

# Package ‘STAREG’

August 15, 2023

**Type** Package

**Title** An Empirical Bayes Approach for Replicability Analysis Across Two Studies

**Version** 1.0.3

**Description** A robust and powerful empirical Bayesian approach is developed for replicability analysis of two large-scale experimental studies. The method controls the false discovery rate by using the joint local false discovery rate based on the replicability null as the test statistic. An EM algorithm combined with a shape constraint nonparametric method is used to estimate unknown parameters and functions. [Li, Y. et al., (2023), <<https://www.biorxiv.org/content/10.1101/2023.05.30.542607v1>>].

**License** GPL-3

**Encoding** UTF-8

**Depends** Rcpp (>= 1.0.9), qvalue

**LinkingTo** Rcpp, RcppArmadillo

**RoxygenNote** 7.2.3

**NeedsCompilation** yes

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**Repository** CRAN

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em_lfdr	<i>EM algorithm to estimate local false discovery rate</i>
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**Description**

Estimate the local false discovery rate across two studies and apply a step-up procedure to control the FDR of replicability null.

**Usage**

```
em_lfdr(pa_in, pb_in, pi0a_in, pi0b_in)
```

**Arguments**

pa_in	A numeric vector of p-values from study 1.
pb_in	A numeric vector of p-values from study 2.
pi0a_in	An initial estimate of the null probability in study 1.
pi0b_in	An initial estimate of the null probability in study 2.

**Value**

Lfdr	The estimated local false discovery rate for replicability null.
fdr	The adjusted values based on local false discovery rate for FDR control.
xi00	An estimate of the prior probability for joint state (0, 0).
xi01	An estimate of the prior probability for joint state (0, 1).
xi10	An estimate of the prior probability for joint state (1, 0).
xi11	An estimate of the prior probability for joint state (1, 1).
f1	A non-parametric estimate for the non-null probability density function in study 1.
f2	A non-parametric estimate for the non-null probability density function in study 2.

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stareg	<i>An empirical Bayes approach for replicability analysis across two studies</i>
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**Description**

An empirical Bayes approach for replicability analysis across two studies

**Usage**

```
stareg(pa, pb, init.pi0 = TRUE)
```

**Arguments**

<code>pa</code>	A numeric vector of p-values from study 1.
<code>pb</code>	A numeric vector of p-values from study 2.
<code>init.pi0</code>	A logistic value for deciding whether to initialize the prior probabilities based on the estimates of $\pi_0$ 's. If true, estimate the marginal $\pi_0$ 's in two studies using <code>qvalue</code> ; otherwise, specify <code>pi0_pa = pi0_pb = 0.9</code> .

**Value**

A list:

<code>Lfdr</code>	The estimated local false discovery rate for replicability null.
<code>fdr</code>	The adjusted Lfdr values based on the step-up procedure for FDR control.
<code>xi00</code>	An estimate of the prior probability for joint state (0, 0) in two studies.
<code>xi01</code>	An estimate of the prior probability for joint state (0, 1) in two studies.
<code>xi10</code>	An estimate of the prior probability for joint state (1, 0) in two studies.
<code>xi11</code>	An estimate of the prior probability for joint state (1, 1) in two studies.
<code>f1</code>	A non-parametric estimate for the non-null probability density function in study 1.
<code>f2</code>	A non-parametric estimate for the non-null probability density function in study 2.

**Examples**

```
# Simulate p-values in two studies
m = 10000
h = sample(0:3, m, replace = TRUE, prob = c(0.9, 0.025, 0.025, 0.05))
states1 = rep(0, m); states2 = rep(0, m)
states1[which(h==2|h==3)] = 1; states2[which(h==1|h==3)] = 1
z1 = rnorm(m, states1*2, 1)
z2 = rnorm(m, states2*3, 1)
p1 = 1 - pnorm(z1); p2 = 1 - pnorm(z2)
# Run STAREG to identify replicable signals
res.stareg = stareg(p1, p2)
sig.idx = which(res.stareg$fdr <= 0.05)
```

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