Package ‘Emcdf’

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Type Package
Title Computation and Visualization of Empirical Joint Distribution
(Empirical Joint CDF)
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Description Computes and visualizes empirical joint distribution of multivariate data with optimized algorithms and multi-thread computation. There is a faster algorithm using dynamic programming to compute the whole empirical joint distribution of a bivariate data. There are optimized algorithms for computing empirical joint CDF function values for other multivariate data. Visualization is focused on bivariate data. Levelplots and wireframes are included.
License GPL-3
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Biemcdf

*Computes bivariate empirical joint distribution*

**Description**

This function computes empirical joint distribution (joint CDF) table with dynamical programming.

**Usage**

`biemcdf(data)`

**Arguments**

- `data` a numeric matrix with two columns.

**Details**

This is an optimization for bivariate data.

**Value**

A matrix of values of empirical joint CDF function, where rows and columns are the sorted variables. Columns are the first variable, and rows are the second variable.

**Examples**

```r
n = 10^2
set.seed(123)
x = rnorm(n)
y = rnorm(n)
data = cbind(x, y)
biemcdf(data)
```

---

**coreNum**

*CPU core number*

**Description**

This function reports the total core number in CPU on the machine.

**Usage**

`coreNum()`
emcdf

Details

This function is a wrapper for the C++ function std::thread::hardware_concurrency(); If core number is not detected, 0 will be returned. See "See Also" for details.

Value

an integer indicating the total number of cores in CPU.

See Also

http://www.cplusplus.com/reference/thread/thread/hardware_concurrency/

Examples

num = coreNum()

emcdf

Computes multivariate empirical joint distribution

Description

This function computes empirical joint distribution (joint CDF) with single/ multi-thread.

Usage

emcdf(data, a)

Arguments

data a numeric matrix stores data. Or an S4 object of class "emcdf_obj".

a a numeric vector or matrix of parameters for CDF function.

Details

When data is a numeric matrix, this function computes joint empirical CDF with single thread. When data is an object of class "emcdf_obj", it computes with multi-thread. Parameter "a" must have equal length (or equal column number) as the column number of data. Both single-thread and multi-thread emcdf algorithms are faster than using the built-in function sum(base). See example for simulation. Note that initializing threads and splitting data takes time though it’s a one-time task. Thus for big data, big number of CDF computation, multi-thread is recommended. Yet for small data, small number of CDF computation, single thread is faster.

Value

a numeric (vector) as value(s) of empirical joint CDF function.
Examples

n = 10^6
set.seed(123)
x = rnorm(n)
y = rnorm(n)
z = rnorm(n)
data = cbind(x, y, z)
#The aim is to compute F(0.5,0.5,0.5) with three
#approaches and compare the performances.
#To avoid CPU noises, we repeat the computation 10 times.
#compute with R built-in function, sum()
sum_time = system.time(
    aws1 = c()
    for(i in 1:10)
        aws1[i] = sum(x <= 0.5 & y <=0.5 & z <=0.5)/n
    )

#compute with emcdf single-thread
a = matrix(rep(c(0.5, 0.5, 0.5), 10), 10, 3)
single_time = system.time(
    aws2 = emcdf(data, a)
    )

obj = initF(data, 2)
multi_time = system.time(
    aws3 = emcdf(obj, a)
    )
aws2 == aws1
aws3 == aws1
sum_time
single_time
multi_time

---

initF                Initialize threads and split data

Description

This function initializes threads and splits data. Returns an S4 object of class "emcdf_obj" that is
ready for parallel computation.

Usage

initF(data, num = 2)
plotcdf

Arguments

data a numeric matrix stores data. Columns as variables.
num an integer specifies number of threads to initialize.

Details

The input data must be a numeric matrix with variables as columns. The choice of "num" is machine dependent. A reasonable number would be the total number of CPU cores - 1. Call coreNum() to get CPU core number.

Value

an S4 object of class "emcdf_obj", holding pointer to a C++ object. When passed to function emcdf(), it computes joint CDF with multi-threads.

Examples

n = 10^5
set.seed(123)
x = rnorm(n)
y = rnorm(n)
z = rnorm(n)
data = cbind(x, y, z)

#decide thread number
num = coreNum() - 1

#initialize threads
obj = initf(data, num)

#compute empirical CDF
emcdf(obj, c(0.5, 0.5, 0.5))

---

plotcdf

Plots multivariate empirical joint distribution of bivariate data

Description

This function plots empirical joint distribution (joint CDF) with levelplot, and 3D wireframes.

Usage

plotcdf(data, type = "levelplot", angle = 60,
main = paste("Bivariate CDF of", deparse(substitute(data))))
Arguments

data a numeric matrix / data frame of two variables.
type a character specifies plot types. Must be one of "levelplot", "wireframe", or "multiple_wireframe".
angle a numeric scalar for z axis rotation. With default = 60 degrees.
main a character of plot title.

Details

When type = "multiple_wireframe", this function plots 8 wireframes of directions 0 to what parameter angle is. This process takes longer. When type = "levelplot", parameter angle has no effect.

Examples

n = 10
set.seed(123)
x = rnorm(n)
y = x^2 + 0.1*rnorm(n)
data = cbind(x, y)
plotcdf(data, type = "multiple_wireframe")
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