Package 'regcorr'

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Type Package

Title Regression Models of Pearson Correlation Coefficient

Version 0.1.0

Description Provides statistical tools for evaluating how covariates influence the strength of Pearson correlation coefficients between two response variables. Supports bivariate normal and bivariate binary responses, with likelihood-based inference and bootstrap-based significance testing. The methodology is based on Dufera, Liu and Xu (2023) ``Regression models of Pearson correlation coefficient'' <doi:10.1080/24754269.2023.2164970>.

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Depends R (>= 4.1.0)

Imports stats

Suggests testthat (>= 3.0.0)

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URL https://github.com/lonze-nb/regcorr

BugReports https://github.com/lonze-nb/regcorr/issues

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`genDataBB` *Generate data from bivariate Bernoulli*

Description

Generate data from bivariate Bernoulli

Usage

```
genDataBB(numSample, p, betaTrue, eta1True, eta2True, link)

genDataBB(numSample, p, betaTrue, eta1True, eta2True, link)
```

Arguments

`numSample`	Sample size.
`p`	Number of covariates.
`betaTrue`	True beta vector.
`eta1True`	True eta1 vector.
`eta2True`	True eta2 vector.
`link`	Link function indicator ("1" = logistic; "2" = tanh).

Value

A list containing X, Y, and rho.

Examples

```
set.seed(123)
dat <- genDataBB(
  numSample = 20,
  p = 2,
  betaTrue = c(0.2, 0, 0),
  eta1True = c(0, 0, 0),
  eta2True = c(0, 0, 0),
  link = "1"
```

```
)
names(dat)
```

---

genDataBN *Generate data from bivariate normal*

Description

Simulate bivariate normal responses with a covariate-dependent Pearson correlation coefficient.

Usage

```
genDataBN(numSample, p, betaTrue, eta1True, eta2True, link)

genDataBN(numSample, p, betaTrue, eta1True, eta2True, link)
```

Arguments

numSample	Number of observations.
p	Number of covariates.
betaTrue	True regression coefficients for the correlation model.
eta1True	Included for interface consistency.
eta2True	Included for interface consistency.
link	Correlation link function: "1" for logistic, "2" for tanh.

Value

A list containing X, Y, and rho.

A list containing:

X Covariate matrix.

Y Response matrix with two columns.

rho True correlation coefficients.

Examples

```
set.seed(123)
dat <- genDataBN(
  numSample = 20,
  p = 2,
  betaTrue = c(0.2, 0, 0),
  eta1True = c(0, 0, 0),
  eta2True = c(0, 0, 0),
  link = "1"
)
names(dat)
```

```
dim(dat$X)
dim(dat$Y)
```

`logistic` *Logistic Function*

Description

Compute the logistic transformation of a numeric input.

Usage

```
logistic(x)

logistic(x)
```

Arguments

`x`	A numeric vector.

Value

A numeric value or vector with elements in (0,1).

The calculated logistic probability.

Examples

```
logistic(0)
logistic(c(-1, 0, 1))
```

`NRfitBivBernoulli` *Fit a Regression Model for Pearson Correlation Coefficient*

Description

Estimate regression coefficients in a covariate-dependent Pearson correlation model for bivariate binary responses using the Newton-Raphson algorithm.

Usage

```
NRfitBivBernoulli(Y, X, beta0, link)

NRfitBivBernoulli(Y, X, beta0, link)
```

Arguments

Y	n by 2 matrix, paired responses.
X	n by p matrix, covariate matrix including first column of ones.
beta0	Initial estimate of beta.
link	Indicator of link function ("1" = logistic, "2" = tanh).

Value

A list containing:

betaCurrent Estimated regression coefficients.

numIter Number of iterations.

restart Number of restarts.

A list containing betaCurrent, numIter, and restart.

Examples

```
set.seed(123)

dat <- genDataBB(
  numSample = 30,
  p = 1,
  betaTrue = c(0.3, 0.1),
  eta1True = c(0, 0),
  eta2True = c(0, 0),
  link = "1"
)

fit <- NRfitBivBernoulli(
  Y = dat$Y,
  X = dat$X,
  beta0 = c(0, 0),
  link = "1"
)

fit$numIter
```

NRfitBivNormal *Fit a Regression Model for Pearson Correlation Coefficient*

Description

Estimate regression coefficients in a covariate-dependent Pearson correlation model for bivariate normal responses using the Newton-Raphson algorithm.

Usage

```
NRfitBivNormal(Y, X, betaIni, link)
```


```
NRfitBivNormal(Y, X, betaIni, link)
```


Arguments

Y	n by 2 matrix, paired responses.
X	n by p matrix, covariate matrix including first column of ones.
betaIni	Initial estimate of beta.
link	Indicator of link function ("1" = logistic, "2" = tanh).

Value

A list containing:

betaCurrent Estimated regression coefficients.

numIter Number of Newton-Raphson iterations.

restart Number of restarts.

A list containing betaCurrent, numIter, and restart.

Examples

```
set.seed(123)

dat <- genDataBN(
  numSample = 30,
  p = 1,
  betaTrue = c(0.5, 0.2),
  eta1True = c(0, 0),
  eta2True = c(0, 0),
  link = "1"
)

fit <- NRfitBivNormal(
  Y = dat$Y,
  X = dat$X,
  betaIni = c(0, 0),
  link = "1"
)

fit$numIter
```

`rbinary` *Generate Correlated Binary Data*

Description

Generate bivariate binary random variables with specified marginal probabilities and correlation.

Usage

```
rbinary(n, p, rho)
```


```
rbinary(n, p, rho)
```


Arguments

`n`	Number of rows.
`p`	1 by 2 mean vector of bivariate variables.
`rho`	Correlation of bivariate variables.

Details

The implementation follows Qaqish (2003).

Value

An `n` x `2` matrix of binary random variables.

n by 2 matrix of generated binary variables.

References

Qaqish, B. F. (2003). A family of multivariate binary distributions for simulating correlated binary variables with specified marginal means and correlations. *Biometrika*, 90(2), 455–463.

Examples

```
set.seed(123)
y <- rbinary(
  n = 10,
  p = c(0.4, 0.5),
  rho = 0.2
)

dim(y)
```

`subRoutineTest` *Subroutine to Test the Significance of Individual Parameters*

Description

Conduct simulation studies for testing regression coefficients in correlation regression models.

Usage

```
subRoutineTest(
  numSample,
  p,
  link,
  model,
  betaTrue,
  betaIni,
  eta1True,
  eta2True,
  numSimu,
  numBoot
)
```

Arguments

`numSample`	Sample size.
`p`	Number of covariates.
`link`	Link function. "1" for logistic and "2" for tanh.
`model`	Model type. "1" for bivariate normal and "2" for bivariate Bernoulli.
`betaTrue`	True beta coefficients.
`betaIni`	Initial beta coefficients.
`eta1True`	True eta1 coefficients.
`eta2True`	True eta2 coefficients.
`numSimu`	Number of simulation replications.
`numBoot`	Number of bootstrap iterations.

Value

A list containing:

RMSE Root mean squared error of the estimated coefficients.

ConsistRate Consistency rate of estimated correlations.

power Estimated testing power.

Examples

```
set.seed(123)

res <- subRoutineTest(
  numSample = 20,
  p = 1,
  link = "1",
  model = "1",
  betaTrue = c(0.2, 0.1),
  betaIni = c(0, 0),
  eta1True = c(0, 0),
  eta2True = c(0, 0),
  numSimu = 1,
  numBoot = 5
)

names(res)
```

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