Package 'kantorovich'

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Type Package

Title Kantorovich Distance Between Probability Measures

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Description Computes the Kantorovich distance between two probability measures on a finite set. The Kantorovich distance is also known as the Monge-Kantorovich distance or the first Wasserstein distance.

License GPL-3

Suggests testthat, knitr, rmarkdown

Imports rcdd, gmp, methods, lpSolve, Rglpk, slam, CVXR

Depends R (>= 2.5.3)

SystemRequirements GMP (https://gmplib.org/)

RoxygenNote 7.1.1

Encoding UTF-8

VignetteBuilder knitr

URL https://github.com/stla/kantorovich

BugReports https://github.com/stla/kantorovich/issues

NeedsCompilation no

Repository CRAN

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R topics documented:

`kantorovich-package` *Kantorovich Distance Between Probability Measures*

Description

Computes the Kantorovich distance between two probability measures on a finite set.

To learn more, start with the vignettes: `browseVignettes(package="kantorovich")`.

If you encounter a bug, or if you have a suggestion to improve the package, please file an issue on the github repo https://github.com/stla/kantorovich.

Details

Package:	kantorovich
Type:	Package
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Author(s)

Stéphane Laurent

`edistances` *Extremal distances*

Description

Compute the distances at the extreme joinings.

Usage

```
edistances(mu, nu, dist = NULL, ...)
```

Arguments

mu	(row margins) probability measure in numeric or bigq/character mode
nu	(column margins) probability measure in numeric or bigq/character mode
dist	function or matrix, the distance to be minimized on average. If NULL, the 0-1 distance is used.
...	arguments passed to dist

Value

A list with two components: the extreme joinings in a list and the distances in a vector.

Note

This function, called by kantorovich, is rather for internal purpose.

ejoinings *Extreme joinings*

Description

Return extreme joinings between mu and nu.

Usage

```
ejoinings(mu, nu, zeros = FALSE)
```

Arguments

mu	(row margins) probability measure in numeric or bigq/character mode
nu	(column margins) probability measure in numeric or bigq/character mode
zeros	logical; in case when mu and nu have different lengths, set FALSE to remove lines or columns full of zeros

Value

A list containing the extreme joinings (matrices).

Examples

```
mu <- nu <- c(0.5, 0.5)
ejoinings(mu, nu)
# use exact arithmetic
library(gmp)
mu <- nu <- as.bigq(c(0.5,0.5))
ejoinings(mu, nu)
# different lengths example
mu <- setNames(as.bigq(c(1,2,4), 7), c("a", "b", "c"))
```

```
nu <- setNames(as.bigq(c(3,1), 4), c("b", "c"))
ejoinings(mu, nu)
```

kantorovich *Kantorovich distance*

Description

Compute the Kantorovich distance between two probability measures on a finite set.

Usage

```
kantorovich(mu, nu, dist = NULL, details = FALSE, ...)
```

Arguments

`mu`	(row margins) probability measure in numeric or bigq/character mode
`nu`	(column margins) probability measure in numeric or bigq/character mode
`dist`	function or matrix, the distance to be minimized on average; if `NULL`, the 0-1 distance is used.
`details`	prints the joinings achieving the Kantorovich distance and returns them in the `"joinings"` attribute of the output
`...`	arguments passed to `dist` (only if it is a function)

Details

The function firstly computes all the extreme joinings of `mu` and `nu`, then evaluates the average distance for each of them, and then returns the minimal one.

Value

The Kantorovich distance between `mu` and `nu`.

Examples

```
mu <- c(1/7, 2/7, 4/7)
nu <- c(1/4, 1/4, 1/2)
kantorovich(mu, nu)
library(gmp)
mu <- as.bigq(c(1,2,4), 7)
nu <- as.bigq(c(1,1,1), c(4,4,2))
kantorovich(mu, nu)
mu <- c("1/7", "2/7", "4/7")
nu <- c("1/4", "1/4", "1/2")
kantorovich(mu, nu, details=TRUE)
```

kantorovich_CVX *Computes Kantorovich distance with CVX*

Description

Kantorovich distance using the CVXR package

Usage

```
kantorovich_CVX(
  mu,
  nu,
  dist = NULL,
  solution = FALSE,
  stop_if_fail = TRUE,
  solver = "ECOS",
  ...
)
```

Arguments

mu (row margins) probability measure in numeric mode

nu (column margins) probability measure in numeric mode

dist matrix, the distance to be minimized on average; if NULL, the 0-1 distance is used.

solution logical; if TRUE the solution is returned in the "solution" attributes of the output

stop_if_fail logical; if TRUE, an error is returned in the case when no solution is found; if FALSE, the output of psolve is returned with a warning

solver the CVX solver, passed to psolve

... other arguments passed to psolve

Examples

```
mu <- c(1/7,2/7,4/7)
nu <- c(1/4,1/4,1/2)
kantorovich_CVX(mu, nu)
```

kantorovich_glpk *Computes Kantorovich distance with GLPK*

Description

Kantorovich distance using the Rglpk package

Usage

```
kantorovich_glpk(
  mu,
  nu,
  dist = NULL,
  solution = FALSE,
  stop_if_fail = TRUE,
  ...
)
```

Arguments

mu	(row margins) probability measure in numeric mode
nu	(column margins) probability measure in numeric mode
dist	matrix, the distance to be minimized on average; if NULL, the 0-1 distance is used.
solution	logical; if TRUE the solution is returned in the "solution" attributes of the output
stop_if_fail	logical; if TRUE, an error is returned in the case when no solution is found; if FALSE, the output of Rglpk_solve_LP is returned with a warning
...	arguments passed to Rglpk_solve_LP

Examples

```
mu <- c(1/7,2/7,4/7)
nu <- c(1/4,1/4,1/2)
kantorovich_glpk(mu, nu)
```

`kantorovich_lp` *Computes Kantorovich distance with lp_solve*

Description

Kantorovich distance using the `lpSolve` package

Usage

```
kantorovich_lp(mu, nu, dist = NULL, solution = FALSE, lp.object = FALSE, ...)
```

Arguments

`mu` (row margins) probability measure in numeric mode

`nu` (column margins) probability measure in numeric mode

`dist` matrix, the distance to be minimized on average; if `NULL`, the 0-1 distance is used.

`solution` logical, to use only if `lp.object=FALSE`; if `TRUE` the solution is returned in the `"solution"` attributes of the output

`lp.object` logical, if `FALSE`, the output is the Kantorovich distance; if `TRUE`, the output is a `lp.object`

`...` arguments passed to `lp`

Examples

```
mu <- c(1/7,2/7,4/7)
nu <- c(1/4,1/4,1/2)
kantorovich_lp(mu, nu)
```

`names.bigq` *Names for bigq vectors*

Description

Names for bigq vectors

Usage

```
## S3 method for class 'bigq'
names(x)
```

Arguments

`x` a bigq vector

Value

the names of x

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