Package 'VC2copula'

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Title Extend the 'copula' Package with Families and Models from 'VineCopula'

Version 0.1.6

Description Provides new classes for (rotated) BB1, BB6, BB7, BB8, and Tawn copulas, extends the existing Gumbel and Clayton families with rotations, and allows to set up a vine copula model using the 'copula' API. Corresponding objects from the 'VineCopula' API can easily be converted.

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Encoding UTF-8

URL https://github.com/tnagler/VC2copula

BugReports https://github.com/tnagler/VC2copula/issues

Depends copula (>= 1.1-2), R (>= 4.1.0)

Imports VineCopula (>= 2.3.0), methods

LinkingTo VineCopula

Suggests lattice, testthat (>= 2.1.0)

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Contents

`BB1Copula` *Constructors for BB1 copulas*

Description

Constructs an object of the BB1Copula (survival `sur`, 90 degree rotated `r90` and 270 degree rotated `r270`) family for given parameters.

Usage

```
BB1Copula(param = c(1, 1))

surBB1Copula(param = c(1, 1))

r90BB1Copula(param = c(-1, -1))

r270BB1Copula(param = c(-1, -1))
```

Arguments

`param`	The parameter `param` defines the copula through `theta` and `delta`.

Value

One of the respective BB1 copula classes (BB1Copula, surBB1Copula, r90BB1Copula, r270BB1Copula).

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also `BB6Copula()`, `BB7Copula()`, `BB8Copula()` and `joeBiCopula()` for further wrapper functions to the VineCopula::VineCopula-package.

Examples

```
library(copula)

persp(BB1Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(surBB1Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(r90BB1Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
persp(r270BB1Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
```

BB1Copula-class *BB1 copula models*

Description

Wrapper classes representing the BB1, survival BB1, 90 degree and 270 degree rotated BB1 copula families (Joe 1997) from VineCopula::VineCopula-package.

Objects from the Classes

Objects can be created by calls of the form `new("BB1Copula", ...)`, `new("surBB1Copula", ...)`, `new("r90BB1Copula", ...)` and `new("r270BB1Copula", ...)` or by the functions `BB1Copula()`, `surBB1Copula()`, `r90BB1Copula()` and `r270BB1Copula()`.

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also BB6Copula, BB7Copula, BB8Copula and joeBiCopula for further wrapper classes to the VineCopula::VineCopula-package.

Examples

```
showClass("BB1Copula")
```

BB6Copula *Constructors for BB6 copulas*

Description

Constructs an object of the BB6Copula (survival `sur`, 90 degree rotated `r90` and 270 degree rotated `r270`) family for given parameters.

Usage

```
BB6Copula(param = c(1, 1))

surBB6Copula(param = c(1, 1))

r90BB6Copula(param = c(-1, -1))

r270BB6Copula(param = c(-1, -1))
```

Arguments

`param`	The parameter `param` defines the copula through `theta` and `delta`.

Value

One of the respective BB6 copula classes (BB6Copula, surBB6Copula, r90BB6Copula, r270BB6Copula).

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also `BB6Copula()`, `BB7Copula()`, `BB8Copula()` and `joeBiCopula()` for further wrapper functions to the VineCopula::VineCopula-package.

Examples

```
library(copula)

persp(BB6Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(surBB6Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(r90BB6Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
persp(r270BB6Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
```

BB6Copula-class *BB6 copula models*

Description

Wrapper classes representing the BB6, survival BB6, 90 degree and 270 degree rotated BB6 copula families (Joe 1997) from VineCopula::VineCopula-package.

Objects from the Classes

Objects can be created by calls of the form `new("BB6Copula", ...)`, `new("surBB6Copula", ...)`, `new("r90BB6Copula", ...)` and `new("r270BB6Copula", ...)` or by the functions `BB6Copula()`, `surBB6Copula()`, `r90BB6Copula()` and `r270BB6Copula()`.

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also BB6Copula, BB7Copula, BB8Copula and joeBiCopula for further wrapper classes to the VineCopula::VineCopula-package.

Examples

```
showClass("BB6Copula")
```

BB7Copula *Constructors for BB7 copulas*

Description

Constructs an object of the BB7Copula (survival `sur`, 90 degree rotated `r90` and 270 degree rotated `r270`) family for given parameters.

Usage

```
BB7Copula(param = c(1, 1))

surBB7Copula(param = c(1, 1))

r90BB7Copula(param = c(-1, -1))

r270BB7Copula(param = c(-1, -1))
```

Arguments

`param`	The parameter `param` defines the copula through `theta` and `delta`.

Value

One of the respective BB7 copula classes (BB7Copula, surBB7Copula, r90BB7Copula, r270BB7Copula).

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also `BB6Copula()`, `BB7Copula()`, `BB8Copula()` and `joeBiCopula()` for further wrapper functions to the VineCopula::VineCopula-package.

Examples

```
library(copula)

persp(BB7Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(surBB7Copula(c(1, 1.5)), dCopula, zlim = c(0, 10))
persp(r90BB7Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
persp(r270BB7Copula(c(-1, -1.5)), dCopula, zlim = c(0, 10))
```

BB7Copula-class *BB7 copula models*

Description

Wrapper classes representing the BB7, survival BB7, 90 degree and 270 degree rotated BB7 copula families (Joe 1997) from VineCopula::VineCopula-package.

Objects from the Classes

Objects can be created by calls of the form `new("BB7Copula", ...)`, `new("surBB7Copula", ...)`, `new("r90BB7Copula", ...)` and `new("r270BB7Copula", ...)` or by the functions `BB7Copula()`, `surBB7Copula()`, `r90BB7Copula()` and `r270BB7Copula()`.

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also BB7Copula, BB7Copula, BB8Copula and joeBiCopula for further wrapper classes to the VineCopula::VineCopula-package.

Examples

```
showClass("BB7Copula")
```

`BB8Copula` *Constructors for BB8 copulas*

Description

Constructs an object of the BB8Copula (survival `sur`, 90 degree rotated `r90` and 270 degree rotated `r270`) family for given parameters.

Usage

```
BB8Copula(param = c(1, 1))

surBB8Copula(param = c(1, 1))

r90BB8Copula(param = c(-1, -1))

r270BB8Copula(param = c(-1, -1))
```

Arguments

`param`	The parameter `param` defines the copula through `theta` and `delta`.

Value

One of the respective BB8 copula classes (BB8Copula, surBB8Copula, r90BB8Copula, r270BB8Copula).

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also `BB6Copula()`, `BB7Copula()`, `BB8Copula()` and `joeBiCopula()` for further wrapper functions to the VineCopula::VineCopula-package.

Examples

```
library(copula)

persp(BB8Copula(c(2, 0.9)), dCopula, zlim = c(0, 10))
persp(surBB8Copula(c(2, 0.9)), dCopula, zlim = c(0, 10))
persp(r90BB8Copula(c(-2, -0.9)), dCopula, zlim = c(0, 10))
persp(r270BB8Copula(c(-2, -0.9)), dCopula, zlim = c(0, 10))
```

BB8Copula-class *BB8 copula models*

Description

Wrapper classes representing the BB8, survival BB8, 90 degree and 270 degree rotated BB8 copula families (Joe 1997) from VineCopula::VineCopula-package.

Objects from the Classes

Objects can be created by calls of the form `new("BB8Copula", ...)`, `new("surBB8Copula", ...)`, `new("r90BB8Copula", ...)` and `new("r270BB8Copula", ...)` or by the functions `BB8Copula()`, `surBB8Copula()`, `r90BB8Copula()` and `r270BB8Copula()`.

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also BB8Copula, BB8Copula, BB8Copula and joeBiCopula for further wrapper classes to the VineCopula::VineCopula-package.

Examples

```
showClass("BB8Copula")
```

BiCop2copula *Construction of a Copula Object from a VineCopula Family Index*

Description

A VineCopula family index along with its parameters is used to construct a corresponding copula::copula object.

Usage

```
BiCop2copula(family, par, par2 = 0, obj = NULL)

copulaFromFamilyIndex(family, par, par2 = 0)
```

Arguments

family	a family index as defined in VineCopula::VineCopula-package.
par	first parameter.
par2	second parameter.
obj	VineCopula::BiCop() object containing the family and parameter specification.

Details

If the family and parameter specification is stored in a [VineCopula::BiCop()] object obj, the alternative version

```
BiCop2copula(u1, u2, obj)
```

can be used.

Value

An object inheriting copula::copula corresponding to the specific family.

Examples

```
# normalCopula with parameter 0.5
BiCop2copula(1, 0.5)

# rotated Tawn T2 copula
BiCop2copula(224, -2, 0.5)
```

---

ddCopula *Partial Derivatives of Copulas*

Description

Similar to copula::dCopula and copula::pCopula the function dduCopula evaluates the partial derivative $\frac{\partial}{\partial u}C(u,v)$ and the function ddvCopula evaluates the partial derivative $\frac{\partial}{\partial v}C(u,v)$ of the provided copula.

Usage

```
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,normalCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,normalCopula'
```

```
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,normalCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,normalCopula'
ddvCopula(u, copula, ...)

## S4 method for signature 'matrix,tCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,tCopula'
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,tCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,tCopula'
ddvCopula(u, copula, ...)

## S4 method for signature 'matrix,gumbelCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,gumbelCopula'
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,gumbelCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,gumbelCopula'
ddvCopula(u, copula, ...)

## S4 method for signature 'matrix,claytonCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,claytonCopula'
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,claytonCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,claytonCopula'
ddvCopula(u, copula, ...)

## S4 method for signature 'matrix,indepCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,indepCopula'
```

```
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,indepCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,indepCopula'
ddvCopula(u, copula, ...)

## S4 method for signature 'matrix,frankCopula'
dduCopula(u, copula)

## S4 method for signature 'numeric,frankCopula'
dduCopula(u, copula, ...)

## S4 method for signature 'matrix,frankCopula'
ddvCopula(u, copula)

## S4 method for signature 'numeric,frankCopula'
ddvCopula(u, copula, ...)
```

Arguments

u	Pairs of values for which the partial derivative should be evaluated.
copula	The copula object representing the family member of interest.
...	additional arguments can be passed on to the underlying functions.

Value

A vector of the evaluated partial derivatives of the same length as rows in u.

Examples

```
library(copula)

BB1Cop <- BB1Copula()
BB1CopSmpl <- rCopula(100, BB1Cop)

# conditional probabilities of a Gaussian copula given u
BB1GivenU <- dduCopula(BB1CopSmpl, BB1Cop)

# vs. conditional probabilities of a Gaussian copula given v
BB1GivenV <- ddvCopula(BB1CopSmpl[, c(2, 1)], BB1Cop)

plot(BB1GivenU, BB1GivenV)
abline(0, 1)
```

fitCopula *A dedicated method to use the estimation routines from the VineCopula package*

Description

Bivariate copulas are estimated based on BiCopEst and vine copulas through RVineStructureSelect or RVineCopSelect depending on the method argument.

Usage

```
BCfitCopula(copula, data, method = "ml")
```

Arguments

copula	an object of the desired copula class
data	a matrix holding the U(0,1) distributed data columns
method	for BIVARIATE copulas either "ml" or "itau" for maximum likelihood estimation or inverse tau estimation (for one parameter families) respectively. See BiCopEst for details. In case of a VINE copulas a list with names entries StructureSelect (default: FALSE), indeptest (default: FALSE), familyset (default: 'NA') and indeptest (default: FALSE). See RVineStructureSelect or RVineCopSelect for details.

Value

an object of class fitCopula as in the copula package.

Examples

```
u <- rCopula(1000, tawnT1Copula(c(3, 0.5)))

fitCopula(tawnT1Copula(), u)
```

joeBiCopula *Constructors for Joe copulas*

Description

Constructs an object of the (survival surJoeBiCopula, 90 degree rotated r90JoeBiCopula and 270 degree rotated r270JoeBiCopula) family for a given parameter. Note that package copula::copula-package() provides a class joeBiCopula as well.

Usage

```
joeBiCopula(param = 2)

surJoeBiCopula(param = 2)

r90JoeBiCopula(param = -2)

r270JoeBiCopula(param = -2)
```

Arguments

`param`	The parameter `param` defines the copula through `theta`.

Value

One of the respective Joe copula classes (joeBiCopula, surJoeBiCopula, r90JoeBiCopula, r270JoeBiCopula).

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also `BB1Copula()`, `BB6Copula()`, `BB7Copula()` and `BB8Copula()` for further wrapper functions to the VineCopula::VineCopula-package.

Examples

```
library(copula)

persp(surJoeBiCopula(1.5), dCopula, zlim = c(0, 10))
persp(r90JoeBiCopula(-1.5), dCopula, zlim = c(0, 10))
persp(r270JoeBiCopula(-1.5), dCopula, zlim = c(0, 10))
```

`joeBiCopula-class` *Joe copula models*

Description

Wrapper classes representing the bivariate Joe, survival Joe, 90 degree and 270 degree rotated Joe copula families (Joe 1997) from VineCopula::VineCopula-package. Note that package `copula::copula-package()` provides a class joeBiCopula as well.

Objects from the Classes

Objects can be created by calls of the form `new("joeBiCopula", ...)`, `new("surJoeBiCopula", ...)`, `new("r90JoeBiCopula", ...)` and `new("r270JoeBiCopula", ...)` or by the functions `joeBiCopula()`, `surJoeBiCopula()`, `r90JoeBiCopula()` and `r270JoeBiCopula()`.

References

Joe, H., (1997). Multivariate Models and Dependence Concepts. Monogra. Stat. Appl. Probab. 73, London: Chapman and Hall.

See Also

See also BB1Copula, BB6Copula, BB7Copula and BB8Copula for further wrapper classes to the VineCopula::VineCopula-package.

Examples

```
showClass("surJoeBiCopula")
```

`surClaytonCopula` *Constructors for survival and rotated Clayton Copulas*

Description

These are wrappers to functions from VineCopula::VineCopula-package

Usage

```
surClaytonCopula(param = 1)

r90ClaytonCopula(param = -1)

r270ClaytonCopula(param = -1)
```

Arguments

`param`	A single parameter defining the Copula.

Value

An object of class surClaytonCopula, r90ClaytonCopula or r270ClaytonCopula respectively.

Examples

```
library(copula)

persp(surClaytonCopula(1.5), dCopula, zlim = c(0, 10))
persp(r90ClaytonCopula(-1.5), dCopula, zlim = c(0, 10))
persp(r270ClaytonCopula(-1.5), dCopula, zlim = c(0, 10))
```

surClaytonCopula-class *Survival and rotated Clayton copula models*

Description

A class representing rotated versions of the Clayton copula family (survival, 90 and 270 degree rotated).

Objects from the Class

Objects can be created by calls of the form `new("surClaytonCopula", ...)`, `new("r90ClaytonCopula", ...)` and `new("r270ClaytonCopula", ...)` or by the function `surClaytonCopula()`, `r90ClaytonCopula()` and `r270ClaytonCopula()` respectively.

See Also

VineCopula::VineCopula-package

Examples

```
library(copula)

persp(surClaytonCopula(.5), dCopula, zlim = c(0, 10))
persp(r90ClaytonCopula(-.5), dCopula, zlim = c(0, 10))
persp(r270ClaytonCopula(-.5), dCopula, zlim = c(0, 10))
```

surGumbelCopula *Constructors for survival and rotated Gumbel Copulas*

Description

These are wrappers to functions from VineCopula::VineCopula-package

Usage

```
surGumbelCopula(param = 1)

r90GumbelCopula(param = -1)

r270GumbelCopula(param = -1)
```

Arguments

`param`	A single parameter defining the Copula.

Value

An object of class surGumbelCopula, r90GumbelCopula or r270GumbelCopula respectively.

Examples

```
library(copula)

persp(surGumbelCopula(1.5), dCopula, zlim = c(0, 10))
persp(r90GumbelCopula(-1.5), dCopula, zlim = c(0, 10))
persp(r270GumbelCopula(-1.5), dCopula, zlim = c(0, 10))
```

---

surGumbelCopula-class *Survival and rotated Gumbel copula models*

Description

A class representing rotated versions of the Gumbel copula family (survival, 90 and 270 degree rotated).

Objects from the Class

Objects can be created by calls of the form `new("surGumbelCopula", ...)`, `new("r90GumbelCopula", ...)` and `new("r270GumbelCopula", ...)` or by the function `surGumbelCopula()`, `r90GumbelCopula()` and `r270GumbelCopula()` respectively.

See Also

VineCopula::VineCopula-package

Examples

```
library(copula)

persp(surGumbelCopula(5), dCopula, zlim = c(0, 10))
persp(r90GumbelCopula(-5), dCopula, zlim = c(0, 10))
persp(r270GumbelCopula(-5), dCopula, zlim = c(0, 10))
```

tawnT1Copula *Constructor for Tawn copulas (type 1)*

Description

Constructs an object of the tawnT1Copula (survival sur, 90 degree rotated r90 and 270 degree rotated r270) family for given parameters.

Usage

```
tawnT1Copula(param = c(2, 0.5))

surTawnT1Copula(param = c(2, 0.5))

r90TawnT1Copula(param = c(-2, 0.5))

r270TawnT1Copula(param = c(-2, 0.5))
```

Arguments

param	The parameter param defines the copula through param1 and param2.

Value

One of the Tawn type 1 copula classes (tawnT1Copula, surTawnT1Copula, r90TawnT1Copula, r270TawnT1Copula).

See Also

tawnT1Copula() and the package VineCopula::VineCopula-package for implementation details.

Examples

```
library(copula)

persp(tawnT1Copula(), dCopula, zlim = c(0, 10))
persp(surTawnT1Copula(), dCopula, zlim = c(0, 10))
persp(r90TawnT1Copula(), dCopula, zlim = c(0, 10))
persp(r270TawnT1Copula(), dCopula, zlim = c(0, 10))
```

tawnT1Copula-class *Tawn copula models (type 1)*

Description

S4-class representation of the Tawn Copula family of type 1 and rotated versions there of.

Objects from the Class

Objects can be created by calls of the form `new("tawnT1Copula", ...)`, or through the explicit constructors `tawnT1Copula()`, `surTawnT1Copula()`, `r90TawnT1Copula()` and `r270TawnT1Copula()` respectively.

See Also

tawnT1Copula and the package VineCopula::VineCopula-package for implementation details.

Examples

```
showClass("tawnT1Copula")
```

tawnT2Copula *Constructor for Tawn copulas (type 2)*

Description

Constructs an object of the tawnT2Copula (survival `sur`, 90 degree rotated `r90` and 270 degree rotated `r270`) family for given parameters.

Usage

```
tawnT2Copula(param = c(2, 0.5))

surTawnT2Copula(param = c(2, 0.5))

r90TawnT2Copula(param = c(-2, 0.5))

r270TawnT2Copula(param = c(-2, 0.5))
```

Arguments

`param`	The parameter `param` defines the copula through `param1` and `param2`.

Value

One of the Tawn type 2 copula classes (tawnT2Copula, surTawnT2Copula, r90TawnT2Copula, r270TawnT2Copula).

See Also

tawnT2Copula() and the package VineCopula::VineCopula-package for implementation details.

Examples

```
library(copula)

persp(tawnT2Copula(), dCopula, zlim = c(0, 10))
persp(surTawnT2Copula(), dCopula, zlim = c(0, 10))
persp(r90TawnT2Copula(), dCopula, zlim = c(0, 10))
persp(r270TawnT2Copula(), dCopula, zlim = c(0, 10))
```

---

tawnT2Copula-class *Tawn copula models (type 2)*

Description

S4-class representation of the Tawn Copula family of type 2 and rotated versions there of.

Objects from the Class

Objects can be created by calls of the form new("tawnT2Copula", ...), or through the explicit constructors tawnT2Copula(), surTawnT2Copula(), r90TawnT2Copula() and r270TawnT2Copula() respectively.

See Also

tawnT2Copula and the package VineCopula::VineCopula-package for implementation details.

Examples

```
showClass("tawnT2Copula")
```

---

vineCopula *Constructor of the Class vineCopula.*

Description

Constructs an instance of the vineCopula class.

Usage

```
vineCopula(RVM, type = "CVine")
```

Arguments

RVM	An object of class RVineMatrix generated from RVineMatrix in the package VineCopula-package or an integer (e.g. 4L) defining the dimension (an independent Gaussian C-vine of this dimension will be constructed).
type	A predefined type if only the dimension is provided and ignored otherwise, the default is a canonical vine

Value

An instance of the vineCopula class.

Author(s)

Benedikt Graeler

References

Aas, K., C. Czado, A. Frigessi, and H. Bakken (2009). Pair-copula constructions of multiple dependence Insurance: Mathematics and Economics 44 (2), 182-198.

Examples

```
# a C-vine of independent copulas
vine <- vineCopula(4L, "CVine")

library(copula)
library(lattice)

cloud(V1 ~ V2 + V3, as.data.frame(rCopula(500, vine)))
```

---

vineCopula-class *Class* "vineCopula"

Description

A class representing vine copulas in a object oriented implementations. Many functions go back to the package VineCopula-package

Objects from the Class

Objects can be created by calls of the form new("vineCopula", ...) or through the function vineCopula.

Author(s)

Benedikt Graeler

References

Aas, K., C. Czado, A. Frigessi, and H. Bakken (2009). Pair-copula constructions of multiple dependence Insurance: Mathematics and Economics 44 (2), 182-198.

See Also

RVineMatrix.

Examples

```
showClass("vineCopula")
```

Index