

# Package: subrank (via r-universe)

September 19, 2024

**Type** Package

**Title** Computes Copula using Ranks and Subsampling

**Version** 0.9.9.3

**Date** 2023-04-06

**Author** Jerome Collet

**Maintainer** Jerome Collet <jeromepcollet@gmail.com>

**Description** Estimation of copula using ranks and subsampling. The main feature of this method is that simulation studies show a low sensitivity to dimension, on realistic cases.

**License** GPL (>= 3)

**LazyLoad** yes

**NeedsCompilation** yes

**Repository** CRAN

**Date/Publication** 2023-04-05 17:50:05 UTC

## Contents

subrank-package . . . . .	2
corc . . . . .	3
corc0 . . . . .	4
desscop . . . . .	5
desscoptous . . . . .	6
estimdep . . . . .	7
predictdep . . . . .	8
predonfly . . . . .	9
simany . . . . .	11
simnul . . . . .	12

<b>Index</b>	<b>14</b>
--------------	-----------

---

subrank-package      *Computes Copula using Ranks and Subsampling*

---

## Description

Estimation of copula using ranks and subsampling. The main feature of this method is that simulation studies show a low sensitivity to dimension, on realistic cases.

## Details

The DESCRIPTION file:

```
Package:          subrank
Type:             Package
Title:            Computes Copula using Ranks and Subsampling
Version:          0.9.9.3
Date:             2023-04-06
Author:           Jerome Collet
Maintainer:       Jerome Collet <jeromepcollet@gmail.com>
Description:      Estimation of copula using ranks and subsampling. The main feature of this method is that simulation st
License:          GPL (>= 3)
LazyLoad:        yes
NeedsCompilation: yes
```

Index of help topics:

```
corc              Function to estimate copula using ranks and
                  sub-sampling
corc0             Function to estimate copula using ranks and
                  sub-sampling, minimal version.
desscop           Discrete copula graph, a two-dimensional
                  projection
desscoptous       Discrete copula graph, ALL two-dimensional
                  projections
estimdep          Dependence estimation
predictdep        Probability forecasting
predonfly         Probability forecasting
simany            Test statistic distribution under any
                  hypothesis
simnul            Test statistic distribution under independence
                  hypothesis
subrank-package   Computes Copula using Ranks and Subsampling
```

Taking a sample, its dimension, and a sub-sample size, allows to estimate a discretized copula. This object has interesting features: convergence to copula, robustness with respect to dimension.

**Author(s)**

Jerome Collet

Maintainer: Jerome Collet &lt;jeromepcollet@gmail.com&gt;

**Examples**

```
lon <- 31
a <- 2.85
x <- rnorm(lon)
y = a*x^2+rnorm(lon)
tablo = as.data.frame(cbind(x,y))
c=corc(tablo,c(1,2),8)
desscop(c,1,2)
```

---

 corc

---

*Function to estimate copula using ranks and sub-sampling*


---

**Description**

Takes a sample, its dimension, a sub-sample size, and returns a discrete copula.

**Usage**

```
corc(dataframe, varnames, subsampsize, nbsafe=5,mixties=FALSE,nthreads=2)
```

**Arguments**

dataframe	a data frame, containing the observations
varnames	the name of the variables we want to estimate the dependence between
subsampsize	the sub-sample size
nbsafe	the ratio between the number of sub-samples and the cardinality of the discretized copula.
mixties	if TRUE, put equal weight on tied values, using random permutations
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using <code>parallel::detectCores()</code>

**Value**

cop	an array representing the discretized copula
ties	the number of sub-samples with a tie
nsubsampreal	the effective number of sub-samples drawn
varnames	the name of the variables studied
nm	the number of observations without missing values

**Author(s)**

Jerome Collet

**Examples**

```
lon <- 30
a <- 2
x <- rnorm(lon)
y = a*x^2+rnorm(lon)
datatable = as.data.frame(cbind(x,y))
c=corc(datatable,c("x","y"),8)
c
sum(c$cop)
```

---

corc0	<i>Function to estimate copula using ranks and sub-sampling, minimal version.</i>
-------	---

---

**Description**

Minimal version of function corc.

**Usage**

```
corc0(datavector,sampsize,dimension,subsampsize,nboot,u,mixties=FALSE,nthreads=2)
```

**Arguments**

datavector	a vector, containing the observations
sampsize	the sample size
dimension	the sample dimension
subsampsize	the sub-sample size
nboot	the number of sub-samples (must be big)
u	a random seed, integer
mixties	if TRUE, put equal weight on tied values, using random permutations
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using <code>parallel::detectCores()</code>

**Value**

the number of hits for each vector of ranks, plus 2 last values of the vector : number of ties and number of sub-samples really used.

**Author(s)**

Jerome Collet

**Examples**

```
lon <- 30
a <- 2.85
x <- rnorm(lon)
y = a*x^2+rnorm(lon)
c=corc0(c(x,y),lon,2,8,1e5,75014)
c

c0=c(
1203, 1671, 1766, 959, 1586, 1715, 1803, 1205, 1260,1988, 2348, 1917, 3506, 2045, 1340,
1093, 2694, 2757,2233, 1085, 2322, 1793, 1569, 1263, 1709, 1747, 1512,1308, 1778, 1354,
1184, 1097, 2487, 2730, 2112, 1100,2435, 2033, 1572, 1093, 1369, 1722, 1462, 1015, 1228,
1419, 1776, 1852, 1009, 1097, 1179, 1323, 1595, 1316,1477, 2628, 889, 1178, 1981, 4000,
35, 840, 2091, 4467,0, 27405)
set.seed(75013)
lon=30
dimension=3
ssize=4
c0==corc0(rnorm(lon*dimension),lon,dimension,ssize,1e5,75014)
```

---

desscop

*Discrete copula graph, a two-dimensional projection*


---

**Description**

Draws a discrete joint probability, for 2 variables, using bubbles

**Usage**

```
desscop(copest, xname, yname, normalize = FALSE, axes = TRUE)
```

**Arguments**

copest	the estimated copula (the whole structure resulting from <a href="#">corc</a> )
xname	the name of the variable we want to put on the horizontal axis
yname	the name of the variable we want to put on the vertical axis
normalize	if TRUE, the smallest probability is rescaled to 0, and the largest to 1
axes	if TRUE, puts the name of the variables on the axes

**Author(s)**

Jerome Collet

**Examples**

```
lon <- 31
a <- 2.85
x <- rnorm(lon)
y = a*x^2+rnorm(lon)
tablo = as.data.frame(cbind(x,y))
c=corc(tablo,c("x","y"),8)
desscop(c,"x","y")

tablo = as.data.frame(cbind(x=rep(0,each=lon),y=rep(0,each=lon)))
c=corc(tablo,c("x","y"),8,mixties=TRUE)
desscop(c,"x","y")
```

---

desscoptous

*Discrete copula graph, ALL two-dimensional projections*

---

**Description**

Draws a discrete joint probability, for 2 variables, using bubbles

**Usage**

```
desscoptous(copest, normalize = FALSE)
```

**Arguments**

copest            the estimated copula (the whole structure resulting from [corc](#))  
normalize        if TRUE, the smallest probability is rescaled to 0, and the largest to 1

**Author(s)**

Jerome Collet

**Examples**

```
lon <- 31
a <- 2.85
x <- rnorm(lon)
y = a*x^2+rnorm(lon)
z = rnorm(lon)
tablo = as.data.frame(cbind(x,y,z))
c=corc(tablo,c("x","y","z"),8)
desscoptous(c)
```

---

estimdep	<i>Dependence estimation</i>
----------	------------------------------

---

**Description**

From a set of observations, builds a description of the multivariate distribution

**Usage**

```
estimdep(dataframe, varnames, subsampsize, nbsafe=5, mixties=FALSE, nthreads=2)
```

**Arguments**

dataframe	a data frame containing the observations
varnames	the name of the variables we want to estimate the multivariate distribution
subsampsize	the sub-sample size
nbsafe	the ratio between the discretized copula size and the number of sub-samples
mixties	if TRUE, put equal weight on tied values, using random permutations
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using <code>parallel::detectCores()</code>

**Value**

the description of the dependence, it is an object with the following parts:

cop	the array representing the discretized copula
margins	the matrix representing the margins, estimated using kernel density estimation
varnames	the names of the variables

**Author(s)**

Jerome Collet

**Examples**

```
lon=3000
plon=3000
subsampsize=20

#####
x=(runif(lon)-1/2)*3
y=x^2+rnorm(lon)
z=rnorm(lon)
donori=as.data.frame(cbind(x,y,z))
depori=estimdep(donori,c("x","y","z"),subsampsize)

knownvalues=data.frame(z=rnorm(plon))
```

```
prev <- predictdep(knownvalues,depori)
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)
```

```
knownvalues=data.frame(x=(runif(10n)-1/2)*3)
prev <- predictdep(knownvalues,depori)
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)
```

```
knownvalues=data.frame(y=runif(plon,min=-2,max=4))
prev <- predictdep(knownvalues,depori)
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)
```

---

predictdep

*Probability forecasting*

---

### Description

From a set of incomplete observations, and a description of the dependence, provides simulated values of the unknown coordinates. It is also possible to simulate unconditionally, with empty observations.

### Usage

```
predictdep(knownvalues,dependence,smoothing=c("Uniform","Beta"),nthreads=2)
```

### Arguments

knownvalues	in case of conditional simulation, a matrix containing incomplete observations, the known coordinates being the same for all observations. If no variable name in knownvalues appears in dependence\$varnames, then the simulation is unconditional.
dependence	the description of the dependence we want to use to forecast, as built by function <a href="#">estimdep</a>
smoothing	the smoothing method for input and output ranks.
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using <code>parallel::detectCores()</code>

### Value

the matrix of the completed observations

### Author(s)

Jerome Collet

**Examples**

```

lon=100
plon=100
subsampsize=10

shift=0
noise=0
knowndims=1

x=rnorm(lon)
y=2*x+noise*rnorm(lon)
donori=as.data.frame(cbind(x,y))
depori=estimdep(donori,c("x","y"),subsampsize)
##
knownvalues=data.frame(x=rnorm(plon)+shift)
prev <- predictdep(knownvalues,depori)
##
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)
##
knownvalues=data.frame(x=rnorm(plon)+shift)
prev <- predictdep(knownvalues,depori,smoothing="Beta")
##
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)

# souci normal si |shift|>>1

knownvalues=data.frame(z=rnorm(plon)+shift)
prev <- predictdep(knownvalues,depori)
##
plot(prev$x,prev$y,xlim=c(-2,2),ylim=c(-2,5),pch=20,cex=0.5)
points(donori[,1:2],col='red',pch=20,cex=.5)

```

---

predonfly

*Probability forecasting*

---

**Description**

From two sets of observations, first one of complete observations and second one of incomplete observations, provides simulated values of the unknown coordinates.

**Usage**

```

predonfly(completeobs,incompleteobs,varnames,subsampsize,nbpreds=1,mixties=FALSE,
          maxtirs=1e5,complete=TRUE,nthreads=2)

```

**Arguments**

completeobs	the set of complete observations.
incompleteobs	the set of incomplete observations.
varnames	the modeled variables.
subsampsize	the sub-sample size.
nbpreds	the number of predictions for each incomplete observation.
mixties	if TRUE, should put equal weight on tied values, using random permutations (not yet implemented)
maxtirs	the maximum number of sub-samples, to stop the computation even if they did not provide nbpreds predictions for each incomplete observation.
complete	If TRUE, predictions are completed with incomplete observations
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using parallel::detectCores()

**Value**

the matrix of the completed observations

**Author(s)**

Jerome Collet

**Examples**

```
lon=100
plon=30
subsampsize=10

x=rnorm(lon)
y=2*x+rnorm(lon)*0
donori=as.data.frame(cbind(x,y))
##
knownvalues=data.frame(x=rnorm(plon))
prev <- predonfly(donori,knownvalues,c("x","y"),subsampsize,100)

##
plot(prev$x,prev$y,pch=20,cex=0.5,
      ylim=range(c(prev$y,donori$y),na.rm=TRUE),xlim=range(c(prev$x,donori$x)))
points(donori[,1:2],col='red',pch=20,cex=.5)

lon=3000
mg=20
dimtot=4
rayon=6

genboules <- function(lon,a,d)
{
  ss <- function(vec)
```

```

    {return(sum(vec*vec))}
    surface=matrix(nrow=lon,ncol=d,data=rnorm(lon*d))
    rayons=sqrt(apply(surface,1,ss))
    surface=surface/rayons
    return(matrix(nrow=lon,ncol=d,data=rnorm(lon*d))+a*surface)
}

#####

donori=genboules(lon,rayon,dimtot)
donori=as.data.frame(donori)

dimconnues=3:dimtot
valconnues=matrix(nrow=1,ncol=length(dimconnues),data=0)
valconnues=as.data.frame(valconnues)
names(valconnues)=names(donori)[3:dimtot]
prev <- predonfly(donori,valconnues,names(donori),subsampsiz,100)

boule2=genboules(plon,rayon,2)

plot(boule2[,1:2],xlab='X1',ylab='X2',pch=20,cex=.5)
plot(prev$V1,prev$V2,xlab='X1',ylab='X2',pch=20,cex=.5)

```

---

simany

*Test statistic distribution under any hypothesis*


---

## Description

Simulates the test statistic, under independence

## Usage

```
simany(sampsiz,dimension,subsampsizes,sampnum,nbsafe=5,nthreads=2, fun=NULL, ...)
```

## Arguments

sampsiz	sample size
dimension	sample dimension
subsampsizes	vector of sub-sample sizes
sampnum	number of samples
nbsafe	the ratio between the number of sub-samples and the cardinality of the discretized copula.
nthreads	number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using <code>parallel::detectCores()</code>
fun	the function describing the dependence.
...	optional arguments to fun

**Value**

lrs	the distances with independent case
lrs2mean	the distances with theoretical value, given dependence fun
scarcities	the proportions of non-reached vector ranks
DistTypes	a recall of the list of the distance types: "KL","L2","L1","APE"

**Author(s)**

Jerome Collet

**Examples**

```
depquad <- function(lon,dd,a)
{
  x <- rnorm(lon)
  y0 <- a*x^2
  y <- y0 + rnorm(lon)
  reste=rnorm((dd-2)*lon)
  return(c(x,y,reste))
}
sims0=simany(101,3,8,50,nbsafe=1)
seuils=apply(sims0$lrs,3,quantile,0.95)
seuils=matrix(ncol=4,nrow=50,seuils,byrow=TRUE)
sims1=simany(101,3,8,50,nbsafe=1,fun=depquad,a=0.5)
apply(sims1$lrs[,1,]>seuils,2,mean)
```

---

simnul

*Test statistic distribution under independence hypothesis*

---

**Description**

Simulates the test statistic, under independence

**Usage**

```
simnul(sampsize, dimension, subsampsizes, sampnum,KL=TRUE,nbsafe=5,nthreads=2)
```

**Arguments**

sampsize	sample size
dimension	sample dimension
subsampsizes	vector of sub-sample sizes
sampnum	number of samples
KL	if TRUE, returns the Kullback-Leibler divergence with the independent case, if FALSE, the L2 distance. There is no re-normalization, contrary to what happens for simany.

`nbsafe` the ratio between the number of sub-samples and the cardinality of the discretized copula.

`nthreads` number of number of threads, assumed to be strictly positive. For "full throttle" computations, consider using `parallel::detectCores()`

**Value**

`lrs` the distances with independent case

`scarcities` the proportions of non-reached vector ranks

**Author(s)**

Jerome Collet

**Examples**

```
library(datasets)
# plot(swiss)
c=corc(swiss,1:3,8)
c
RV=sum(c$cop*log(c$cop),na.rm=TRUE)+3*log(8)
sims=simnul(47,3,8,100)
pvalue=mean(RV<sims$lrs)
pvalue
RV
summary(sims$lrs)
```

# Index

corc, [3](#), [5](#), [6](#)

corc0, [4](#)

desscop, [5](#)

desscoptous, [6](#)

estimdep, [7](#), [8](#)

predictdep, [8](#)

predonfly, [9](#)

simany, [11](#)

simnul, [12](#)

subrank (subrank-package), [2](#)

subrank-package, [2](#)