Package ‘elitism’

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Description Recently many new p-value based multiple test procedures have been proposed, and these new methods are more powerful than the widely used Hochberg procedure. These procedures strongly control the familywise error rate (FWER). This is a comprehensive collection of p-value based FWER-control stepwise multiple test procedures, including six procedure families and thirty multiple test procedures. In this collection, the conservative Hochberg procedure, linear time Hommel procedures, asymptotic Rom procedure, Gou-Tamhane-Xi-Rom procedures, and Quick procedures are all developed in recent five years since 2014. The package name ‘elitism’ is an acronym of ‘e’quipment for ‘l’ogarithmic and l’inear ‘t’ime ‘s’tepwise ‘m’ultiple hypothesis testing. Version 1.0.0 was released on June 26, 2019. See Gou, J., and Zhang, F. (2020). Quick multiple test procedures and p-value adjustments. Technical report.
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Multiple Test Procedures

Description

Given a set of p-values and the level of significance, returns decisions whether the corresponding hypotheses should be rejected or not, including the hybrid Hochberg-Hommel procedure (Gou et al., 2014) and Quick procedure (Gou and Zhang, 2020).

Usage

```r
mtp(p, alpha = 0.05, method = "gtxr", n = length(p))
```

Arguments

- `p`: vector of p-values.
- `alpha`: the level of significance.
- `method`: multiplicity correction method, including the Holm procedure ("holm"), the Hochberg procedure ("hochberg", "chochberg"), the Hommel procedure ("hommel", "hommelq", "hommell", "hommellsb"), the Rom procedure ("rom", "rom1", "roma", "romx"), the Gou-Tamhane-Xi-Rom procedure ("gtxr", "gtxr0i", "gtxr1ci", "gtxr2di", "gtxr0b", "gtxr1cb", "gtxr2db"), and the Quick procedure ("quick", "quick00i", "quick01i", "quick10i", "quick11i", "quickxi", "quick00b", "quick01b", "quick10b", "quick11b", "quickxb").
- `n`: number of p-values.

Details

Given a set of p-values, returns a binary vector of decisions, where 1 stands for rejection, and 0 stands for acceptance. There are six families of procedures.

1. Holm procedure (1 procedure)
   - (a) `holm`, the Holm (1979) step-down method.
2. Hochberg procedure (2 procedures)
   - (a) `hochberg`, the Hochberg (1988) step-up method.
   - (b) `chochberg`, the conservative Hochberg method developed by Gou and Tamhane (2018).
3. Hommel procedure (5 procedures)
   - (a) `hommel`, the Hommel (1988) step-up method, linear time algorithm with standard binary search, equivalent to `hommellsb`.
   - (b) `hommelq`, the Hommel (1988) step-up method, quadratic time algorithm.
   - (c) `hommell`, the Hommel (1988) step-up method, linear time algorithm by Meijer, Krebs and Goeman (2019).
   - (d) `hommellsb`, the Hommel (1988) step-up method, linear time algorithm by Meijer, Krebs and Goeman (2019), with standard binary search enhancement.
(e) hommellsi, the Hommel (1988) step-up method, linear time algorithm by Meijer, Krebs and Goeman (2019), with interpolation search enhancement.

4. Rom procedure (4 procedure)
   (a) rom, the Rom (1990) step-up method, equivalent to romx.
   (b) roml, the Rom-1 method proposed by Gou and Zhang (2020).
   (c) roma, the Rom-1A method proposed by Gou and Zhang (2020).
   (d) romx, the Rom (1990) step-up method.

5. Gou-Tamhane-Xi-Rom procedure (7 procedure)
   (a) gtxr, the zeroth order hybrid Hommel-Hochberg procedure, proposed by Gou et al. (2014), equivalent to gtxr0b.
   (b) gtxr0b, the zeroth order GTXR procedure, with standard binary search enhancement.
   (c) gtxr1cb, the GTXR procedure with refined c critical constants, with standard binary search enhancement.
   (d) gtxr2db, the GTXR procedure with refined d critical constants, with standard binary search enhancement.
   (e) gtxr0i, the zeroth order GTXR procedure, with interpolation search enhancement.
   (f) gtxr1ci, the GTXR procedure with refined c critical constants, with interpolation search enhancement.
   (g) gtxr2di, the GTXR procedure with refined d critical constants, with interpolation search enhancement.

6. Quick procedure (11 procedure)
   (a) quick, the Quick method, proposed by Gou and Zhang (2020), equivalent to quick00b.
   (b) quick00b, the zeroth order Quick procedure, proposed by Gou and Zhang (2020), with standard binary search enhancement.
   (c) quick01b, the Quick procedure with refined d critical constants, with standard binary search enhancement.
   (d) quick10b, the Quick procedure with refined c critical constants, with standard binary search enhancement.
   (e) quick11b, the Quick procedure with refined c and d critical constants, with standard binary search enhancement.
   (f) quickxb, the exact Quick procedure with refined c critical constants, with standard binary search enhancement.
   (g) quick00i, the zeroth order Quick procedure, proposed by Gou and Zhang (2020), with interpolation search enhancement.
   (h) quick01i, the Quick procedure with refined d critical constants, with interpolation search enhancement.
   (i) quick10i, the Quick procedure with refined c critical constants, with interpolation search enhancement.
   (j) quick11i, the Quick procedure with refined c and d critical constants, with interpolation search enhancement.
   (k) quickxi, the exact Quick procedure with refined c critical constants, with interpolation search enhancement.
Value

a list, including a binary vector of rejections, the total number of comparisons, and an indicator of consonance.

Author(s)

Jiangtao Gou

References


See Also

`elitism::p.adjust`

Examples

```r
library(elitism)
pvalues.raw <- c(0.002,0.007,0.005,0.024,0.022,0.009,0.007,0.036,0.060,0.035)
pkev <- new.env(I; pkev$global.count.IS <- 0; pkev$global.count.FS <- 0; decision.hoch <- mtp(pvalues.raw, alpha = 0.025, method = "hochberg")
pkev <- new.env(I; pkev$global.count.IS <- 0; pkev$global.count.FS <- 0;
```
decision.quick <- mtp(pvalues.raw, alpha = 0.025, method = "quick")
pkev <- new.env(); pkev$global.count.IS <- 0; pkev$global.count.FS <- 0;
decision.gtxr <- mtp(pvalues.raw, alpha = 0.025, method = "gtxr")

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**mtp.wt**  
*Multiple Test Procedures with known true significances and non-significances*

**Description**

Given a set of p-values, a set of indicators whether the corresponding hypothesis is true significance or true null, and the level of significance, returns a summary of false/true positive/negative, including the hybrid Hochberg-Hommel procedure (Gou et al., 2014) and Quick procedure (Gou and Zhang, 2020).

**Usage**

```r
mtp.wt(p, indctr.sig, alpha = 0.05, method = "gtxr", n = length(p))
```

**Arguments**

- `p`  
  vector of p-values.
- `indctr.sig`  
  vector of indicators, 1 stands for true significance and 0 stands for true null.
- `alpha`  
  the level of significance.
- `method`  
  multiplicity correction method, including the Holm procedure ("holm"), the Hochberg procedure ("hochberg", "chochberg"), the Hommel procedure ("hommel", "hommelq", "hommell", "hommellsi", "hommellsb"), the Rom procedure ("rom", "rom1", "roma", "romx"), the Gou-Tamhane-Xi-Rom procedure ("gtxr", "gtxr0i", "gtxr1ci", "gtxr2di", "gtxr0b", "gtxr1cb", "gtxr2db"), and the Quick procedure ("quick", "quick00i", "quick01i", "quick10i", "quick11i", "quickxi", "quick00b", "quick01b", "quick10b", "quick11b", "quickxb").
- `n`  
  number of p-values.

**Details**

Given a set of p-values with a binary vector of true significances, where 1 stands for true significances, and 0 stands for true nulls. There are six families of procedures.

1. Holm procedure (1 procedure)
   - (a) `holm`, the Holm (1979) step-down method.
2. Hochberg procedure (2 procedures)
   - (a) `hochberg`, the Hochberg (1988) step-up method.
   - (b) `chochberg`, the conservative Hochberg method developed by Gou and Tamhane (2018).
3. Hommel procedure (5 procedures)
(a) *hommel*, the Hommel (1988) step-up method, linear time algorithm with standard binary search, equivalent to *hommellsb*.

(b) *hommelq*, the Hommel (1988) step-up method, quadratic time algorithm.


4. Rom procedure (4 procedure)

(a) *rom*, the Rom (1990) step-up method, equivalent to *romx*.

(b) *rom1*, the Rom-1 method proposed by Gou and Zhang (2020).

(c) *roma*, the Rom-1A method proposed by Gou and Zhang (2020).

(d) *romx*, the Rom (1990) step-up method.

5. Gou-Tamhane-Xi-Rom procedure (7 procedure)

(a) *gtxr*, the zeroth order hybrid Hommel-Hochberg procedure, proposed by Gou et al. (2014), equivalent to *gtxr0b*.

(b) *gtxr0b*, the zeroth order GTXR procedure, with standard binary search enhancement.

(c) *gtxr1cb*, the GTXR procedure with refined c critical constants, with standard binary search enhancement.

(d) *gtxr2db*, the GTXR procedure with refined d critical constants, with standard binary search enhancement.

(e) *gtxr0i*, the zeroth order GTXR procedure, with interpolation search enhancement.

(f) *gtxr1ci*, the GTXR procedure with refined c critical constants, with interpolation search enhancement.

(g) *gtxr2di*, the GTXR procedure with refined d critical constants, with interpolation search enhancement.

6. Quick procedure (11 procedure)

(a) *quick*, the Quick method, proposed by Gou and Zhang (2020), equivalent to *quick00b*.

(b) *quick00b*, the zeroth order Quick procedure, proposed by Gou and Zhang (2020), with standard binary search enhancement.

(c) *quick01b*, the Quick procedure with refined d critical constants, with standard binary search enhancement.

(d) *quick10b*, the Quick procedure with refined c critical constants, with standard binary search enhancement.

(e) *quick11b*, the Quick procedure with refined c and d critical constants, with standard binary search enhancement.

(f) *quickxb*, the exact Quick procedure with refined c critical constants, with standard binary search enhancement.

(g) *quick00i*, the zeroth order Quick procedure, proposed by Gou and Zhang (2020), with interpolation search enhancement.

(h) *quick01i*, the Quick procedure with refined d critical constants, with interpolation search enhancement.
(i) quick10i, the Quick procedure with refined c critical constants, with interpolation search enhancement.

(j) quick11i, the Quick procedure with refined c and d critical constants, with interpolation search enhancement.

(k) quickxi, the exact Quick procedure with refined c critical constants, with interpolation search enhancement.

Value

a list, including five integers and a binary indicator: number of false positives, number of true negatives, number of true positives, number of false negatives, the number of total comparisons, and an indicator of consonance.

Author(s)

Jiangtao Gou
Fengqing (Zoe) Zhang

References


See Also

elitism::mtp

Examples

library(elitism)
pvalues.raw <- c(0.002, 0.007, 0.005, 0.024, 0.022, 0.009, 0.007, 0.036, 0.060, 0.035)
indctr.sig <- c(1, 0, 0, 0, 1, 1, 1, 0, 0)
pkev <- new.env(); pkev$global.count.IS <- 0; pkev$global.count.FS <- 0;
summary.hoch <- mtp.wt(pvalues.raw, indctr.sig, alpha = 0.025, method = "hochberg")
pkev <- new.env(); pkev$global.count.IS <- 0; pkev$global.count.FS <- 0;
summary.quick <- mtp.wt(pvalues.raw, indctr.sig, alpha = 0.025, method = "quick")
pkev <- new.env(); pkev$global.count.IS <- 0; pkev$global.count.FS <- 0;
summary.gtxr <- mtp.wt(pvalues.raw, indctr.sig, alpha = 0.025, method = "gtxr")

p.adjust

Adjust P-values for Multiple Test Procedures

Description

Given a set of p-values, returns adjusted p-values, including the hybrid Hochberg-Hommel procedure (Gou et al., 2014) and Quick procedure (Gou and Zhang, 2020).

Usage

p.adjust(p, method = "gtxr", n = length(p))

Arguments

- `p`: vector of p-values.
- `method`: multiplicity correction method, "gtxr" is the hybrid Hochberg-Hommel method, "quick" is the Quick method. Other methods include: "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" from the standard R function p.adjust.
- `n`: number of p-values.

Details

Given a set of p-values, returns p-values adjusted using one of several methods. The default method is "gtxr". Another option is "quick". Other adjustment methods have been included in function p.adjust in R package stats.

Value

a vector of corrected p-values.
p.adjust

Author(s)
Jiangtao Gou

References

See Also
stats::p.adjust

Examples
library(elitism)

pvalues.raw <- c(0.002, 0.007, 0.005, 0.024, 0.022, 0.009, 0.007, 0.036, 0.060, 0.035)
p.adj.hoch <- elitism::p.adjust(pvalues.raw, method = "hochberg")
p.adj.quick <- elitism::p.adjust(pvalues.raw, method = "quick")
p.adj.gtxr <- elitism::p.adjust(pvalues.raw, method = "gtxr")
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