Package ‘kantorovich’

August 26, 2020

Type Package
Title Kantorovich Distance Between Probability Measures
Version 2.0.1
Date 2020-08-25
Author Stéphane Laurent
Maintainer Stéphane Laurent <laurent_step@outlook.fr>
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-2
LazyData TRUE
Suggests testthat, knitr, rmarkdown
Imports rcdd, gmp, methods, lpSolve, Rglpk
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
Date/Publication 2020-08-26 10:00:03 UTC
**R topics documented:**

- kantorovich-package ........................................... 2
- edistances ......................................................... 2
- ejoinings .......................................................... 3
- kantorovich ....................................................... 4
- kantorovich_glpk ................................................. 5
- kantorovich_lp ..................................................... 6
- names.bigq .......................................................... 7

**Index**

---

**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](https://github.com/stla/kantorovich).

**Details**

- **Package:** kantorovich
- **Type:** Package
- **Version:** 2.0.0
- **Date:** 2016-05-25
- **License:** GPL-2

**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

```r
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

```r
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

```r
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_glpk

Computes Kantorovich distance with GLPK

---

**Description**

Kantorovich distance using the Rglpk package

**Usage**

```r
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)
u <- 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)
u <- c(1/4, 1/4, 1/2)
kantorovich_lp(mu, nu)
names.bigq  

## Description

Names for bigq vectors

## Usage

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

## Arguments

- `x`: a bigq vector

## Value

the names of `x`
Index

edistances, 2
ejoinings, 3

kantorovich, 3, 4
kantorovich-package, 2
kantorovich_glpk, 5
kantorovich_lp, 6

lp, 6
lp.object, 6

names.bigq, 7

Rglpk_solve_LP, 5