Package ‘CorrectedFDR’

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<table>
<thead>
<tr>
<th>Type</th>
<th>Package</th>
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<tbody>
<tr>
<td>Title</td>
<td>Correcting False Discovery Rates</td>
</tr>
<tr>
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<td>2021-10-06</td>
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<tr>
<td>Author</td>
<td>Abbas Rahal, Anna Akpawu, Justin Chitpin and David R. Bickel</td>
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<tr>
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**Description**
There are many estimators of false discovery rate. In this package we compute the Nonlocal False Discovery Rate (NFDR) and the estimators of local false discovery rate: Corrected False discovery Rate (CFDR), Re-ranked False Discovery rate (RFDR) and the blended estimator. Bickel, D.R., Rahal, A. (2019) [https://tinyurl.com/kkdc9rk8](https://tinyurl.com/kkdc9rk8).

**Depends**  R(>= 2.14.2)

**Suggests**  LFDR.MLE, LFDREmpiricalBayes, ProData

**biocViews**  Bayesian Statistics, MathematicalBiology

**License**  LGPL-3

**NeedsCompilation**  no

**Repository**  CRAN

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**R topics documented:**

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CorrectedFDR-package  Correcting False Discovery Rates

Description

There are many estimators of false discovery rate. In this package we compute the Nonlocal False Discovery Rate (NFDR) and the estimators of local false discovery rate: Corrected False discovery Rate (CFDR), Re-ranked False Discovery rate (RFDR) and the blended estimator. Bickel, D.R., Rahal, A. (2019) <https://tinyurl.com/kkdc9rk8>.

Details

The DESCRIPTION file:

```
Package: CorrectedFDR
Type: Package
Version: 1.1
Date: 2021-10-06
License: GPL-3
Depends: R(>= 2.14.2)
Suggests: LFDR.MLE, LFDREmpiricalBayes, ProData
```

Two functions in CorrectedFDR package to compute the LFDR estimators. The function EstimatorsFDR computes the nonlocal false discovery rate (NFDR), the CFDR and the RFDR. The function BlendedLFDR uses a Benchmark of FDR, and other estimators of LFDR in order to get an estimate of LFDR.

Author(s)

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References


Bickel, D. R. (2015). Corrigendum to: Simple estimators of false discovery rates given as few as one or two p-values without strong parametric assumptions. Statistical Applications in Genetics and Molecular Biology, 2015, 14, 225.


Bickel, D. R. (2013). Simple estimators of false discovery rates given as few as one or two p-values without strong parametric assumptions. Statistical Applications in Genetics and Molecular Biology, 2013, 12, 529-543.
**Description**

BlendedLFDR is a function used to compute the blended estimator based on a benchmark estimator, usually the nonlocal false discovery rate (NFDR), and a set of estimators of local false discovery rates (LFDR).

**Usage**

BlendedLFDR(Benchmark, EstLFDR)

**Arguments**

- **Benchmark**: Input numeric vector for benchmark estimator (often NFDR).
- **EstLFDR**: Input a matrix containing two or more sets of LFDR estimators.

**Details**

- **Benchmark** is an estimator of the FDR. This is usually the nonlocal false discovery rate (NFDR).
- **EstLFDR** is a matrix of several LFDR estimators such as corrected FDR (CFDR), re-ranked FDR (RFDR), MLE (Maximum Likelihood Estimator), BBE1 (Binomial Based Estimator), etc.

The output returns a single numeric vector containing the blended estimator of the LFDR.

**Value**

The value of the blended estimator is an estimator of the LFDR.

**Note**

The number of rows for the Benchmark and EstLFDR must have equal lengths.

**Author(s)**

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Documentation: Anna Akpawu, Justin Chitpin and Abbas Rahal.
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**References**

EstimatorsFDR

**Examples**

# The data used to compute the LFDR estimators (CFDR, RFDR, MLE, and BBE1)
# comes from the ER/PR breast cancer data from the "ProData" package.
# To read more about the data, visit the website: https://www.bioconductor.org/
# Test statistics were first obtained, then the estimators for the FDR and LFDR were estimated.
# Benchmark vector
NFDR<-c(0.5661106448, 0.6897735492, 0.0000288516, 0.1549745113, 0.1305508970, 0.2421032979, 0.1482395568, 1, 1, 1, 0.6602562820, 0.7034682859, 0.7036332234, 0.0071192090, 0.8204536037, 0.9757716498, 0.7379329991, 1, 0.6333245479, 0.9904389701)

# Estimators of LFDR
CFDR<- c(1, 1, 0.0000288516, 0.2841199373, 0.2841199373, 0.5931530799, 0.3088199101, 1, 1, 1, 1, 1, 1, 0.0106788135, 1, 1, 1, 1, 1, 1)
RFDR<- c(0.689773549, 1, 0.007119209, 0.130550897, 0.703633223, 0.660256282, 0.242103298, 1, 1, 1, 0.820453604, 1, 0.703468286, 0.154974511, 1, 1, 1, 1, 1, 1)
MLE<- c(0.9865479126, 0.9969935995, 0.0002372158, 0.6531633437, 0.7611453549, 0.9187425383, 0.7359259207, 0.9996548155, 0.9997310453, 0.9997437131, 0.9944712582, 0.9981685029, 0.9937604664, 0.0215892618, 0.9990504315, 0.9997493086, 0.9967673540, 0.997016985, 0.9970142319, 0.9979625263)
BBE1<- c(1,1, 0.0003169812, 0.1138333734, 1, 1, 1, 1, 1, 1, 0.3279109564, 1, 0.0504755806, 0.0091823115, 0.0182614994, 0.0165386682, 1, 0.6964403713, 0.1001337298, 0.8415641198 )

# Matrix of LFDR Estimators
Est.LFDR<- matrix(c(CFDR,RFDR,MLE,BBE1), ncol=4)
output<-BlendedLFDR(Benchmark = NFDR, EstLFDR = Est.LFDR)
output$Blended

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EstimatorsFDR  
**Estimators of Local False Discovery Rate (LFDR)**

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**Description**

EstimatorsFDR is an R function that computes the Nonlocal False Discovery Rate (NFDR) and the estimators of local false discovery rate: Corrected False discovery Rate (CFDR) and Re-ranked False Discovery rate (RFDR).

**Usage**

EstimatorsFDR(pvalue)

**Arguments**

pvalue  
Input numeric vector of pvalues.
Details

The input is a list of pvalues. The pvalues can be obtained for example by performing Student’s t-test between two datasets. The two groups can be data from healthy and disease states. Let \( i = 1, 2, \ldots, N \), where \( i \) represents the \( ith \) feature (SNP or gene, for example). Then, for each \( i \), the hypothesis indicator \( A_i \) can have two possible values.

\( A_i = 0 \), if the \( ith \) null hypothesis is true, or

\( A_i = 1 \), if the \( ith \) null hypothesis is not true,

where the null hypothesis is defined by: the \( ith \) feature is unaffected by a treatment, unassociated with a disease, etc. The values for each estimator (NFDR, CFDR, RFDR) indicate the probability that the null hypothesis of the \( ith \) feature is true \((A_i = 0)\) given the statistics \( T_i \). The alternative hypothesis is true if \( A_i = 1 \). For example, in gene expression data analysis, if the null hypothesis is true, this would mean that the genes are not differentially expressed.

Value

The output returns three lists. It returns the NFDR, CFDR, and RFDR estimators:

- **NFDR** nonlocal FDR
- **CFDR** corrected FDR
- **RFDR** re-ranked FDR

Author(s)

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References


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Examples

#The examples below are from the "ProData" package.
#In order to use the "Prodata" input you would first need to install the ProData package.
#You will also need the function exprs in this package.
#First, make sure that the ProData package is properly installed:
#source("https://bioconductor.org/biocLite.R")
#biocLite("ProData")
#library(ProData)
#data("f45cbmk")
#q1<- quantile(as(exprs(f45cbmk[, pData(f45cbmk)$GROUP == "B"]), "numeric"), probs = 0.25)
#logish<- function(x){log(x + q1)}
#Vectors of proteins for 20 patients ER/PR-positive and Healthy
#Y<- logish(exprs(f45cbmk[, pData(f45cbmk)$GROUP == "B"])) # Control (Healthy)
#X.ER<- logish(exprs(f45cbmk[, pData(f45cbmk)$GROUP == "C"])) # Case ER/PR-positive
#pvalue<- NULL
#for (i in 1:nrow(X.ER))
#
#   t<-t.test(x=X.ER[i,], y=Y[i,], alternative = "two.sided")
#   pvalue[i]<- t$p.value
#

#The pvalues obtained from the t-test:
pvalue<- c(0.1981, 0.3794, 0.000001443, 0.02325, 0.03264, 0.07263, 0.02965, 0.8016, 0.8888, 0.9133, 0.2971, 0.4573, 0.2815, 0.0007119, 0.5743, 0.927, 0.369, 0.8478, 0.38, 0.9904)
output<- EstimatorsFDR(pvalue)
#Three lists
output$NFDR
output$CFDR
output$RFDR