

Package ‘qch’

July 4, 2025

Title Query Composite Hypotheses

Version 2.1.0

Maintainer Tristan Mary-Huard <tristan.mary-huard@agroparistech.fr>

Description Provides functions for the joint analysis of Q sets of p-values obtained for the same list of items. This joint analysis is performed by querying a composite hypothesis, i.e. an arbitrary complex combination of simple hypotheses, as described in Mary-Huard et al. (2021) <[doi:10.1093/bioinformatics/btab592](https://doi.org/10.1093/bioinformatics/btab592)> and De Walsche et al. (2023) <[doi:10.1101/2024.03.17.585412](https://doi.org/10.1101/2024.03.17.585412)>. In this approach, the Q -uplet of p-values associated with each item is distributed as a multivariate mixture, where each of the 2^Q components corresponds to a specific combination of simple hypotheses. The dependence between the p-value series is considered using a Gaussian copula function. A p-value for the composite hypothesis test is derived from the posterior probabilities.

License GPL-3

Depends R (>= 2.10)

Imports copula, dplyr, graphics, ks, purrr, qvalue, Rcpp, stats, stringr, utils

LinkingTo Rcpp, RcppArmadillo

Encoding UTF-8

LazyData true

RoxygenNote 7.3.2

NeedsCompilation yes

Author Tristan Mary-Huard [aut, cre] (ORCID: <<https://orcid.org/0000-0002-3839-9067>>),
Annaig De Walsche [aut] (ORCID: <<https://orcid.org/0000-0003-0603-1716>>),
Franck Gauthier [ctb] (ORCID: <<https://orcid.org/0000-0003-0574-065X>>)

Repository CRAN

Date/Publication 2025-07-04 12:50:02 UTC

Contents

Copula.Hconfig_gaussian_density	2
EM_calibration_gaussian	3
EM_calibration_gaussian_memory	4
EM_calibration_indep	5
EM_calibration_indep_memory	5
f1_separation_signed	6
FastKerFdr_signed	7
FastKerFdr_unsigned	8
fHconfig_sum_update_gaussian_copula_ptr_parallel	9
fHconfig_sum_update_ptr_parallel	10
gaussian_copula_density	10
GetH1AtLeast	11
GetH1Equal	12
GetHconfig	13
prior_update_arma_ptr_parallel	13
prior_update_gaussian_copula_ptr_parallel	14
PvalSets	15
PvalSets_cor	15
qch.fit	16
qch.test	17
R.MLE	19
R.MLE.check	19
R.MLE.memory	20
R_MLE_update_gaussian_copula_ptr_parallel	21
Index	22

Copula.Hconfig_gaussian_density

Gaussian copula density for each H-configuration.

Description

Gaussian copula density for each H-configuration.

Usage

```
Copula.Hconfig_gaussian_density(Hconfig, F0Mat, F1Mat, R)
```

Arguments

Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the <code>GetHconfig()</code> function.
F0Mat	a matrix containing the evaluation of the marginal cdf under H_0 at each items, each column corresponding to a p-value serie.

F1Mat	a matrix containing the evaluation of the marginal cdf under H_1 at each items, each column corresponding to a p-value serie.
R	the correlation matrix.

Value

A matrix containing the evaluation of the Gaussian density function for each H-configuration in columns.

EM_calibration_gaussian

EM calibration in the case of the Gaussian copula (unsigned)

Description

EM calibration in the case of the Gaussian copula (unsigned)

Usage

```
EM_calibration_gaussian(
  Hconfig,
  F0Mat,
  F1Mat,
  fHconfig,
  R.init,
  Prior.init,
  Precision = 1e-06
)
```

Arguments

Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
F0Mat	a matrix containing the evaluation of the marginal cdf under H_0 at each items, each column corresponding to a p-value serie.
F1Mat	a matrix containing the evaluation of the marginal cdf under H_1 at each items, each column corresponding to a p-value serie.
fHconfig	a matrix containing H-config densities evaluated at each items, each column corresponding to a configurations.
R.init	the initialization of the correlation matrix of the Gaussian copula parameter.
Prior.init	the initialization of prior probabilities for each of the H-configurations.
Precision	Precision for the stop criterion. (Default is 1e-6)

Value

A list with the following elements:

priorHconfig	vector of estimated prior probabilities for each of the H-configurations.
Rcopula	the estimated correlation matrix of the Gaussian copula.

EM_calibration_gaussian_memory

EM calibration in the case of the Gaussian copula (unsigned) with memory management

Description

EM calibration in the case of the Gaussian copula (unsigned) with memory management

Usage

```
EM_calibration_gaussian_memory(
  Logf0Mat,
  Logf1Mat,
  F0Mat,
  F1Mat,
  Prior.init,
  R.init,
  Hconfig,
  Precision = 1e-06,
  threads_nb
)
```

Arguments

Logf0Mat	a matrix containing the $\log(f_0(x_q^i))$
Logf1Mat	a matrix containing the $\log(f_1(x_q^i))$
F0Mat	a matrix containing the evaluation of the marginal cdf under H_0 at each items, each column corresponding to a p-value serie.
F1Mat	a matrix containing the evaluation of the marginal cdf under H_1 at each items, each column corresponding to a p-value serie.
Prior.init	the initialization of prior probabilities for each of the H-configurations.
R.init	the initialization of the correlation matrix of the gaussian copula parameter.
Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
Precision	Precision for the stop criterion. (Default is 1e-6)
threads_nb	The number of threads to use.

Value

A list with the following elements:

priorHconfig	vector of estimated prior probabilities for each of the H-configurations.
Rcopula	the estimated correlation matrix of the Gaussian copula.

EM_calibration_indep	<i>EM calibration in the case of conditional independence</i>
----------------------	---

Description

EM calibration in the case of conditional independence

Usage

```
EM_calibration_indep(fHconfig, Prior.init, Precision = 1e-06)
```

Arguments

fHconfig	a matrix containing config densities evaluated at each items, each column corresponding to a configurations.
Prior.init	the initialization of prior probabilities for each of the H-configurations.
Precision	Precision for the stop criterion. (Default is 1e-6)

Value

a vector of estimated prior probabilities for each of the H-configurations.

EM_calibration_indep_memory	<i>EM calibration in the case of conditional independence with memory management (unsigned)</i>
-----------------------------	---

Description

EM calibration in the case of conditional independence with memory management (unsigned)

Usage

```
EM_calibration_indep_memory(
  Logf0Mat,
  Logf1Mat,
  Prior.init,
  Hconfig,
  Precision = 1e-06,
  threads_nb
)
```

Arguments

Logf0Mat	a matrix containing the $\log(f_0(x_q^i))$
Logf1Mat	a matrix containing the $\log(f_1(x_q^i))$
Prior.init	the initialization of prior probabilities for each of the H-configurations.
Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
Precision	Precision for the stop criterion. (Default is 1e-6)
threads_nb	The number of threads to use.

Value

a vector of estimated prior probabilities for each of the H-configurations.

f1_separation_signed *Signed case function: Separate f1 into f+ and f-*

Description

Signed case function: Separate f1 into f+ and f-

Usage

```
f1_separation_signed(XMat, f0Mat, f1Mat, p0, plotting = FALSE)
```

Arguments

XMat	a matrix of probit-transformed p-values, each column corresponding to a p-value serie.
f0Mat	a matrix containing the evaluation of the marginal density functions under H_0 at each items, each column corresponding to a p-value serie.
f1Mat	a matrix containing the evaluation of the marginal density functions under H_1 at each items, each column corresponding to a p-value serie.
p0	the proportions of H_0 items for each series.
plotting	boolean, should some diagnostic graphs be plotted. (Default is FALSE.)

Value

A list with the following elements:

f1plusMat	a matrix containing the evaluation of the marginal density functions under H_1^+ at each items, each column corresponding to a p-value serie.
f1minusMat	a matrix containing the evaluation of the marginal density functions under H_1^- at each items, each column corresponding to a p-value serie.
p1plus	an estimate of the proportions of H_1^+ items for each series.
p1minus	an estimate of the proportions of H_1^- items for each series.

FastKerFdr_signed	<i>FastKerFdr signed</i>
-------------------	--------------------------

Description

Kernel estimation of the density in a two-components mixture model where one component are a standard Gaussian density.

Usage

```
FastKerFdr_signed(
  X,
  p0 = NULL,
  plotting = FALSE,
  NbKnot = 1e+05,
  tol = 1e-05,
  max_iter = 10000
)
```

Arguments

<code>X</code>	a vector of probit-transformed p-values (corresponding to a p-value serie).
<code>p0</code>	a priori proportion of H_0 hypotheses.
<code>plotting</code>	boolean, should some diagnostic graphs be plotted. (Default is FALSE.)
<code>NbKnot</code>	The (maximum) number of knot for the kde procedure. (Default is 1e5.)
<code>tol</code>	a tolerance value for convergence. (Default is 1e-5.)
<code>max_iter</code>	the maximum number of iterations allowed for the algorithm to converge or complete its process.(Default is 1e4.)

Value

A list with the following elements:

<code>p0</code>	vector of the estimated proportions of H_0 hypotheses for each of p-value serie.
<code>tau</code>	the vector of H_1 posteriors.
<code>f1</code>	a numeric vector, each coordinate i corresponding to the evaluation of the H_1 density at point x_i , where x_i is the i th item in <code>X</code> .
<code>F1</code>	a numeric vector, each coordinate i corresponding to the evaluation of the H_1 cdf at point x_i , where x_i is the i th item in <code>X</code> .

FastKerFdr_unsigned *FastKerFdr unsigned*

Description

Kernel estimation of the density in a two-components mixture model where one component are a standard Gaussian density. Here we suppose that the density to estimate lives in R^+ .

Usage

```
FastKerFdr_unsigned(
  X,
  p0 = NULL,
  plotting = FALSE,
  NbKnot = 1e+05,
  tol = 1e-05,
  max_iter = 10000
)
```

Arguments

X	a vector of probit-transformed p-values (corresponding to a p-value serie)
p0	a priori proportion of H_0 hypotheses
plotting	boolean, should some diagnostic graphs be plotted. (Default is FALSE.)
NbKnot	The (maximum) number of knot for the kde procedure. (Default is 1e5.)
tol	a tolerance value for convergence. (Default is 1e-5.)
max_iter	the maximum number of iterations allowed for the algorithm to converge or complete its process.(Default is 1e4.)

Value

A list with the following elements:

p0	vector of the estimated proportions of H_0 hypotheses for each of p-value serie.
tau	the vector of H_1 posteriors.
f1	a numeric vector, each coordinate i corresponding to the evaluation of the H_1 density at point x_i , where x_i is the i th item in
F1	a numeric vector, each coordinate i corresponding to the evaluation of the H_1 cdf at point x_i , where x_i is the i th item in

fHconfig_sum_update_gaussian_copula_ptr_parallel

*Computation of the sum $\text{sum_c}(w_c * \psi_c)$ using Gaussian copula parallelized version*

Description

Computation of the sum $\text{sum_c}(w_c * \psi_c)$ using Gaussian copula parallelized version

Usage

```
fHconfig_sum_update_gaussian_copula_ptr_parallel(
  Hconfig,
  NewPrior,
  Logf0Mat,
  Logf1Mat,
  zeta0,
  zeta1,
  R,
  Rinv,
  threads_nb = 0L
)
```

Arguments

Hconfig	list of vector of 0 and 1, corresponding to the configurations
NewPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the $\log(f_0(x_{i_q}))$
Logf1Mat	a double matrix containing the $\log(f_1(x_{i_q}))$
zeta0	a double matrix containing the $qnorm(F_0(x_{i_q}))$
zeta1	a double matrix containing the $qnorm(F_1(x_{i_q}))$
R	a double matrix corresponding to the copula parameter
Rinv	a double matrix corresponding to the inverse copula parameter
threads_nb	an int the number of threads

Value

a double vector containing $\text{sum_c}(w_c * \psi_c)$

fHconfig_sum_update_ptr_parallel

*Computation of the sum $\text{sum_c}(w_c * \text{psi_c})$ parallelized version*

Description

Computation of the sum $\text{sum_c}(w_c * \text{psi_c})$ parallelized version

Usage

```
fHconfig_sum_update_ptr_parallel(
    Hconfig,
    NewPrior,
    Logf0Mat,
    Logf1Mat,
    threads_nb = 0L
)
```

Arguments

Hconfig	list of vector of 0 and 1, corresponding to the configurations
NewPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the $\log(f_0(x_{i_q}))$
Logf1Mat	a double matrix containing the $\log(f_1(x_{i_q}))$
threads_nb	an int the number of threads

Value

a double vector containing $\text{sum_c}(w_c * \text{psi_c})$

gaussian_copula_density

Gaussian copula density

Description

Gaussian copula density

Usage

```
gaussian_copula_density(zeta, R, Rinv)
```

Arguments

zeta	the matrix of probit-transformed observations.
R	the correlation matrix.
Rinv	the inverse correlation matrix.

Value

A numeric vector, each coordinate i corresponding to the evaluation of the Gaussian copula density function at observation zeta_i .

GetH1AtLeast	<i>Specify the configurations corresponding to the composite H_1 test "AtLeast".</i>
--------------	---

Description

Specify which configurations among Hconfig correspond to the composite alternative hypothesis : {at least "AtLeast" H_1 hypotheses are of interest }

Usage

```
GetH1AtLeast(Hconfig, AtLeast, Consecutive = FALSE, SameSign = FALSE)
```

Arguments

Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
AtLeast	How many H_1 hypotheses at least for the item to be of interest ? (an integer or a vector).
Consecutive	Should the significant test series be consecutive ? (optional, default is FALSE).
SameSign	Should the significant test series have the same sign ? (optional, default is FALSE).

Value

A vector 'Hconfig.H1' of components of Hconfig that correspond to the 'AtLeast' specification.

See Also

[GetH1Equal\(\)](#)

Examples

```
GetH1AtLeast(GetHconfig(4), 2)
```

GetH1Equal	<i>Specify the configurations corresponding to the composite H_1 test "Equal".</i>
------------	---

Description

Specify which configurations among Hconfig correspond to the composite alternative hypothesis :{Exactly "Equal" H_1 hypotheses are of interest }

Usage

```
GetH1Equal(Hconfig, Equal, Consecutive = FALSE, SameSign = FALSE)
```

Arguments

Hconfig	A list of all possible combination of H0 and H1 hypotheses generated by the GetHconfig() function.
Equal	What is the exact number of H_1 hypotheses for the item to be of interest? (an integer or a vector).
Consecutive	Should the significant test series be consecutive ? (optional, default is FALSE).
SameSign	Should the significant test series have the same sign ? (optional, default is FALSE).

Value

A vector 'Hconfig.H1' of components of Hconfig that correspond to the 'Equal' specification.

See Also

[GetH1AtLeast\(\)](#)

Examples

```
GetH1Equal(GetHconfig(4), 2)
```

GetHconfig	<i>Generate the H_0/H_1 configurations.</i>
------------	--

Description

Generate all possible combination of simple hypotheses H_0/H_1 .

Usage

```
GetHconfig(Q, Signed = FALSE)
```

Arguments

Q	The number of test series to be combined.
Signed	Should the sign of the effect be taken into account? (optional, default is FALSE).

Value

A list 'Hconfig' of all possible combination of H_0 and H_1 hypotheses among Q hypotheses tested.

Examples

```
GetHconfig(4)
```

prior_update_arma_ptr_parallel	<i>Update of the prior estimate in EM algo parallelized version</i>
--------------------------------	---

Description

Update of the prior estimate in EM algo parallelized version

Usage

```
prior_update_arma_ptr_parallel(
  Hconfig,
  fHconfig_sum,
  OldPrior,
  Logf0Mat,
  Logf1Mat,
  threads_nb = 0L
)
```

Arguments

Hconfig	list of vector of 0 and 1, corresponding to the configurations
fHconfig_sum	a double vector containing $\text{sum_c}(w_c * \psi_c)$, obtained by <code>fHconfig_sum_update_ptr_parallel()</code>
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the $\log(f_0(x_{i_q}))$
Logf1Mat	a double matrix containing the $\log(f_1(x_{i_q}))$
threads_nb	an int the number of threads

Value

a double vector containing the new estimate of prior w_c

`prior_update_gaussian_copula_ptr_parallel`

Update of the prior estimate in EM algo using Gaussian copula, parallelized version

Description

Update of the prior estimate in EM algo using Gaussian copula, parallelized version

Usage

```
prior_update_gaussian_copula_ptr_parallel(
  Hconfig,
  fHconfig_sum,
  OldPrior,
  Logf0Mat,
  Logf1Mat,
  zeta0,
  zeta1,
  R,
  Rinv,
  threads_nb = 0L
)
```

Arguments

Hconfig	list of vector of 0 and 1, corresponding to the configurations
fHconfig_sum	a double vector containing $\text{sum_c}(w_c * \psi_c)$, obtained by <code>fHconfig_sum_update_ptr_parallel()</code>
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the $\log(f_0(x_{i_q}))$
Logf1Mat	a double matrix containing the $\log(f_1(x_{i_q}))$
zeta0	a double matrix containing the $qnorm(F_0(x_{i_q}))$

zeta1	a double matrix containing the $qnorm(F1(x_{iq}))$
R	a double matrix corresponding to the copula parameter
Rinv	a double matrix corresponding to the inverse copula parameter
threads_nb	an int the number of threads

Value

a double vector containing the new estimate of prior w_c

PvalSets	<i>Synthetic example to illustrate the main qch functions</i>
----------	---

Description

PvalSets is a data.frame with 10,000 rows and 3 columns. Each row corresponds to an item, columns 'Pval1' and 'Pval2' each correspond to a test serie over the items, and column 'Class' provides the truth, i.e. if item i belongs to class 1 then the H_0 hypothesis is true for the 2 tests, if item i belongs to class 2 (resp. 3) then the H_0 hypothesis is true for the first (resp. second) test only, and if item i belongs to class 4 then both H_0 hypotheses are false (for the first and the second test).

Usage

```
PvalSets
```

Format

A data.frame

PvalSets_cor	<i>Synthetic example to illustrate the main qch functions using Gaussian copula</i>
--------------	---

Description

PvalSets_cor is a data.frame with 10,000 rows and 3 columns. Each row corresponds to an item, columns Pval1 and Pval2 each correspond to a test serie over the items, and column 'Class' provides the truth, i.e. if item i belongs to class 1 then the H_0 hypothesis is true for the 2 tests, if item i belongs to class 2 (resp. 3) then the H_0 hypothesis is true for the first (resp. second) test only, and if item i belongs to class 4 then both H_0 hypotheses are false (for the first and the second test). The correlation between the two pvalues series within each class is 0.3.

Usage

```
PvalSets_cor
```

Format

A data.frame

qch.fit

*Infer posterior probabilities of H_0/H_1 configurations.***Description**

For each item, estimate the posterior probability for each configuration. This function use either the model accounting for the dependence structure through a Gaussian copula function (copula=="gaussian") or assuming the conditional independence (copula=="indep"). Utilizes parallel computing, when available. For package documentation, see [qch-package](#).

Usage

```
qch.fit(
  pValMat,
  EffectMat = NULL,
  Hconfig,
  copula = "indep",
  threads_nb = 0,
  plotting = FALSE,
  Precision = 1e-06
)
```

Arguments

pValMat	A matrix of p-values, each column corresponding to a p-value serie.
EffectMat	A matrix of estimated effects corresponding to the p-values contained in pValMat. If specified, the procedure will account for the direction of the effect. (optional, default is NULL)
Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
copula	A string specifying the form of copula to use. Possible values are "indep" and "gaussian". Default is "indep" corresponding to the independent case.
threads_nb	The number of threads to use. The number of thread will set to the number of cores available by default.
plotting	A boolean. Should some diagnostic graphs be plotted ? Default is FALSE.
Precision	The precision for EM algorithm to infer the parameters. Default is 1e-6.

Value

A list with the following elements:

prior	vector of estimated prior probabilities for each of the H-configurations.
Rcopula	the estimated correlation matrix of the Gaussian copula. (if applicable)
Hconfig	the list of all configurations.
null_prop	the estimation of items under the null for each test series.

- If the storage permits, the list will additionally contain:

posterior matrix providing for each item (in row) its posterior probability to belong to each of the H-configurations (in column)
 fhconfig matrix containing ψ_c densities evaluated at each items, each column corresponding to a configuration.

- Else, the list will additionally contain:

f0Mat matrix containing the evaluation of the marginal densities under H_0 at each items, each column corresponding to a configuration
 f1Mat matrix containing the evaluation of the marginal densities under H_1 at each items, each column corresponding to a configuration
 F0Mat matrix containing the evaluation of the marginal cdf under H_0 at each items, each column corresponding to a configuration
 F1Mat matrix containing the evaluation of the marginal cdf under H_1 at each items, each column corresponding to a configuration
 fhconfig_sum vector containing $(\sum_c w_c \psi_c(Z_i))$ for each items i .

The elements of interest are the posterior probabilities matrix, posterior, the estimated proportion of observations belonging to each configuration, prior, and the estimated correlation matrix of the Gaussian copula, Rcopula. The remaining elements are returned primarily for use by other functions.

Examples

```
data(PvalSets_cor)
PvalMat <- as.matrix(PvalSets_cor[, -3])
## Build the Hconfig objects
Q <- 2
Hconfig <- GetHconfig(Q)

## Run the function
res.fit <- qch.fit(pValMat = PvalMat, Hconfig = Hconfig, copula = "gaussian")

## Display the prior of each class of items
res.fit$prior

## Display the correlation estimate of the gaussian copula
res.fit$Rcopula

## Display the first posteriors
head(res.fit$posterior)
```

qch.test

Perform composite hypothesis testing.

Description

Perform any composite hypothesis test by specifying the configurations 'Hconfig.H1' corresponding to the composite alternative hypothesis among all configurations 'Hconfig'.

Usage

```
qch.test(res.qch.fit, Hconfig, Hconfig.H1 = NULL, Alpha = 0.05, threads_nb = 0)
```

Arguments

res.qch.fit	The result provided by the qch.fit() function.
Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
Hconfig.H1	An integer vector (or a list of such vector) of the Hconfig index corresponding to the composite alternative hypothesis configuration(s). Can be generated by the GetH1AtLeast() or GetH1Equal() functions. If NULL, the composite hypothesis tests of being associated with "at least q " simple tests, for $q=1,..Q$ are performed.
Alpha	the nominal Type I error rate for FDR control. Default is 0.05.
threads_nb	The number of threads to use. The number of thread will set to the number of cores available by default.

Details

By default, the function performs the composite hypothesis test of being associated with "at least q " simple tests, for $q = 1, ..Q$.

Value

A list with the following elements:

Rejection	a matrix providing for each item the result of the composite hypothesis test, after adaptive Benjamin-Höcherberg method.
lFDR	a matrix providing for each item its local FDR estimate.
Pvalues	a matrix providing for each item its p-value of the composite hypothesis test.

See Also

[qch.fit\(\)](#), [GetH1AtLeast\(\)](#), [GetH1Equal\(\)](#)

Examples

```
data(PvalSets_cor)
PvalMat <- as.matrix(PvalSets_cor[, -3])
Truth <- PvalSets[, 3]

## Build the Hconfig objects
Q <- 2
Hconfig <- GetHconfig(Q)

## Infer the posteriors
res.fit <- qch.fit(pValMat = PvalMat, Hconfig = Hconfig, copula = "gaussian")

## Run the test procedure with FDR control
H1config <- GetH1AtLeast(Hconfig, 2)
```

```
res.test <- qch.test(res.qch.fit = res.fit, Hconfig = Hconfig, Hconfig.H1 = H1config)
table(res.test$Rejection$AtLeast_2, Truth == 4)
```

R.MLE

*Gaussian copula correlation matrix Maximum Likelihood estimator.***Description**

Gaussian copula correlation matrix Maximum Likelihood estimator.

Usage

```
R.MLE(Hconfig, zeta0, zeta1, Tau)
```

Arguments

Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
zeta0	a matrix containing the $\Phi(F_0(Z_{iq}))$, each column corresponding to a p-value serie.
zeta1	a matrix containing the $\Phi(F_1(Z_{iq}))$, each column corresponding to a p-value serie.
Tau	a matrix providing for each item (in row) its posterior probability to belong to each of the H-configurations (in columns).

Value

Estimate of the correlation matrix.

R.MLE.check

*Check the Gaussian copula correlation matrix Maximum Likelihood estimator***Description**

Check the Gaussian copula correlation matrix Maximum Likelihood estimator

Usage

```
R.MLE.check(R)
```

Arguments

R	Estimate of the correlation matrix.
---	-------------------------------------

Value

Estimate of the correlation matrix.

R.MLE.memory	<i>Gaussian copula correlation matrix Maximum Likelihood estimator (memory handling)</i>
--------------	--

Description

Gaussian copula correlation matrix Maximum Likelihood estimator (memory handling)

Usage

```
R.MLE.memory(
  Hconfig,
  fHconfig_sum,
  OldPrior,
  Logf0Mat,
  Logf1Mat,
  zeta0,
  zeta1,
  OldR,
  OldRinv
)
```

Arguments

Hconfig	A list of all possible combination of H_0 and H_1 hypotheses generated by the GetHconfig() function.
fHconfig_sum	a vector containing $\sum_c (w_c * psi_c)$ for each items.
OldPrior	a vector containing the prior probabilities for each of the H-configurations.
Logf0Mat	a matrix containing $\log(f_0 Mat)$, each column corresponding to a p-value serie.
Logf1Mat	a matrix containing $\log(f_1 Mat)$, each column corresponding to a p-value serie.
zeta0	a matrix containing $qnorm(F0Mat)$, each column corresponding to a p-value serie.
zeta1	a matrix containing $qnorm(F1Mat)$, each column corresponding to a p-value serie.
OldR	the copula correlation matrix.
OldRinv	the inverse of copula correlation matrix.

Value

Estimate of the correlation matrix.

R_MLE_update_gaussian_copula_ptr_parallel

Update the estimate of R correlation matrix of the gaussian copula, parallelized version

Description

Update the estimate of R correlation matrix of the gaussian copula, parallelized version

Usage

```
R_MLE_update_gaussian_copula_ptr_parallel(
  Hconfig,
  fHconfig_sum,
  OldPrior,
  Logf0Mat,
  Logf1Mat,
  zeta0,
  zeta1,
  OldR,
  OldRinv,
  RhoIndex,
  threads_nb = 0L
)
```

Arguments

Hconfig	list of vector of 0 and 1, corresponding to the configurations
fHconfig_sum	a double vector containing $\text{sum}_c(w_c * \psi_c)$, obtained by <code>fHconfig_sum_update_ptr_parallel()</code>
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the $\log(f_0(x_{i_q}))$
Logf1Mat	a double matrix containing the $\log(f_1(x_{i_q}))$
zeta0	a double matrix containing the $qnorm(F_0(x_{i_q}))$
zeta1	a double matrix containing the $qnorm(F_1(x_{i_q}))$
OldR	a double matrix corresponding to the copula parameter
OldRinv	a double matrix corresponding to the inverse copula parameter
RhoIndex	a int matrix containing the index of lower triangular part of a matrix
threads_nb	an int the number of threads

Value

a double vector containing the lower triangular part of the MLE of R

Index

* datasets

PvalSets, [15](#)

PvalSets_cor, [15](#)

Copula.Hconfig_gaussian_density, [2](#)

EM_calibration_gaussian, [3](#)

EM_calibration_gaussian_memory, [4](#)

EM_calibration_indep, [5](#)

EM_calibration_indep_memory, [5](#)

f1_separation_signed, [6](#)

FastKerFdr_signed, [7](#)

FastKerFdr_unsigned, [8](#)

fHconfig_sum_update_gaussian_copula_ptr_parallel,
[9](#)

fHconfig_sum_update_ptr_parallel, [10](#)

gaussian_copula_density, [10](#)

GetH1AtLeast, [11](#)

GetH1AtLeast(), [12](#), [18](#)

GetH1Equal, [12](#)

GetH1Equal(), [11](#), [18](#)

GetHconfig, [13](#)

GetHconfig(), [2–4](#), [6](#), [11](#), [12](#), [16](#), [18–20](#)

prior_update_arma_ptr_parallel, [13](#)

prior_update_gaussian_copula_ptr_parallel,
[14](#)

PvalSets, [15](#)

PvalSets_cor, [15](#)

qch.fit, [16](#)

qch.fit(), [18](#)

qch.test, [17](#)

R.MLE, [19](#)

R.MLE.check, [19](#)

R.MLE.memory, [20](#)

R_MLE_update_gaussian_copula_ptr_parallel,
[21](#)