleisch, J.D., Li, Y. and Li, Y., 2013. Evaluating hospital readmission rates in dialysis facilities; adjusting for hospital effects. Lifetime data analysis, 19(4), pp.490-512.

See Also

fe.prov, test.fe.prov, funnel.SRR, confint.fe.prov

Examples

```
data(hospital) # build in data set
# Name input variables and other parameters
cutoff <- 10          # an integer as cutoff of facility (or provider) size with 10 as default
alpha <- 0.05             # significance level
Y.char <- 'Y'
prov.char <- 'prov.ID'
Z.char <- paste0('z', 1:3)

hospital_prepared <- fe.data.prep(hospital, Y.char, Z.char, prov.char, cutoff) # data preparation
```

---

fe.prov *Fit logistic fixed-effect model with high-dimensional predictors*

Description

fe.prov fits a fixed-effect logistic model using structured profile likelihood algorithm. Standardized readmission ratios (SRRs) are also computed. Go to Github for a tutorial.

Usage

```
fe.prov(data, Y.char, Z.char, prov.char, tol = 1e-05, null = "median")
```

Arguments

data	prepared data.frame. Use fe.data.prep to prepare the raw data
Y.char	name of the response variable from data as a character string
Z.char	names of covariates from data as vector of character strings
prov.char	name of provider IDs variable as a character string
tol	tolerance level for convergence. Default is 1e-5
null	use median for null comparison

Value

An object of class fe.prov, which is just a List object with the following named elements:

- beta: a vector of fixed effect estimates
- Obs: a vector of responses for included providers
- Exp: a vector of expected probabilities of readmission within 30 days of discharge
- iter: number of iterations needed for convergence

- `beta.max.diff`: value of the stopping criterion
- `df.prov`:

`df.prov` is a `data.frame` of provider-level information with the following items:

- `Obs`: provider-level observed number of readmissions within 30 days
- `Exp`: expected number of readmissions within 30 days
- `SRR`: standardized readmission ratios for each hospital
- `gamma`: a vector of provider effect estimates for included hospitals

References

He, K., Kalbfleisch, J.D., Li, Y. and Li, Y., 2013. Evaluating hospital readmission rates in dialysis facilities; adjusting for hospital effects. Lifetime data analysis, 19(4), pp.490-512.

See Also

`fe.data.prep`, `test.fe.prov`, `funnel.SRR`, `confint.fe.prov`

Examples

```
# Name input variables and other parameters
# a small positive number specifying stopping
# criterion of Newton-Raphson algorithm
tol <- 1e-5
Y.char <- 'Y'
prov.char <- 'prov.ID'
Z.char <- paste0('z', 1:3)
data(hospital_prepared) # build in data set
fe.ls <- fe.prov(hospital_prepared, Y.char, Z.char, prov.char, tol) # model fitting
```

`funnel.SRR` *Funnel plot for SRR (standardized readmission ratios)*

Description

`funnel.SRR` produces and returns funnel plots for the analysis using discharge-specific and patient-specific inputs with provider ID. Go to Github for a tutorial.

Usage

```
funnel.SRR(input.dis, input.prov, target = 1, alphas = c(0.1, 0.05,
  0.01), type = "FE.score", sigma.b = NULL)
```

Arguments

input.dis	a data.frame consisting of discharge-specific inputs and provider ID
input.prov	a data.frame consisting of provider-specific inputs and provider ID
target	target standardized readmission ratio (SRR)
alphas	numeric vector of alpha levels of interest
type	string of length one containing the type of test performed. Currently options include "score", "exact", "FE.score", "FE.exact", "FERE.score", "FERE.exact"
sigma.b	sigma for random effects. Should only have value other than null if prefix "FERE." specified in type= argument

Value

Returns a ggplot object. Unless stored in a new object, will be printed automatically.

References

He, K., Kalbfleisch, J.D., Li, Y. and Li, Y., 2013. Evaluating hospital readmission rates in dialysis facilities; adjusting for hospital effects. Lifetime data analysis, 19(4), pp.490-512.

See Also

fe.data.prep, fe.prov, test.fe.prov, confint.fe.prov, ggplot2

Examples

```
# Name input variables and other parameters
# a small positive number specifying stopping
# criterion of Newton-Raphson algorithm
tol <- 1e-5
Y.char <- 'Y'
prov.char <- 'prov.ID'
Z.char <- paste0('z', 1:3)
data(hospital_prepared) # build in data set
fe.ls <- fe.prov(hospital_prepared, Y.char, Z.char, prov.char, tol) # model fitting


# Hypothesis tests
null = "median"
alpha <- 0.05             # significance level
score.fe <- test.fe.prov(hospital_prepared, fe.ls, Y.char,
                         Z.char, prov.char, test="score", null, alpha)

# format input data for funnel plot
input.dis <- data.frame(ID=hospital_prepared[hospital_prepared$included==1, prov.char],
                        prob=fe.ls$Exp)
input.prov <- data.frame(SRR=fe.ls$df.prov$SRR, flag=score.fe$flag)

# render funnel plot
target <- c(1)
```

```
alphas = c(0.1, 0.05, 0.01)
funnel.SRR(input.dis, input.prov, target, alphas, type="FE.score")
```

`hospital` *Simulated readmissions data for 500 hospitals*

Description

A data set containing simulated readmissions data for 500 hospitals with three continuous covariates. This data needs to be processed with `fe.data.prep`.

Usage

```
hospital
```

Format

A `data.frame` with 24438 rows and 5 variables (columns):

Y Indicator for readmission; 1=Yes, 0=No; numeric

prov.ID Provider ID; numeric

z1 Simulated covariate 1, numeric

z2 Simulated covariate 2, numeric

z3 Simulated covariate 3, numeric

`hospital_prepared` *Prepared version of simulated readmissions data for 500 hospitals*

Description

A data set containing simulated and processed readmissions data for 500 hospitals with three continuous covariates. This is the form of the data needed to use `fe.prov`.

Usage

```
hospital_prepared
```

Format

A `data.frame` with 24438 rows and 8 variables (columns):

Y Indicator for readmission; 1=Yes, 0=No; numeric

prov.ID Provider ID; numeric

z1 Simulated covariate 1, numeric

z2 Simulated covariate 2, numeric

z3 Simulated covariate 3, numeric

included variable 'included' as an indicator

no.readm providers with no readmission within 30 days

all.readm providers with all readmissions within 30 days

`test.fe.prov` *Hypothesis tests for fe.prov model object*

Description

`test.fe.prov` Conducts hypothesis tests for model parameter estimates. First fit a `fe.prov` model object. Go to Github for a tutorial.

Usage

```
test.fe.prov(data, fe.ls, Y.char, Z.char, prov.char, test = "score",
  null = "median", alpha = 0.05, n = 10000)
```

Arguments

`data`	prepared `data.frame`. Use `fe.data.prep`
`fe.ls`	fitted model object (fit using `fe.prov`)
`Y.char`	Y.char name of the response variable from `data` as a character string
`Z.char`	Z.char names of covariates from `data` as vector of character strings
`prov.char`	name of provider IDs variable as a character string
`test`	string denoting hypothesis test to be conducted. Currently, options include "exact.binom", "exact.poisbinom", "exact.bootstrap", "score". The default is `test="score"`
`null`	use median for null comparison
`alpha`	alpha level for the CIs
`n`	number of bootstrap draws

Value

Returns a `data.frame` of the results of the test for each provider with attributes:

- flag: Either "1" for p<alpha/2, "0" p<=1-alpha/2 and p<alpha/2, or "-1" for neither
- p: p-value for the hypothesis test of the model parameter

References

He, K., Kalbfleisch, J.D., Li, Y. and Li, Y., 2013. Evaluating hospital readmission rates in dialysis facilities; adjusting for hospital effects. Lifetime data analysis, 19(4), pp.490-512.

See Also

fe.data.prep, fe.prov, funnel.SRR, confint.fe.prov

Examples

```
# Name input variables and other parameters
# a small positive number specifying stopping
# criterion of Newton-Raphson algorithm
tol <- 1e-5
Y.char <- 'Y'
prov.char <- 'prov.ID'
Z.char <- paste0('z', 1:3)
data(hospital_prepared) # build in data set
fe.ls <- fe.prov(hospital_prepared, Y.char, Z.char, prov.char, tol) # model fitting

# Hypothesis tests
null = "median"
alpha = 0.05
score.fe <- test.fe.prov(hospital_prepared, fe.ls, Y.char, Z.char,
                         prov.char, test="score", null, alpha)
```

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