

Package ‘jaccard’

July 22, 2025

Type Package

Title Test Similarity Between Binary Data using Jaccard/Tanimoto Coefficients

Version 0.1.0

Date 2018-06-06

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Description Calculate statistical significance of Jaccard/Tanimoto similarity coefficients for binary data.

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Encoding UTF-8

LazyData true

Imports Rcpp (>= 0.12.6), qvalue, dplyr, magrittr

LinkingTo Rcpp

NeedsCompilation yes

SystemRequirements C++11

RoxygenNote 6.0.1

Repository CRAN

Date/Publication 2018-06-14 17:53:00 UTC

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jaccard	<i>Compute a Jaccard/Tanimoto similarity coefficient</i>
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Description

Compute a Jaccard/Tanimoto similarity coefficient

Usage

```
jaccard(x, y, center = FALSE, px = NULL, py = NULL)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
center	whether to center the Jaccard/Tanimoto coefficient by its expectation
px	probability of successes in x (optional)
py	probability of successes in y (optional)

Value

jaccard returns a Jaccard/Tanimoto coefficient.

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard(x,y)
```

jaccard.ev	<i>Compute an expected Jaccard/Tanimoto similarity coefficient under independence</i>
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Description

Compute an expected Jaccard/Tanimoto similarity coefficient under independence

Usage

```
jaccard.ev(x, y, px = NULL, py = NULL)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
px	probability of successes in x (optional)
py	probability of successes in y (optional)

Value

jaccard.ev returns an expected value.

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard.ev(x,y)
```

jaccard.rahman	<i>Compute p-value using an extreme value distribution</i>
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Description

Rahman et al. (2014) proposes a method to compute a p-value of a Jaccard/Tanimoto coefficient using an extreme value distribution. Their paper provides the following description: The mean (μ) and s.d. (σ) of the similarity scores are used to define the z score, $z = (T_w - \mu)/\sigma$. For the purpose of calculating the P value, only hits with $T > 0$ are considered. The P value w is derived from the z score using an extreme value distribution $P = 1 - \exp(-e^{-z \cdot \pi / \sqrt{6}} - G'(1))$, where the Euler=Mascheroni constant $G'(1)=0.577215665$.

Usage

```
jaccard.rahman(j)
```

Arguments

`j` a numeric vector of observed Jaccard coefficients (uncentered)

Value

`jaccard.rahman` returns a numeric vector of p-values

References

Rahman, Cuesta, Furnham, Holliday, and Thornton (2014) EC-BLAST: a tool to automatically search and compare enzyme reactions. *Nature Methods*, 11(2) <http://www.nature.com/nmeth/journal/v11/n2/full/nmeth.2803.html>

jaccard.test	<i>Test for Jaccard/Tanimoto similarity coefficients</i>
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Description

Compute statistical significance of Jaccard/Tanimoto similarity coefficients between binary vectors, using four different methods.

Usage

```
jaccard.test(x, y, method = "mca", px = NULL, py = NULL, verbose = TRUE,
...)
```

Arguments

<code>x</code>	a binary vector (e.g., fingerprint)
<code>y</code>	a binary vector (e.g., fingerprint)
<code>method</code>	a method to compute a p-value ("mca", "bootstrap", "asymptotic", or "exact")
<code>px</code>	probability of successes in x (optional)
<code>py</code>	probability of successes in y (optional)
<code>verbose</code>	whether to print progress messages
<code>...</code>	optional arguments for specific computational methods

Details

There exist four methods to compute p-values of Jaccard/Tanimoto similarity coefficients: `mca`, `bootstrap`, `asymptotic`, and `exact`. This is simply a wrapper function for corresponding four functions in this package: `jaccard.test.mca`, `jaccard.test.bootstrap`, `jaccard.test.asymptotic`, and `jaccard.test.exact`.

We recommend using either `mca` or `bootstrap` methods, since the `exact` solution is slow for a moderately large vector and `asymptotic` approximation may be inaccurate depending on the input vector size. The `bootstrap` method uses resampling with replacement binary vectors to compute a p-value (see optional arguments). The `mca` method uses the measure concentration algorithm that estimates the multinomial distribution with a known error bound (specified by an optional argument `accuracy`).

Value

jaccard.test returns a list mainly consisting of

statistics	centered Jaccard/Tanimoto similarity coefficient
pvalue	p-value
expectation	expectation

Optional arguments for method="bootstrap"

fix whether to fix (i.e., not resample) x and/or y

B a total bootstrap iteration

seed a seed for a random number generator

Optional arguments for method="mca"

accuracy an error bound on approximating a multinomial distribution

error.type an error type on approximating a multinomial distribution ("average", "upper", "lower")

seed a seed for the random number generator.

See Also

[jaccard.test.bootstrap](#) [jaccard.test.mca](#) [jaccard.test.exact](#) [jaccard.test.asymptotic](#)

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard.test(x,y,method="bootstrap")
jaccard.test(x,y,method="mca")
jaccard.test(x,y,method="exact")
jaccard.test(x,y,method="asymptotic")
```

```
jaccard.test.asymptotic
```

Compute p-value using an asymptotic approximation

Description

Compute statistical significance of Jaccard/Tanimoto similarity coefficients.

Usage

```
jaccard.test.asymptotic(x, y, px = NULL, py = NULL, verbose = TRUE)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
px	probability of successes in x (optional)
py	probability of successes in y (optional)
verbose	whether to print progress messages

Value

jaccard.test.asymptotic	returns a list consisting of
statistics	centered Jaccard/Tanimoto similarity coefficient
pvalue	p-value
expectation	expectation

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard.test.asymptotic(x,y)
```

```
jaccard.test.bootstrap
```

Compute p-value using the bootstrap procedure

Description

Compute statistical significance of Jaccard/Tanimoto similarity coefficients.

Usage

```
jaccard.test.bootstrap(x, y, px = NULL, py = NULL, verbose = TRUE,
  fix = "x", B = 1000, seed = NULL)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
px	probability of successes in x (optional)
py	probability of successes in y (optional)
verbose	whether to print progress messages
fix	whether to fix (i.e., not resample) x and/or y
B	a total bootstrap iteration
seed	a seed for a random number generator

Value

jaccard.test.bootstrap returns a list consisting of

statistics	centered Jaccard/Tanimoto similarity coefficient
pvalue	p-value
expectation	expectation

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard.test.bootstrap(x,y,B=500)
```

jaccard.test.exact	<i>Compute p-value using the exact solution</i>
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Description

Compute statistical significance of Jaccard/Tanimoto similarity coefficients.

Usage

```
jaccard.test.exact(x, y, px = NULL, py = NULL, verbose = TRUE)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
px	probability of successes in x (optional)
py	probability of successes in y (optional)
verbose	whether to print progress messages

Value

jaccard.test.exact returns a list consisting of

statistics	centered Jaccard/Tanimoto similarity coefficient
pvalue	p-value
expectation	expectation

Examples

```
set.seed(1234)
x = rbinom(100,1,.5)
y = rbinom(100,1,.5)
jaccard.test.exact(x,y)
```

jaccard.test.mca	<i>Compute p-value using the Measure Concentration Algorithm</i>
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Description

Compute statistical significance of Jaccard/Tanimoto similarity coefficients.

Usage

```
jaccard.test.mca(x, y, px = NULL, py = NULL, accuracy = 1e-05,  
  error.type = "average", verbose = TRUE)
```

Arguments

x	a binary vector (e.g., fingerprint)
y	a binary vector (e.g., fingerprint)
px	probability of successes in x (optional)
py	probability of successes in y (optional)
accuracy	an error bound on approximating a multinomial distribution
error.type	an error type on approximating a multinomial distribution ("average", "upper", "lower")
verbose	whether to print progress messages

Value

jaccard.test.mca returns a list consisting of

statistics	centered Jaccard/Tanimoto similarity coefficient
pvalue	p-value
expectation	expectation

Examples

```
set.seed(1234)  
x = rbinom(100,1,.5)  
y = rbinom(100,1,.5)  
jaccard.test.mca(x,y,accuracy = 1e-05)
```

jaccard.test.pairwise *Pair-wise tests for Jaccard/Tanimoto similarity coefficients*

Description

Given a data matrix, it computes pair-wise Jaccard/Tanimoto similarity coefficients and p-values among rows (variables). For fine controls, use "jaccard.test".

Usage

```
jaccard.test.pairwise(dat, method = "mca", verbose = TRUE,  
  compute.qvalue = TRUE, ...)
```

Arguments

dat	a data matrix
method	a method to compute a p-value ("mca", "bootstrap", "asymptotic", or "exact")
verbose	whether to print progress messages
compute.qvalue	whether to compute q-values
...	optional arguments for specific computational methods

Value

jaccard.test.pairwise returns a list of matrices

statistics	Jaccard/Tanimoto similarity coefficients
pvalues	p-values
qvalues	q-values

See Also

[jaccard.test](#)

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