

# PUcopula

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## Short introduction to the PUcopula R-package

In this short introduction it will be shown how to use the PUcopula package. The following examples are based on:

[1] Pfeifer, D., Mändle, A. & Ragulina, O., *New copulas based on general partitions-of-unity and their applications to risk management (part II). Dependence Modeling (2017), 246 – 255. <https://doi.org/10.1515/demo-2017-0014>*

### Install

So far the package *PUcopula* is not available on CRAN, but the development version can be installed from GitHub using the `install_github` function from the package *devtools*:

```
library(devtools)
install_github("amaendle/PUcopula")
```

### Load the package

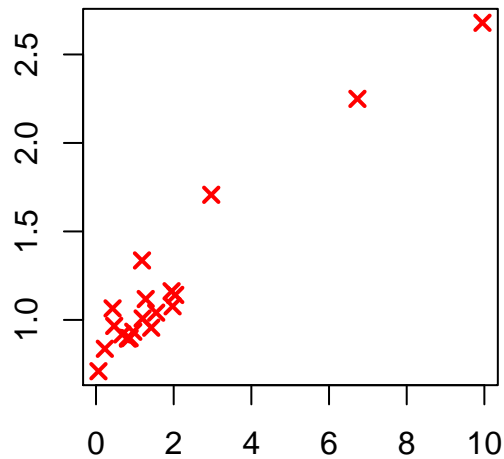
```
library(PUcopula)
```

In the following examples the data from the paper

[2] Cottin, C. & Pfeifer, D. (2014)., *From Bernstein polynomials to Bernstein copulas, Journal of Applied Functional Analysis (2014), 277 – 288*

are considered. The data can be accessed directly from the package:

```
data("stormflood")
# plot the data using R's plot function:
plot(stormflood, sub="Stormflood data from [2]", xlab="", ylab="", pch=4, col="red", lwd=2)
```



Stormflood data from [2]

### Example: The NB-copula

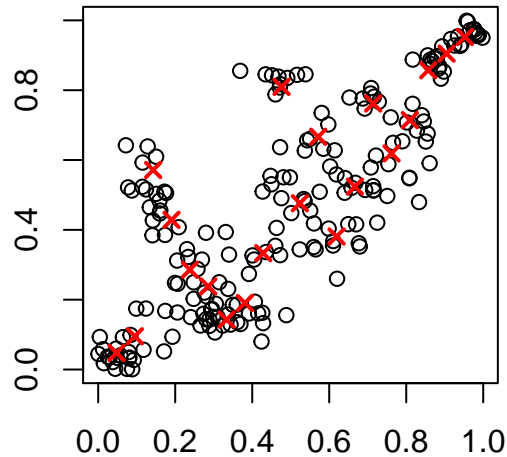
At first a copula model has to be created:

```
x <- PUCopula(family="nbinom", pars.a=c(40, 43), patch="lFrechet", data=stormflood)
```

This creates a copula model for a (asymmetric) NB-copula with parameters 40 and 43 with a lower Fréchet copula driver fitted to the stormflood data.

The above defined object can now be used to simulate from the above NB-copula model:

```
sampladata <- x@rand(200)
plot(sampladata, sub="Simulations using lower Fréchet driver", xlab="", ylab="")
points(x@relRanks, xlab="", ylab="", pch=4, col="red", lwd=2)
```



### Simulations using lower Fréchet driver

Negative binomial copulas (see Examples 2 and 5) can easily be simulated through the alternative representation formula (2) involving mixed Beta distributions here.

Poisson copulas can be simulated using the transformation  $z \mapsto 1 - e^{-z}$  applied to Gamma distributed random variables  $Z$  with a random shape parameter  $\alpha$  where  $\alpha - 1$  is generated by the geometric distribution shown in (7), and scale parameter  $1 + \gamma$ .

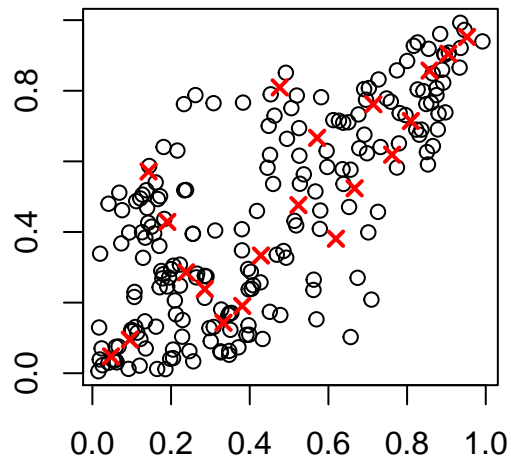
### Example: The Poisson-copula

Create the Poisson-copula model has to be created:

```
x <- PUCopula(family="poisson", pars.a=c(17, 17), patch="rook", data=stormflood)
```

Simulations with using a rook copula driver:

```
sampladata <- x@rand(200)
plot(sampladata, sub="Poisson copula with rook copula driver", xlab="", ylab="")
points(x@relRanks, xlab="", ylab="", pch=4, col="red", lwd=2)
```



Poisson copula with rook copula driver

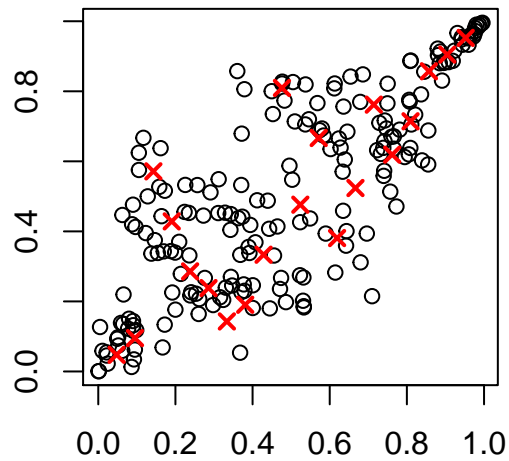
### Example: The Gamma-copula

At first a copula model has to be created:

```
x <- PUCopula(family="gamma", pars.a=c(15, 15), patch="uFrechet", data=stormflood)
```

Simulations using an upper Fréchet copula driver:

```
sampladata <- x@rand(200)
plot(sampladata, sub="Gamma copula with upper Fréchet driver", xlab="", ylab="")
points(x@relRanks, xlab="", ylab="", pch=4, col="red", lwd=2)
```



Gamma copula with upper Fréchet driver

### Further help

The documentation of the package with further details is available via:

```
help("PUCopula")
```

Consider that the package is under development. Some of the functions included in the package might not work as expected. For further questions regarding the package contact [maendle@uni-bremen.de](mailto:maendle@uni-bremen.de).