Package 'qch'

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Title Query Composite Hypotheses

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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> and De Walsche et al.(2025) <doi:10.1093/nargab/lqaf118>. 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.

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Contents

`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 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.
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,
  max_iter = 10000
)
```

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)
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:

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

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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,
  max_iter = 10000
)
```

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.
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:

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

EM_calibration_indep *EM calibration in the case of conditional independence*

Description

EM calibration in the case of conditional independence

Usage

```
EM_calibration_indep(fHconfig, Prior.init, Precision = 1e-06, max_iter = 10000)
```

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)
max_iter	the maximum number of iterations allowed for the algorithm to converge or complete its process.(Default is 1e4.)

Value

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

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

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,
  max_iter = 10000
)
```

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.
`max_iter`	the maximum number of iterations allowed for the algorithm to converge or complete its process.(Default is 1e4.)

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 corr
f1minusMat	a matrix containing the evaluation of the marginal density functions under H_1^- at each items, each column corr
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 *FastKerFdr signed*

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

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 ith ite
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 ith item in

---

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 ith ite
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 ith item in

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fHconfig_sum_update_gaussian_copula_ptr_parallel

*Computation of the sum sum_c(w_c*psi_c) using Gaussian copula parallelized version*

Description

Computation of the sum 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(f0(xi_q))
Logf1Mat	a double matrix containing the log(f1(xi_q))
zeta0	a double matrix containing the qnorm(F0(x_iq))
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 sum_c(w_c*psi_c)

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fHconfig_sum_update_ptr_parallel

*Computation of the sum sum_c(w_c*psi_c) parallelized version*

Description

Computation of the sum sum_c(w_c*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(f0(xi_q))
Logf1Mat	a double matrix containing the log(f1(xi_q))
threads_nb	an int the number of threads

Value

a double vector containing sum_c(w_c*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 $\texttt{zeta}_i$.

GetH1AtLeast *Specify the configurations corresponding to the composite H_1 test "AtLeast".*

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 *Specify the configurations corresponding to the composite H_1 test "Equal".*

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 *Generate the H_0/H_1 configurations.*

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)
```

last_incomplete_trapezoid_arma *This function is a re-implementation of the initial R loop computing last incomplete trapezoid. See R function integral.kde_adapted().*

Description

This function is a re-implementation of the initial R loop computing last incomplete trapezoid. See R function integral.kde_adapted().

Usage

```
last_incomplete_trapezoid_arma(
  q_prob,
  q_ind,
  q,
  eval,
  est,
  simp_rule,
  density = TRUE
)
```

Arguments

q_prob	reference of the vector q_prob containing the probability of each quantile q
q_ind	reference of the vector q_ind
q	reference of the vector q containing the quantiles
eval	reference of the vector eval
est	reference of the vector est
simp_rule	reference of the vector simp_rule
density	logical

Value

void. Its first argument q_prob is passed as a reference and modified in place.

---

prior_update_arma_ptr_parallel

Update of the prior estimate in EM algo parallelized version

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 sum_c(w_c*psi_c), obtained by fHconfig_sum_update_ptr_parallel()
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the log(f0(xi_q))
Logf1Mat	a double matrix containing the log(f1(xi_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 sum_c(w_c*psi_c), obtained by fHconfig_sum_update_ptr_parallel()
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the log(f0(xi_q))
Logf1Mat	a double matrix containing the log(f1(xi_q))
zeta0	a double matrix containing the qnorm(F0(x_iq))
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 — *Synthetic example to illustrate the main qch functions*

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 H0 hypothesis is true for the 2 tests, if item i belongs to class 2 (resp. 3) then the H0 hypothesis is true for the first (resp. second) test only, and if item i belongs to class 4 then both H0 hypotheses are false (for the first and the second test).

Usage

```
PvalSets
```

Format

A data.frame

PvalSets_cor — *Synthetic example to illustrate the main qch functions using Gaussian copula*

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 H0 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",
  memory_efficient_EM = FALSE,
  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.
`memory_efficient_EM`	Logical. If `TRUE`, use the memory-efficient implementation of the EM algorithm. This option is recommended for large datasets, as it reduces memory usage at the cost of additional computation time. The memory-efficient implementation is automatically used when the size of the `posterior` matrix exceeds 2 GB.
`threads_nb`	Integer. Number of threads to use for parallel computation. This parameter is only used when `memory_efficient_EM = TRUE`. By default, the number of threads is set to the number of available CPU cores.
`plotting`	Logical. 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 memory efficient version of EM algorithm is not used, 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 colu
`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 correspondi
`f1Mat`	matrix containing the evaluation of the marginal densities under H_1 at each items, each column correspondi
`F0Mat`	matrix containing the evaluation of the marginal cdf under H_0 at each items, each column corresponding to a
`F1Mat`	matrix containing the evaluation of the marginal cdf under H_1 at each items, each column corresponding to a
`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-Höchberg m
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 — *Gaussian copula correlation matrix Maximum Likelihood estimator (memory handling)*

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.

`remove_decreasing_values_cpp`

Same as function above but does not handle the index ordering of the vector q. Therefore, the 2nd argument order_q has to be an index ordered version of the vector q. Indeed, the R base function: order() is twice as fast as the arma::sort_index(q) This is therefore the recommended function to use.

Description

Same as function above but does not handle the index ordering of the vector q. Therefore, the 2nd argument order_q has to be an index ordered version of the vector q. Indeed, the R base function: order() is twice as fast as the arma::sort_index(q) This is therefore the recommended function to use.

Usage

```
remove_decreasing_values_cpp(q_prob, order_q, tol = 1e-10)
```

Arguments

`q_prob`	reference of the vector q_prob
`order_q`	reference of the vector q
`tol`	By default 1e-10

Value

void. Its first argument q_prob is passed as a reference and modified in place.

`remove_decreasing_values_cpp_slow_ordering`
This function is a re-implementation of the initial R side while loop. See the end of R function integral.kde_adapted(). As shown in the commentary below, it is twice as slow to handle the index ordering of the vector q (2nd argument) here with the function arma::sort_index(). Consequently, it is recommended to use the function remove_decreasing_values_cpp() instead.

Description

This function is a re-implementation of the initial R side while loop. See the end of R function integral.kde_adapted(). As shown in the commentary below, it is twice as slow to handle the index ordering of the vector q (2nd argument) here with the function arma::sort_index(). Consequently, it is recommended to use the function remove_decreasing_values_cpp() instead.

Usage

```
remove_decreasing_values_cpp_slow_ordering(q_prob, q, tol = 1e-10)
```

Arguments

`q_prob`	reference of the vector q_prob
`q`	reference of the vector q
`tol`	By default 1e-10

Value

void. Its first argument q_prob is passed as a reference and modified in place.

`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 sum_c(w_c*psi_c), obtained by fHconfig_sum_update_ptr_parallel()
OldPrior	a double vector containing the prior w_c
Logf0Mat	a double matrix containing the log(f0(xi_q))
Logf1Mat	a double matrix containing the log(f1(xi_q))
zeta0	a double matrix containing the qnorm(F0(x_iq))
zeta1	a double matrix containing the qnorm(F1(x_iq))
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

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