Package ‘CorrectedFDR’

October 12, 2022

Type Package

Title Correcting False Discovery Rates

Version 1.1

Date 2021-10-06

Author Abbas Rahal, Anna Akpawu, Justin Chitpin and David R. Bickel

Maintainer Abbas Rahal <Abbas.Rahal13@gmail.com>

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.


Depends R(>= 2.14.2)

Suggests LFDR.MLE, LFDREmpiricalBayes, ProData

biocViews Bayesian Statistics, MathematicalBiology

License LGPL-3

NeedsCompilation no

Repository CRAN

Date/Publication 2021-10-07 13:50:06 UTC

R topics documented:

  CorrectedFDR-package .................................................. 2
  BlendedLFDR .................................................................. 3
  EstimatorsFDR ................................................................. 4

Index
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:

<table>
<thead>
<tr>
<th>Package</th>
<th>CorrectedFDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Package</td>
</tr>
<tr>
<td>Version</td>
<td>1.1</td>
</tr>
<tr>
<td>Date</td>
<td>2021-10-06</td>
</tr>
<tr>
<td>License</td>
<td>GPL-3</td>
</tr>
<tr>
<td>Depends</td>
<td>R(&gt;= 2.14.2)</td>
</tr>
<tr>
<td>Suggests</td>
<td>LFDR.MLE, LFDREmpiricalBayes, ProData</td>
</tr>
</tbody>
</table>

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)

Abbas Rahal, Anna Akpawu, Justin Chitpin and David R. Bickel
Maintainer: Abbas Rahal <Abbas.Rahal13@gmail.com>

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)

Code: Abbas Rahal.
Documentation: Anna Akpawu, Justin Chitpin and Abbas Rahal.
Maintainer: Abbas Rahal <Abbas.Rahal13@gmail.com>

References

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 obtain, 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, 0.1482335568, 1, 1, 1, 0.6602562828, 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, 0.2980912149, 0.5931530799, 0.3088199101, 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, 0.975771650, 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, 0.021582618, 0.9990504315, 0.9997493086, 0.9967673540, 0.9997016985, 0.9970142319, 0.9997625673)
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, 0.696403713, 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

---

<table>
<thead>
<tr>
<th>EstimatorsFDR</th>
<th>Estimators of Local False Discovery Rate (LFDR)</th>
</tr>
</thead>
</table>

**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 p-values. The p-values 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 \( i \)th 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 \( i \)th null hypothesis is true,
- \( A_i = 1 \), if the \( i \)th null hypothesis is not true,

where the null hypothesis is defined by: the \( i \)th 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 \( i \)th 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)

Code: Abbas Rahal.
Documentation: Anna Akpawu, Justin Chitpin and Abbas Rahal.
Maintainer: Abbas Rahal <Abbas.Rahal13@gmail.com>

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.

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")
EstimatorsFDR

#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
# Index

- **BBE1**
  - BlendedLFDR, 3
- **Blended**
  - BlendedLFDR, 3
- **CFDR**
  - BlendedLFDR, 3
  - EstimatorsFDR, 4
- **False Discovery Rate**
  - BlendedLFDR, 3
  - EstimatorsFDR, 4
- **LFDR**
  - BlendedLFDR, 3
  - EstimatorsFDR, 4
- **MLE**
  - BlendedLFDR, 3
- **NFDR**
  - BlendedLFDR, 3
  - EstimatorsFDR, 4
- **Null**
  - EstimatorsFDR, 4
- **RFDR**
  - BlendedLFDR, 3
  - EstimatorsFDR, 4
- **hypothesis**
  - EstimatorsFDR, 4
- **package**
  - CorrectedFDR-package, 2

BlendedLFDR, 3

CorrectedFDR-package, 2

EstimatorsFDR, 4