Package: renyi (via r-universe)

March 3, 2025

Type Package

Title Renyi Outlier Test

Version 1.0.0

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Description renyi implements the Renyi Outlier Test <arXiv:2411.13542>, an outlier test designed for modern large scale testing applications, especially where prior information available. The test combines a vector of independent uniform p-values into one p-value with power against alternatives where a small number of p-values are non-null. The test can leverage prior probabilities/weights specifying which variables are likely to be outliers and prior estimates of effect size. The procedure is fast even when the number of initial p-values is large (e.g. in the millions) and numerically stable even for very small p-values (e.g. 10^-300).

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BugReports https://github.com/ryanchrist/renyi/issues

URL https://ryanchrist.r-universe.dev/renyi, https://github.com/ryanchrist/renyi

Encoding UTF-8

LazyData true

RoxygenNote 7.3.2

Depends R (>= 3.5.0)

Imports stats, utils

Repository https://ryanchrist.r-universe.dev

RemoteUrl https://github.com/ryanchrist/renyi

RemoteRef HEAD

RemoteSha 6c5ebcf279de4081d411b3afd49077c17c1d50d7

Contents

`generalized_renyi_transform`
Generalized Renyi Transform

Description

A Generalization of Aldous Renyi's representation of exponential order statistics

Usage

```
generalized_renyi_transform(x, eta = NULL, zeta = NULL)
```

Arguments

`x`	a vector of independent exponential random variables of the form $X_j = \eta_j Y_j + \zeta_j$ where each X_j is an independent exponential random variable with rate 1
`eta`	vector of scale parameters implicit in the construction of `x`: `eta[j]` = η_j
`zeta`	vector of shift parameters implicit in the construction of `x`: `zeta[j]` = ζ_j

Details

Maps a vector of shifted and scaled independent exponential random variables to a sequence of standard independent exponential random variables based on the gaps (jumps) between the initial random variables

Value

a list containing two elements

'exps' a vector of independent standard exponentials where `exps[1]` is the exponential jump corresponding to `min(x)` and `tail(exps,1)` is the exponential jump corresponding to `max(x)`.

'order' `order(x)`.

References

Christ, R., Hall, I. and Steinsaltz, D. (2024) "The Renyi Outlier Test", arXiv:2411.13542 . Available at: doi:10.48550/arXiv.2411.13542.

Examples

```
# example code

a <- rchisq(10,1)
b <- rnorm(10)
xx <- a*rexp(10)+b
generalized_renyi_transform(xx, a, b)
```

`renyi` *Renyi Outlier Test*

Description

A fast, numerically precise outlier test for a vector of exact p-values allowing for prior information

Usage

```
renyi(u, k = ceiling(0.01 * length(u)), pi = NULL, eta = NULL)
```

Arguments

`u`	a vector of p-values
`k`	a rough upper bound on the number of outliers expected to be present in `u`
`pi`	optional vector such that `pi[j]` is proportional to the probability that `u[j]` is an outlier. The default, `NULL`, corresponds to `pi = rep_len(1,length(u))`.
`eta`	optional vector proportional to how far outlying we expect `u[j]` to be given `u[j]` is an outlier. More precisely, in the common context where each element of `u` can be thought of as a p-value for testing whether some coefficient β in a linear regression model is zero, we assume `eta[j]` is proportional to $\mathbb{E}\left[\beta_j^2 \middle| \beta_j \neq 0\right]$. The default, `NULL`, corresponds to `eta = rep_len(1,length(u))`.

Details

The about which p-values are outlying and "how much" of an outlier they are expected to be

Value

a list containing three elements

'p_value' the p-value returned by the Renyi Outlier Test;

'exit_status' a character string describing any problems that may have been encountered during evaluation, "default is no problems";

'u' the vector of p-values used by the outlier test after adjusting the `u` provided for `pi` and `eta`.

References

Christ, R., Hall, I. and Steinsaltz, D. (2024) "The Renyi Outlier Test", arXiv:2411.13542 . Available at: doi:10.48550/arXiv.2411.13542.

Examples

```
# example code

p <- 1e4
u <- runif(p)
u[c(53,88,32)] <- 1e-6 # add a few outliers
renyi(u)$p_value # test for outliers without any prior knowledge
renyi(u,pi=c(rep(1,100),rep(10^-3,p-100)))$p_value # test for outliers with prior knowledge
```

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