Package 'ChangepointTesting'

July 21, 2025

Type Package

Title Change Point Estimation for Clustered Signals

Version 1.2

Date 2025-05-03

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Description A multiple testing procedure for clustered alternative hypotheses. It is assumed that the p-values under the null hypotheses follow U(0,1) and that the distributions of p-values from the alternative hypotheses are stochastically smaller than U(0,1). By aggregating information, this method is more sensitive to detecting signals of low magnitude than standard methods. Additionally, sporadic small p-values appearing within a null hypotheses sequence are avoided by averaging on the neighboring p-values.

License GPL-2

Depends graphics, methods, stats

NeedsCompilation no

Repository CRAN

Date/Publication 2025-05-03 18:30:02 UTC

Contents

`ChangepointTesting-package` *Change Point Estimation for Clustered Signals*

Description

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Details

Package:	ChangepointTesting
Type:	Package
Version:	1.1
Date:	2022-06-05
License:	GPL-2

Author(s)

Hongyuan Cao, Wei Biao Wu, and Shannon T. Holloway Maintainer: Shannon T. Holloway <shannon.t.holloway@gmail.com>

References

Cao, H. and Wu, W. B. (2015) Changepoint estimation: Another look at multiple testing problems. Biometrika, 102, 974–980.

`changePoint` *Change Point Estimation for Clustered Signals*

Description

A multiple testing procedure for clustered alternative hypotheses. It is assumed that the p-values under the null hypotheses follow U(0,1) and that the distributions of p-values from the alternative hypotheses are stochastically smaller than U(0,1). By aggregating information, this method is more sensitive to detecting signals of low magnitude than standard methods. Additionally, sporadic small p-values appearing within a null hypotheses sequence are avoided by averaging on the neighboring p-values.

Usage

```
changePoint(pvalues, alpha, km, lm, compare = "BOTH", fdrlWindow = 3,
fdrlNStep = 300, fdrlLambda = 0.1)
```

Arguments

pvalues	an object of class numeric. A vector of p-values.
alpha	an object of class numeric. The significant level for the estimation of the critical value, gamma*.
km	an object of class numeric. The size of the window defining the neighborhood in left and right distances.
lm	an object of class numeric. The size of the window defining the neighborhood in the long-run variance estimation.
compare	one of ("FDRL", "BH", "Both", "None"). In addition to the Cao-Wu method, obtain significance indicators using the FDR_L method (FDRL) (Zhang et al., 2011), the Benjamini-Hochberg method (BH), (Benjamini andHochberg, 1995), "both" the FDRL and the BH methods, or do not consider alternative methods (none).
fdrlWindow	an object of class numeric. If FDR_L method requested, the size of the window defining the neighborhood.
fdrlNStep	an object of class numeric. If FDR_L method requested, the number of threshold values to consider.
fdrlLambda	and object of class numeric. If FDR_L method requested, the tuning constant.

Details

The comparison capability is included only for convenience and reproducibility of the original manuscript. The Benjamini-Hochberg and FDR_L methods cannot be accessed outside of the changePoint function.

The following methods retrieve individual results from a changePoint object, x:

`BH(x)`: Retrieves a vector of integer values. An element is 1 if the null hypothesis is rejected by the Benjamini-Hochberg (1995) method.

`blocks(x)`: Retrieves a list, each element of which is a vector of integer values. Each vector contains the indices of an alternative hypothesis block.

`CW(x)`: Retrieves a vector of integer values. An element is 1 if the null hypothesis is rejected by the Cao-Wu change point (2015) method.

`changePts(x)`: Retrieves a vector of integer values. The vector of change points identified by the Cao-Wu (2015) method. If no change points are identified, NULL is returned.

`FDRL(x)`: Retrieves a vector of integer values. Elements are 1 if the null hypothesis is rejected by the FDR_L (Zhang et al. 2011) method.

`critical(x)`: Retrieves the estimated critical value for testing used by the Cao-Wu (2015) method.

`numAlt(x)`: Retrieves the estimated number of alternative hypotheses obtained by the Cao-Wu (2015) method.

`piAlt(x)`: Retrieves the estimated proportion of alternative hypotheses obtained by the Cao-Wu (2015) method.

`plot(x, y, logp, ...)`: Generates plots of -log(p) vs position or p-value vs position for each alternative hypothesis block obtained by the Cao-Wu (2015) method. logp is TRUE/FALSE indicating if -log(p)/p-values are plotted on the y-axis.

`sigmaSq(x)`: Retrieves the estimated variance used to determine the critical value of the Cao-Wu (2015) method.

Value

Returns an object of class `changePoint`.

Author(s)

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References

Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. Journal of the Royal Statistical Society: Series B, 57, 289–300.

Cao, H. and Wu, W. B. (2015) Changepoint estimation: Another look at multiple testing problems. Biometrika, 102, 974–980.

Zhang, C., Fan, J., and Yu, T. (2011). Multiple testing via FDRL for large-scale imaging data. Anals of Statistics, 39, 613–642.

Examples

```
m <- 5000

T <- c(rep(0.1,  75), rep( 0.8, 75), rep(1.8, 100),
       rep(0.0,2250), rep(-1.5,250), rep(0.0,2250)) +
     rnorm(m, mean=0.0, sd = 1.0)

pv <- 2.0*(1.0-pnorm(abs(T)))

res <- changePoint(pvalues = pv,
                   alpha = 0.05,
                   km = {log(m)}^2,
                   lm = m^{1/4},
                   compare = "Both")

print(changePts(res))

print(head(cbind(BH(res),FDRL(res),CW(res))))
```

changePoint-class *Class* "changePoint"

Description

Value object returned by call to changePoint().

Objects from the Class

This object should not be created by users.

Slots

CW: Object of class numeric or NULL. A vector of 1/0 values; 1 indicates that hypothesis was rejected by the Cao-Wu method.

chgPts: Object of class numeric or NULL. The vector of change points identified by the Cao-Wu method. If no change points are identified, NULL.

pi_alt: Object of class numeric. The estimated proportion of alternative hypotheses calculated using the Cao-Wu method.

num_alt: Object of class numeric. The estimated number of alternative hypotheses calculated using the Cao-Wu method.

FDRL: Object of class numeric or NULL. A vector of 1/0 values; 1 indicates that hypothesis was rejected by the FDR_L method.

BH: Object of class numeric or NULL. A vector of 1/0 values; 1 indicates that hypothesis was rejected by the FDR_L method.

gammaStar: Object of class numeric. The estimated critical value for testing used by the Cao-Wu method.

sigmaSq: Object of class numeric. The estimated variance used to determine the critical value of the Cao-Wu method.

pVals: Object of class numeric. The original p-values provided as input.

Methods

BH signature(x = "changePoint"): Retrieves a vector of integer values. An elements is 1 if the null hypothesis is rejected by the Benjamini-Hochberg (1995) method.

blocks signature(x = "changePoint"): Retrieves a list, each element of which is a vector of integer values. Each vector contains the indices of an alternative hypothesis block.

CW signature(x = "changePoint"): Retrieves a vector of integer values. An element is 1 if the null hypothesis is rejected by the Cao-Wu change point (2015) method.

changePts signature(x = "changePoint"): Retrieves a vector of integer values. The vector of change points identified by the Cao-Wu (2015) method. If no change points are identified, NULL is returned.

FDRL signature(x = "changePoint"): Retrieves a vector of integer values. Elements are 1 if the null hypothesis is rejected by the FDR_L (Zhang et al. 2011) method.

critical `signature(x = "changePoint")`: Retrieves the estimated critical value for testing used by the Cao-Wu (2015) method.

numAlt `signature(x = "changePoint")`: Retrieves the estimated number of alternative hypotheses obtained by the Cao-Wu (2015) method.

piAlt `signature(x = "changePoint")`: Retrieves the estimated proportion of alternative hypotheses obtained by the Cao-Wu (2015) method.

plot `signature(x = "changePoint", y = "missing", logp = FALSE, ...)`: Generates x-y plots of -log(p) vs position or p-value vs position for each alternative hypothesis block obtained by the Cao-Wu (2015) method. logp is TRUE/FALSE indicating if -log(p)/p-values are plotted on the y-axis.

sigmaSq `signature(x = "changePoint")`: Retrieves the estimated variance used to determine the critical value of the Cao-Wu (2015) method.

Author(s)

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References

Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. Journal of the Royal Statistical Society: Series B, 57, 289–300.

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Examples

```
showClass("changePoint")
```

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