

# Package ‘VC2copula’

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

**Version** 0.1.2

**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.

**License** GPL-3

**Encoding** UTF-8

**URL** <https://github.com/tnagler/VC2copula>

**BugReports** <https://github.com/tnagler/VC2copula/issues>

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BB1Copula	<i>Constructors for BB1 copulas</i>
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### 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 [joeCopula\(\)](#) for further wrapper functions to the [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-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 [joeCopula](#) for further wrapper classes to the [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 [joeCopula\(\)](#) for further wrapper functions to the [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	<i>BB6 copula models</i>
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---

### Description

Wrapper classes representing the BB6, survival BB6, 90 degree and 270 degree rotated BB6 copula families (Joe 1997) from [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 [joeCopula](#) for further wrapper classes to the [VineCopula-package\(\)](#).

### Examples

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

---

BB7Copula	<i>Constructors for BB7 copulas</i>
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---

### 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 [joeCopula\(\)](#) for further wrapper functions to the [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-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 [joeCopula](#) for further wrapper classes to the [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 [joeCopula\(\)](#) for further wrapper functions to the [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-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 [joeCopula](#) for further wrapper classes to the [VineCopula-package\(\)](#).

## Examples

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



**Description**

A VineCopula family index along with its parameters is used to construct a corresponding [copula](#) object.

**Usage**

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

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

**Arguments**

family	a family index as defined in <a href="#">VineCopula-package()</a> .
par	first parameter.
par2	second parameter.
obj	<a href="#">BiCop()</a> object containing the family and parameter specification.

**Details**

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

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

can be used.

**Value**

An object inheriting [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 `dCopula()` and `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, ...)
```

**Arguments**

<code>u</code>	Pairs of values for which the partial derivative should be evaluated.
<code>copula</code>	The copula object representing the family member of interest.
<code>...</code>	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	<i>A dedicated method to use the estimation routines from the VineCopula package</i>
-----------	--

---

### 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 <a href="#">BiCopEst</a> 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 <a href="#">RVineStructureSelect</a> or <a href="#">RVineCopSelect</a> 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	<i>Constructors for Joe copulas</i>
-------------	-------------------------------------

---

### 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-package\(\)](#) provides a class [joeCopula](#) 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-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-package\(\)](#). Note that package [copula-package\(\)](#) provides a class [joeCopula](#) 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-package\(\)](#).

## Examples

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

---

surClaytonCopula	<i>Constructors for survival and rotated Clayton Copulas</i>
------------------	--

---

## Description

These are wrappers to functions from [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-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-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-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	<i>Constructor for Tawn copulas (type 1)</i>
--------------	--

---

### 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-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	<i>Tawn copula models (type 1)</i>
--------------------	------------------------------------

---

**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-package()` for implementation details.

**Examples**

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

---

tawnT2Copula	<i>Constructor for Tawn copulas (type 2)</i>
--------------	--

---

**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-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	<i>Tawn copula models (type 2)</i>
--------------------	------------------------------------

---

**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-package\(\)](#) for implementation details.

**Examples**

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

---

vineCopula	<i>Constructor of the Class <a href="#">vineCopula</a>.</i>
------------	---

---

### Description

Constructs an instance of the [vineCopula](#) class.

### Usage

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

### Arguments

RVM	An object of class <code>RVineMatrix</code> generated from <a href="#">RVineMatrix</a> in the package <a href="#">VineCopula-package</a> 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	<i>Class "vineCopula"</i>
------------------	---------------------------

---

**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](#) from package [VineCopula-package](#)

**Examples**

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

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