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] New copulas based on general partitions-of-unity and their applications to risk management (part II) (with A. Mändle and O. Ragulina). 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*:

```r
# uncomment the following to install:
#library(devtools)
#install_github("amaendle/PUcopula")
```

Load the package

```r
library(PUcopula)
```

In the following examples the data from the paper

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

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

```r
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)
```
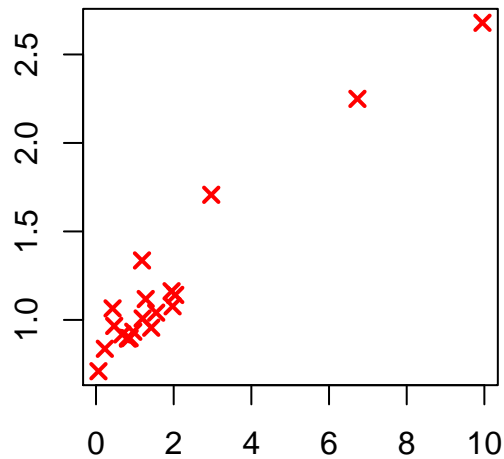
Stormflood data from [2]

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 stromflood data.

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

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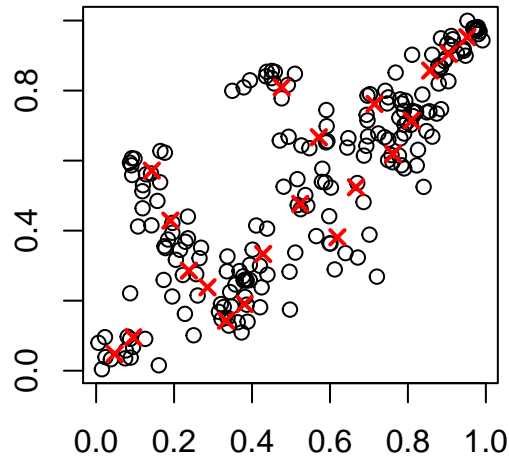
Simulations using lower Fréchet driver

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 α where $\alpha - 1$ is generated by the geometric distribution shown in (7), and scale parameter $1 + \gamma$.
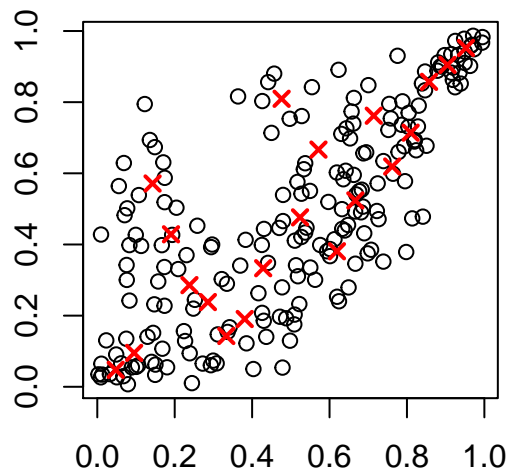
Example: The Poisson-copula

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:

```
sampledata <- x@rand(200)
plot(sampledata, 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:

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

Simulations using an upper Fréchet copula driver:

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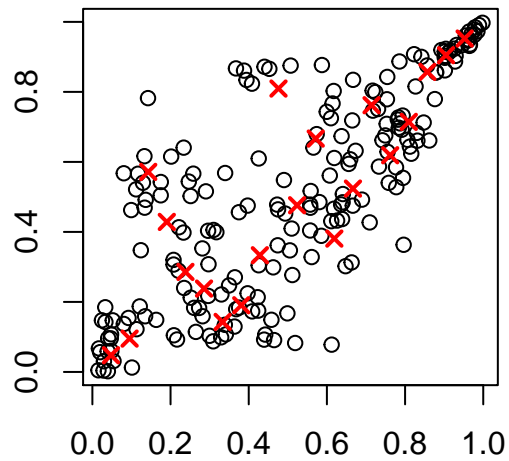
Gamma copula with upper Fréchet driver

Further help

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

```r
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.