Package 'fgac'

February 14, 2012

Version 0.6-1

Date 2009-07-31

Title Generalized Archimedean Copula

Author Veronica Andrea Gonzalez-Lopez <veronica@ime.unicamp.br>

Maintainer Veronica Andrea Gonzalez-Lopez <veronica@ime.unicamp.br>

Description Bi-variate data fitting is done by two stochastic components: the marginal distributions and the dependency structure. The dependency structure is modeled through a copula. An algorithm was implemented considering seven families of copulas (Generalized Archimedean Copulas), the best fitting can be obtained looking all copula's options (totally positive of order 2 and stochastically increasing models).

License GPL

Repository CRAN

Date/Publication 2009-08-01 09:38:26

R topics documented:

`cumulativemarg` *cumulativemarg*

Description

Auxiliary function that is used in copula fitting. This function works with different cumulative forms, like pnorm, pbeta, ... and transforms it as cumulative1 and / or cumulative2 in fitCBB function and OptimCBB function.

Usage

```
cumulativemarg(cumulative, x, a)
```

Arguments

cumulative	can be pnorm, punif, pbeta, pempirical, ...
x	real vector
a	parameters associated with cumulative

Value

Cumulative distribution, evaluated in the vector x

Author(s)

Veronica A. Gonzalez-Lopez

See Also

match.arg, pempirical

Examples

```
#x<-rnorm(50,2,1)
#a<-cumulativemarg(pnorm,x,c(2,1))
#a1<-cumulativemarg(pempirical,x)
```

---

dirac1 *dirac1*

Description

Indicator function of the set A, where A = [u,infinity)

Usage

```
dirac1(u, x)
```

Arguments

u	real value
x	real value

Value

dirac1(u,x)=1 if x>=u and dirac1(u,x)=0 in other case.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

dirac2, diracS1, diracS2

---

dirac2 *dirac2*

Description

Indicator function of the set A, where A = [u,infinity)x[v,infinity)

Usage

```
dirac2(u, v, x, y)
```

Arguments

u	real value
v	real value
x	real value
y	real value

Value

dirac2(u,v,x,y)=1 if x>=u and y>=v, in other case dirac2(u,v,x,y)=0.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

dirac1, diracS1, diracS2

diracS1 *diracS1*

Description

Indicator function of the set A, where A = (-infinity,u)

Usage

```
diracS1(u, x)
```

Arguments

u	real value
x	real value

Value

diracS1(u,x)=1 if x<u and diracS1(u,x)=0 in other case.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

dirac1, dirac2, diracS2

---

diracS2 *diracS2*

Description

Indicator function of the set A, where A = (-infinity,u)x(-infinity,v).

Usage

```
diracS2(u, v, x, y)
```

Arguments

u	real value
v	real value
x	real value
y	real value

Value

diracS2(u,v,x,y)=1 if x<u and y<v; diracS2(u,v,x,y)=0 in other case.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

dirac1, dirac2, diracS1

`fcopulamodel` *fcopulamodel*

Description

Auxiliary function that is used in copula fitting. This function works with different cumulative copulas, fcopulamodel transforms it as cumulatives in fitCBB function and OptimCBB function.

Usage

```
fcopulamodel(theta, delta, x, y, model = c("pCBB1", "pCBB2", "pCBB3", "pCBB4", "pCBB5",
 "pCBB6", "pCBB7", "pCMax", "pCMin"))
```

Arguments

`theta`	real parameter
`delta`	real parameter
`x`	real vector
`y`	real vector
`model`	bidimensional cumulative, can be any of the following : pCBB1, pCBB2, pCBB3, pCBB4, pCBB5, pCBB6, pCBB7, pCMax, pCMin

Details

If model is missing fcopulamodel works with pCBB1.

Value

Bidimensional cumulative. Specific form that can be used in copula fitting.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

match.arg, pCBB1,pCBB1, pCBB2, pCBB3, pCBB4,pCBB5. pCBB6, pCBB7, pCMax, pCMin

Examples

```
#x<-runif(50)
#y<-runif(50)
#a<-fcopulamodel(2,3,x,y, model = "pCBB6")
```

FE1vector *FE1vector*

Description

Empirical cumulative distribution

Usage

```
FE1vector(u, x)
```

Arguments

u	real vector
x	real vector (can be like u)

Value

empirical cumulative distribution from u sample, evaluated in the vector x.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

SOB2, FE2

Examples

```
# x<-rnorm(50)
# FE1vector(x,x)
# y<-rnorm(10)
# FE1vector(x,y)
```

FE2 *FE2*

Description

Bidimensional empirical cumulative distribution

Usage

```
FE2(u, v, x, y)
```

Arguments

u	real vector
v	real vector
x	real value (can be some component of u)
y	real value (can be some component of v)

Details

$$FE2(u,v,x,y) = \frac{1}{n}\sum_{i=1}^{n} I_{(u_i \leq x)} I_{(v_i \leq y)}, \quad u = (u_1, \cdots, u_n),\ v = (v_1, \cdots, v_n)$$

Value

Bidimensional empirical cumulative distribution from (u,v) sample, evaluated in the point (x,y)

Author(s)

Veronica Andrea Gonzalez-Lopez

See Also

SOB2, FE1vector

Examples

```
#u<-matrix(c(1,3,5,1,6),nrow=5,ncol=1)
#FE2(u,u,6.5,3)
#u<-matrix(c(1:15),nrow=15,ncol=1)
#v<-matrix(c(16:30),nrow=15,ncol=1)
#FE2(u,v,5,35)
```

`fitCBB` *fitCBB*

Description

Fitting an specific generalized archimedean copula

Usage

```
fitCBB(x, y, theta0, delta0, copulamodel = c("pCBB1", "pCBB2", "pCBB3", "pCBB4",
"pCBB5", "pCBB6", "pCBB7", "pCMax", "pCMin"), m, step, deltamin, thetamin,
 test = c("wilcox.test", "t.test"), empcumulative = TRUE, cumulative1,
cumulative2, parameters1, parameters2)
```

Arguments

`x`	real vector
`y`	real vector
`theta0`	parameter in the model pCBBi (in variable copulamodel). For default, theta0 is obtained from fitlambdas
`delta0`	parameter in the model pCBBi (in variable copulamodel). For default, delta0 is obtained from fitlambdas
`copulamodel`	specific model that we need to fit, it need to be one option from: pCBB1 (default), pCBB2, pCBB3, pCBB4, pCBB5, pCBB6, pCBB7, pCMax, pCMin
`m`	integer positive number (default=15)
`step`	real positive number (default=0.01)
`deltamin`	minimum value admited for delta's domain (default=epsilon-see details)
`thetamin`	minimum value admited for theta's domain (default=epsilon-see details)
`test`	test used for fitting selection, it need to be wilcox.test(default) or t.test
`empcumulative`	logical value, can be TRUE (default) or FALSE (see details)
`cumulative1`	marginal cumulative associated with x. Can be used pnorm, pbeta, pempirical,...(only used when empcumulative=FALSE)
`cumulative2`	marginal cumulative associated with y. Can be used pnorm, pbeta, pempirical,...(only used when empcumulative=FALSE)
`parameters1`	specifics parameters for cumulative1's definition
`parameters2`	specifics parameters for cumulative2's definition

Details

The function constructs a neighbourhood around (theta0,delta0) for family specified in 'copulamodel' , and using the test specified in 'test' the function search the best (theta*,delta*) in the neighbourhood such that copulamodel(theta*,delta*,u,v) is close to the bivariate empirical copula from (x,y). Where (u,v)=(cumulative1(x),cumulative2(y)). m and step control the neighbourhood' definition. deltamin and thetamin depend on the model worked. For default, we have, pCBB1: deltamin=1, thetamin=0.05; pCBB2: deltamin=0.05, thetamin = 0.05; pCBB3: deltamin=1, thetamin=0.05; pCBB4: deltamin=0.05, thetamin=0.05; pCBB5: deltamin=0.05, thetamin=1; pCBB6: deltamin=1, thetamin=1; pCBB7: deltamin = 0.05, thetamin = 1. If empcumulative=TRUE like default, the algorithm uses for uniformization, empirical cumulative from x for x and empirical cumulative from y for y. If empcumulative=FALSE, we need to put an specific cumulative1 and an specific cumulative2. If necessary, parameters1 contains the special parameter(s) for cumulative1 and parameters2 contains the special parameter(s) for cumulative2.

Value

`Empirical`	empirical copula from (x,y)
`Copula`	best copulamodel evaluated in (u,v)=(cumulative1(x),cumulative2(y))
`fit`	performance from the best copulamodel in the neighbourhood. Result: p.value in fit[1], delta in fit[2], theta in fit[3]
`thetai`	theta's vector constructed in the neighbourhood
`deltaj`	delta's vector constructed in the neighbourhood
`pthetaideltaj`	p value matrix from each combination. The position (i,j) represents the p value from 'test' in thetai(i),deltaj(j) for copulamodel.

Author(s)

Veronica Andrea Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

`fitlambdas`, `OptimCBB` ~~~

Examples

```
#x<-rnorm(100)
#y<-x/10+rnorm(100)
#M<-fitCBB(x,y) # default fitting
#default: thetas0 and delta0 from fitlambdas function,  m=15, step=0.01,
#copulamodel="pCBB1", test="wilcox.test", empcumulative=TRUE.
#
#M<-fitCBB(x,y,theta0=1.1,delta0=0.8,copulamodel="pCBB5",m=20,step=0.5,deltamin=0.1,thetamin=1.1,
```

```
#test="w",empcumulative=FALSE,cumulative1=pnorm,cumulative2=pnorm)
#
#x<-rnorm(100)
#y<-x/100+rnorm(100,5,2)
#M<-fitCBB(x,y,theta0=1.1,delta0=0.8,copulamodel="pCBB7",m=20,step=0.5,deltamin=0.1,thetamin=1.1,
#test="t",empcumulative=FALSE,cumulative1=pnorm,cumulative2=pnorm,parameters2=c(5,2))
```

`fitlambdas` *fitlambdas*

Description

The function tests the compatibility for each model pCBBi, i=1,2,3,4,5,6,7, pCMax and pCMin in relation to a proposal caudal measures: lambdaLE, lambdaUE. Also, this function gives theta and delta in function of lambsaLE and lambadaUE.

Usage

```
fitlambdas(lambdaLE, lambdaUE)
```

Arguments

`lambdaLE`	real number in [0,1]
`lambdaUE`	real number in [0,1]

Details

NaN values can be used in lambdaLE and lambdaUE

Value

For i=1,2,3,4,5,7

`BBi.model`	is =TRUE BBi if the BBi model can be used and is = FALSE BBi in other case
`BBi.theta`	real value if BBi.model is =TRUE BBi and = NaN if BBi.model is = FALSE BBi
`BBi.delta`	real value if BBi.model is =TRUE BBi and = NaN if BBi.model is = FALSE BBi
`BB6.model`	is =TRUE BB6 if the BB6 model can be used and is =FALSE BB6 in other case
`BB6.deltaxtheta`	real value if BB6.model is =TRUE BB6 and =NaN if BB6.model is =FALSE BB6
`CMin.model`	is =TRUE CMin if the CMin model can be used and is =FALSE CMin in other case
`CMax.model`	is =TRUE CMax if the CMax model can be used and is =FALSE CMax in other case

Author(s)

Veronica Andrea Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB1, pCBB2,pCBB3,pCBB4,pCBB5,pCBB6,pCBB7

Examples

```
#fitlambdas(0.3,0.7)
#fitlambdas(0.9,NaN)
#fitlambdas(0.18,0)
#fitlambdas(0.18,0)
#fitlambdas(0,0)
#fitlambdas(0,NaN)
#fitlambdas(1,1)
```

`ftest` *ftest*

Description

Auxiliary function that is used in copula fitting. This function works with different two sample test, ftest transforms it as test in fitCBB function and OptimCBB function.

Usage

```
ftest(x, y, test = c("wilcox.test", "t.test"))
```

Arguments

`x`	real vector
`y`	real vector
`test`	can be wilcox.test or t.test

Details

form that work with two test, if test is missing test is defined for wilcox.test.

Value

test between x and y.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

`match.arg`, `wilcox.test`, `t.test`

Examples

```
#x<-rnorm(100)
#y<-rnorm(100)
#ftest(x,y)
#ftest(x,y,test="t")
```

`ivphiBB1` *ivphiBB1*

Description

Inverse Laplace's transform (phiBB1's inverse)

Usage

```
ivphiBB1(theta, delta, t)
```

Arguments

`theta`	positive, real parameter
`delta`	real parameter (>=1)
`t`	real vector

Value

return the value for the inverse in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

phiBB1

Examples

```
#a<-phiBB1(0.5,1.5,c(1,6))
#b<-ivphiBB1(0.5,1.5,c(a[5],a[6]))
```

---

ivphiBB2 *ivphiBB2*

Description

Inverse Laplace's transform (phiBB2's inverse)

Usage

```
ivphiBB2(theta, delta, t)
```

Arguments

theta	positive, real parameter
delta	positive, real parameter
t	real vector

Value

return the value for the inverse in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03; Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

phiBB2

Examples

```
#a<-phiBB2(0.3,2.6,c(2,3,4))
#b<-ivphiBB2(0.3,2.6,c(a[6],a[7],a[8]))
```

`ivphiBB3` *ivphiBB3*

Description

Inverse Laplace's transform (phiBB3's inverse)

Usage

```
ivphiBB3(theta, delta, t)
```

Arguments

`theta`	positive, real parameter
`delta`	real parameter (>=1)
`t`	real vector

Value

return the value for the inverse in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

`phiBB3`

Examples

```
#a<-phiBB3(0.2,4,c(0.2,0.3,0.4))
#b<-ivphiBB3(0.2,4,c(a[6],a[7],a[8]))
```

ivphiBB6 *ivphiBB6*

Description

Inverse Laplace's transform (phiBB6's inverse)

Usage

```
ivphiBB6(theta, delta, t)
```

Arguments

theta	real parameter (>=1)
delta	real parameter (>=1)
t	real vector

Value

return the value for the inverse in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

phiBB6

Examples

```
#a<-phiBB6(1.1,2.1,c(0.55,0.66,0.77,0.88))
# b<-ivphiBB6(1.1,2.1,c(a[7],a[8],a[9],a[10]))
```

ivphiBB7 *ivphiBB7*

Description

Inverse Laplace's transform (phiBB7's inverse)

Usage

```
ivphiBB7(theta, delta, t)
```

Arguments

theta	real parameter (>=1)
delta	positive, real parameter
t	real vector

Value

return the value for the inverse in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

phiBB7

Examples

```
#a<-phiBB7(1.1,0.8,c(0.55,0.66,0.77,0.88))
#b<-ivphiBB7(1.1,0.8,c(a[7],a[8],a[9],a[10]))
```

`ivpsiGumbel` *ivpsiGumbel*

Description

Inverse Laplace's transform (psiGumbel's inverse)

Usage

```
ivpsiGumbel(delta, t)
```

Arguments

`delta`	real (>=1), parameter
`t`	real positive vector

Value

return the value for the inverse transform in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

`psiGumbel`

Examples

```
#delta=2, vector=c(1,2,3,4)
#ivpsiGumbel(2,c(1,2,3,4))
```

ivpsiKS *ivpsiKS*

Description

Inverse Laplace's transform (psiKS's inverse)

Usage

```
ivpsiKS(delta, t)
```

Arguments

delta	real and positive parameter
t	real positive vector

Value

return the value for the inverse transform in the vector t

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

psiKS

Examples

```
#a<-psiKS(0.4,c(1,1.5,2,2.5,3,3.5))
#b<-ivpsiKS(0.4,c(a[8],a[9],a[10],a[11],a[12],a[13]))
#
```

KGalambos *KGalambos*

Description

Galambos's cumulative. Stochastically increasing copula.

Usage

```
KGalambos(u, v, delta)
```

Arguments

u	real in [0,1]
v	real in [0,1]
delta	real and positive parameter

Value

Cumulative value for (u,v) obtained using Galambos's cumulative

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB4, pCBB5, psiKS, psiGumbel

Examples

```
#u=0.6,v=0.7,delta=7
#KGalambos(0.6,0.5,7)
```

OptimCBB *OptimCBB*

Description

The best fitting into the generalized archimedean copula class is selected

Usage

```
OptimCBB(x, y, m, step, test = c("wilcox.test", "t.test"), empcumulative = TRUE,
cumulative1, cumulative2, parameters1, parameters2)
```

Arguments

x	real vector
y	real vector
m	integer positive number (default=15)
step	real positive number (default=0.01)
test	test used for fitting selection, it have to be wilcox.test (default) or t.test
empcumulative	logical value, can be TRUE (default) or FALSE (see details)
cumulative1	marginal cumulative associated with x. Can be used pnorm, pbeta, pempirical,...(only used when empcumulative=FALSE)
cumulative2	marginal cumulative associated with y. Can be used pnorm, pbeta, pempirical,...(only used when empcumulative=FALSE)
parameters1	specifics parameters for cumulative1's definition
parameters2	specifics parameters for cumulative2's definition

Details

The function cheks the compatibility of each family using 'fitlambdas' then, the function 'fitCBB' is applied for each possible family . Partial and global good fit are showed.

Value

Empirical	empirical copula for (x,y)
Copula	best copulamodel evaluated in (u,v)=cumulative1(x),cumulative2(y)
OptimumFit	performance from the best copulamodel in the neighbourhood and between all copula's families pCBB1,..., pCBB7, pCMax, pCMin. Family in OptimumFit[1]; p.value in OptimumFit[2], delta in OptimumFit[3], theta in OptimumFit[4], MSE in OptimumFit[5]
Initial.BBi	For i in 1,...,7. Initial values for BBi family provided by the fitlambdas function. If Initial.BBi[1]=FALSE BBi, the BBi family is excluded (because empirical evidence from the data shows that this family is not appropriated). If Initial.BBi[1]=TRUE BBi, theta e delta suggested from fitlambdas function is showed in Initial.BBi[2] and Initial.BBi[3] respectively.

`Final.BBi` For i in 1,...,7, we have the characteristics from the best fit in BBi family. If Final.BBi[1]=FALSE BBi, the BBi family is excluded (only when the family was excluded in Initial. BBi). In other case ,Final.BBi[1]=p.value (from test); the best theta e delta are showed in Final.BBi[2] and Final.BBi[3] respectively.

`Initial.CMax (Initial.CMin)` like Initial.BBi (in this kind of component theta and delta do not have sense)

`Final.CMax (Final.CMin)` like Final.BBi

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03

See Also

`fitCBB`, `fitlambdas`

Examples

```
#x<-rnorm(100)
#y<-x/100+rnorm(100,5,2)
#M<-OptimCBB(x=x,y=y)
#
#x<-rbeta(50,2,3)
#y<-0.5*x+rgamma(50,1,2)
#M<-OptimCBB(x,y,m=30,step=0.5,test="t",empcumulative=TRUE)
#M<-OptimCBB(x,y,m=30,step=0.5,test="w",empcumulative=FALSE,cumulative1=pbeta,
#cumulative2=pempirical,parameters1=c(2,3))
```

---

pCBB1 *pCBB1*

Description

Cumulative generalized archimedean Copula BB1

Usage

```
pCBB1(theta, delta, s, t)
```

Arguments

`theta`	real and positive parameter
`delta`	real parameter (>=1)
`s`	real vector
`t`	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

`pcopula1`, `phiBB1`, `psiGumbel`

Examples

```
#a<-pCBB1(2,3,matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5),matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5))
```

---

pCBB2 *pCBB2*

Description

Cumulative generalized archimedean Copula BB2

Usage

```
pCBB2(theta, delta, s, t)
```

Arguments

`theta`	real and positive parameter
`delta`	real and positive parameter
`s`	real vector
`t`	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula1, phiBB2, psiKS

Examples

```
#a<-pCBB2(0.9,0.3,matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5),matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5))
```

---

pCBB3 *pCBB3*

Description

Cumulative generalized archimedean Copula BB3

Usage

```
pCBB3(theta, delta, s, t)
```

Arguments

theta	real and positive parameter
delta	real parameter (>=1)
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula1, phiBB3, psiKS

Examples

```
#a<-pCBB3(0.2,1.7,matrix(c(0.11,0.22,0.34,0.21,0.35),nrow=5),
#matrix(c(0.55,0.77,0.65,0.79,0.76),nrow=5))
```

---

pCBB4 *pCBB4*

Description

Cumulative generalized archimedean Copula BB4

Usage

```
pCBB4(theta, delta, s, t)
```

Arguments

theta	real and positive parameter
delta	real and positive parameter
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula2, psiKS, KGalambos

Examples

```
#s<-matrix(c(0.1,0.2,0.3,0.4,0.5),nrow=5)
#t<-matrix(c(0.15,0.28,0.31,0.49,0.51),nrow=5)
#a<-pCBB4(0.5,0.9,s,t)
```

---

pCBB5 *pCBB5*

Description

Cumulative generalized archimedean Copula BB5

Usage

```
pCBB5(theta, delta, s, t)
```

Arguments

theta	real parameter(>=1)
delta	real and positive parameter
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula2, psiGumbel, KGalambos

Examples

```
#s<-matrix(c(0.1,0.2,0.3,0.4,0.5),nrow=5)
#t<-matrix(c(0.15,0.28,0.31,0.49,0.51),nrow=5)
#a<-pCBB5(1.5,0.9,s,t)
```

---

pCBB6 *pCBB6*

Description

Cumulative generalized archimedean Copula BB6

Usage

```
pCBB6(theta, delta, s, t)
```

Arguments

theta	real parameter (>=1)
delta	real parameter (>=1)
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula1, phiBB6, psiGumbel

Examples

```
#a<-pCBB6(3,1.7,matrix(c(0.11,0.22,0.34,0.21,0.35),nrow=5),
#matrix(c(0.55,0.77,0.65,0.79,0.76),nrow=5))
```

pCBB7 *pCBB7*

Description

Cumulative generalized archimedean Copula BB7

Usage

```
pCBB7(theta, delta, s, t)
```

Arguments

theta	real parameter (>=1)
delta	real and positive parameter
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pcopula1, phiBB7, psiKS

Examples

```
#s<-matrix(c(0.1,0.2,0.3,0.4,0.5),nrow=5)
#t<-matrix(c(0.15,0.28,0.31,0.49,0.51),nrow=5)
#a<-pCBB7(2,0.9,s,t)
```

pCMax *pCMax*

Description

Cumulative copula Frechet's bound, pCMax

Usage

```
pCMax(theta, delta, s, t)
```

Arguments

theta	is missing
delta	is missing
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample.

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCMin

Examples

```
#a<-pCMax(s=matrix(c(0.9,0.2,0.4,0.5),nrow=4),t=matrix(c(0.2,0.33,0.5,0.2),nrow=4))
```

pCMin *pCMin*

Description

Cumulative copula Frechet's bound, pCMin

Usage

```
pCMin(theta, delta, s, t)
```

Arguments

theta	is missing
delta	is missing
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample.

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCMax

Examples

```
#x<-rnorm(50,0,1)
#y<-1-x+rnorm(50,0.05,0.1)
#plot(x,y)
#a<-pCMin(s=x,t=y)
```

pcopula1 *pcopula1*

Description

Generator of generalized archimedean copula. Different kind of cumulative copulas can be obtained using pcopula1, for example pCBBi, i=1,2,3,6,7.

Usage

```
pcopula1(theta, delta, psi, phi, ivpsi, ivphi, s, t)
```

Arguments

theta	parameter, real and positive value
delta	parameter, real and positive value
psi	Laplace transformation
phi	Laplace transformation
ivpsi	psi's inverse
ivphi	phi's inverse
s	real vector
t	real vector

Value

returns the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters and Laplace transformation.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03

See Also

pCBB1, pCBB2, pCBB3, pCBB6,pCBB7

Examples

```
#pcopula1(2,3,psiGumbel,phiBB6,ivpsiGumbel,ivphiBB6,matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5),
#matrix(c(0.9,0.2,0.4,0.1,0.3),nrow=5))
```

pcopula2 *pcopula2*

Description

Generator of generalized archimedean copula. Different cumulative copulas can be obtained using pcopula2, for example pCBBi, i=4,5.

Usage

```
pcopula2(theta, delta, psi, v1, ivpsi, v2, s, t)
```

Arguments

theta	parameter, real and positive value
delta	parameter, real and positive value
psi	Laplace transformation
v1	real number
ivpsi	psi's inverse
v2	real number
s	real vector
t	real vector

Value

return the values from bidimensional cumulative for (s,t) sample using (theta,delta) parameters and Laplace transformation.

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03

See Also

pCBB4, pCBB5

Examples

```
#pcopula2(2.5,3,psiGumbel,1,ivpsiGumbel,1,
#matrix(c(0.9,0.7,0.2,0.5,0.4),nrow=5),matrix(c(0.9,0.7,0.2,0.5,0.4),nrow=5))
```

pempirical *pempirical*

Description

Empirical cumulative distribution

Usage

```
pempirical(x, arg)
```

Arguments

x	real vector
arg	real vector (can be like x)

Details

pempirical can be used like pnorm, punif, pbeta,...

Value

empirical cumulative distribution for x sample, evaluated in the vector arg. If arg is missing, arg<-x.

Author(s)

Veronica A. Gonzalez-Lopez

See Also

cumulativemarg, pnorm

Examples

```
#x<-rnorm(50,2,1)
#pempirical(x)
```

phiBB1 *phiBB1*

Description

Laplace's transform. This function is associated with BB1 Copula

Usage

```
phiBB1(theta, delta, s)
```

Arguments

theta	positive, real parameter
delta	real parameter (>=1)
s	real vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB1, psiKS

Examples

```
#phiBB1(0.5,1.5,c(1,6))
```

phiBB2 *phiBB2*

Description

Laplace's transform. This function is associated with BB2 Copula

Usage

```
phiBB2(theta, delta, s)
```

Arguments

theta	positive, real parameter
delta	positive, real parameter
s	real vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB2, psiKS

Examples

```
#theta=0.3,delta=2.6, s=c(2,3,4)
#phiBB2(0.3,2.6,c(2,3,4))
```

phiBB3 *phiBB3*

Description

Laplace's transform. This function is associated with BB3 Copula

Usage

```
phiBB3(theta, delta, s)
```

Arguments

theta	positive, real parameter
delta	real parameter (>=1)
s	real vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB3, psiKS

Examples

```
#theta=0.2,delta=4, s=c(0.2,0.3,0.4)
#phiBB3(0.2,4,c(0.2,0.3,0.4))
```

phiBB6 *phiBB6*

Description

Laplace's transform. This function is associated with BB6 Copula

Usage

```
phiBB6(theta, delta, s)
```

Arguments

theta	real parameter (>=1)
delta	real parameter (>=1)
s	real vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB6, psiGumbel

Examples

```
#theta=1.1,delta=2.1,s=c(0.55,0.66,0.77,0.88)
#phiBB6(1.1,2.1,c(0.55,0.66,0.77,0.88))
```

phiBB7 *phiBB7*

Description

Laplace's transform. This function is associated with BB7 Copula

Usage

```
phiBB7(theta, delta, s)
```

Arguments

theta	real parameter (>=1)
delta	positive, real parameter
s	real vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03; Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB7, psiKS

Examples

```
#theta=1.1,delta=0.8,s=c(0.55,0.66,0.77,0.88)
#phiBB7(1.1,0.8,c(0.55,0.66,0.77,0.88))
```

psiGumbel *psiGumbel*

Description

Laplace's transform. This function is associated with Gumbel Archimedean Copula

Usage

```
psiGumbel(delta, s)
```

Arguments

delta	parameter, real (>=1)
s	real positive vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB1, pCBB5, pCBB6

Examples

```
#Gumbel'TL with delta=1.7 and s=c(1:6)
#psiGumbel(1.7,c(1:6))
```

psiKS *psiKS*

Description

Laplace's transform. This function is associated with Kimeldorf-Sampson Archimedean Copula

Usage

```
psiKS(delta, s)
```

Arguments

delta	real and positive parameter
s	real positive vector

Value

return the value for the transform in the vector s

Author(s)

Veronica A. Gonzalez-Lopez

References

Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

pCBB2, pCBB3, pCBB4, pCBB7

Examples

```
#delta=0.4, s=c(1,1.5,2,2.5,3,3.5)
#psiKS(0.4,c(1,1.5,2,2.5,3,3.5))
```

SOB2 *SOB2*

Description

Bidimensional empirical survival function

Usage

```
SOB2(u, v, x, y)
```

Arguments

u	real vector
v	real vector
x	real vector
y	real vector

Details

$$SOB2(u,v,x,y) = \frac{1}{n}\sum_{i=1}^{n} I_{(u_i>x)} I_{(v_i>y)}), \quad u=(u_1,\cdots,u_n),\ v=(v_1,\cdots,v_n)$$

Value

Bidimensional empirical survival function for vector (u,v), evaluated in (x,y)

Author(s)

Veronica A. Gonzalez-Lopez

References

Veronica A. Gonzalez-Lopez and Nelson I. Tanaka. 'Bi-variate Data Modeling Through Generalized Archimedean Copula' RT-MAE 2003-03. Harry Joe. 'Multivariate Models and Dependence Concepts' Monogra. Stat. & Appl. Probab. 73. Chapman and Hall (1997)

See Also

FE1vector, FE2

Examples

```
#u<-matrix(c(1,3,5,1,6),nrow=5)
#SOB2(u,u,6.5,3)
#u<-matrix(c(1:15),nrow=15)
#v<-matrix(c(16:30),nrow=15)
#SOB2(u,v,10,24)
```

Index