

# Package: renyi (via r-universe)

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**Type** Package

**Title** Renyi Outlier Test

**Version** 1.0.0

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**Description** renyi implements the Renyi Outlier Test <[arXiv:2411.13542](https://arxiv.org/abs/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.  $10^{-300}$ ).

**License** Apache License ( $\geq 2$ )

**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 ( $\geq 3.5.0$ )

**Imports** stats, utils

**Repository** <https://ryanchrist.r-universe.dev>

**RemoteUrl** <https://github.com/ryanchrist/renyi>

**RemoteRef** HEAD

**RemoteSha** 2dc35e987f9660fe71b8ac4ef2fd6a759e5c0fdc

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generalized\_renyi\_transform  
*Generalized Renyi Transform*

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### Description

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

### Usage

```
generalized_renyi_transform(x, a = NULL, b = NULL)
```

### Arguments

x	a vector of independent exponential random variables of the form $X_j = a_j Y_j + b_j$ where each $Y_j$ is an independent exponential random variable with rate 1
a	vector of scale parameters implicit in the construction of x: $a[j] = a_j$
b	vector of shift parameters implicit in the construction of x: $b[j] = b_j$

### 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 Available at: [doi:](#)

**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 = rep(1, length(u)),
  eta = rep(1, length(u))
)
```

**Arguments**

<code>u</code>	a vector of p-values
<code>k</code>	a rough upper bound on the number of outliers expected to be present in <code>u</code>
<code>pi</code>	optional vector such that <code>pi[j]</code> is proportional to the probability that <code>u[j]</code> is an outlier
<code>eta</code>	optional vector proportional to how far outlying we expect <code>u[j]</code> to be given <code>u[j]</code> is an outlier. More precisely, in the common context where each element of <code>u</code> can be thought of as a p-value for testing whether some coefficient $\beta$ in a linear regression model is zero, we assume <code>eta[j]</code> is proportional to $\mathbb{E}[\beta_j^2   \beta_j \neq 0]$ .

**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 Available at: [doi:](#).

**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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