

# Package ‘BivarP’

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**Type** Package

**Title** Estimating the Parameters of Some Bivariate Distributions

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**Description** Parameter estimation of bivariate distribution functions modeled as a Archimedean copula function. The input data may contain values from right censored. Used marginal distributions are two-parameter. Methods for density, distribution, survival, random sample generation.

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BivarP-package

*Estimating the Parameters of Some Bivariate Distributions*

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### Description

Parameter estimation of bivariate distribution functions modeled as a Archimedean copula function. The input data may contain values from right censored. Used marginal distributions are two-parameter. Methods for density, distribution, survival, random sample generation.

### Details

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License: GPL (>= 3)

### Author(s)

Josef Brejcha

Maintainer: Josef Brejcha <brchjo@gmail.com>

### References

M. Mahfoud, "Bivariate Archimedean copulas: an application to two stock market indices", *Vrije Universiteit Amsterdam, BMI Paper*, Amsterdam-2012, [https://www.few.vu.nl/en/Images/werkstuk-mahfoud\\_tcm39-277460.pdf](https://www.few.vu.nl/en/Images/werkstuk-mahfoud_tcm39-277460.pdf)

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BiCopGen

*Random sample generation of variables X and Y marginal distributions for the Archimedean copula*

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### Description

Generates a random sample of variables X and Y of the marginal distribution for the Archimedean copula. X and Y are of the same size and can be censored.

### Usage

```
BiCopGen(x, rodiny = c("weibull", "weibull"), rodina = "gumbel", No,  
cens = TRUE, bicens = TRUE, digi = 0)
```

**Arguments**

x	vector of these parameters: x[1], x[3] shape ("weibull" or "gamma") or mean ("norm") or meanlog ("log-normal") x[2], x[4] scale ("weibull" or "gamma") or sd ("norm") or sdlog ("lognormal") x[5] copula parameter
rodiny	vector of length 2 of names of the marginal distributions. Distributions can be "weibull", "gamma", "norm", "lnorm". "norm" is the name for the Normal distribution. "lnorm" is the name for the Lognormal distribution.
rodina	copula family. Currently supported families are "gumbel", "clayton" and "frank".
No	sample size
cens	cens = TRUE ... censored sample
bicens	if both bicens and cens are TRUE, both X and Y are censored. If cens is TRUE and bicens is FALSE, one of the X or Y can be uncensored
digi	number of decimal places in the output X and Y

**Details**

Random censoring using distribution function having the same specifications as the original uncensored distribution.

**Value**

A list with the following components:

X, Y	vectors sizes of No and having digi number of decimal places.
dX	vector size of No and consisting of 0 or 1. If X[i] is censored, dX[i] = 0.
dY	Vector size of No and consisting of 0 or 1. If Y[i] is censored, dY[i] = 0.

**Author(s)**

Josef Brejcha

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BiVarEst	<i>Estimation of the parameters of the bivariate distribution function of the Archimedean copula family.</i>
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**Description**

Estimation the parameters of the bivariate distribution function of the Archimedean copula family.

**Usage**

```
BiVarEst(Z, kopule = "gumbel", rodiny = c("weibull", "weibull"))
```

**Arguments**

Z	data frame with these columns: Z[, 1:2] are numeric vectors. Z[, 3] is an integer vector consisting of 0 or 1. $Z[i, 3] = 0$ , if $Z[i, 1]$ is censored. Z[, 4] is an integer vector consisting of 0 or 1. $Z[i, 4] = 0$ , if $Z[i, 2]$ is censored.
kopule	a character string specifying the family of an Archimedean copula. Currently supported families are "gumbel", "clayton" and "frank".
rodiny	vector of length 2 of names of the marginal distributions. Names can be "weibull", "gamma", "norm" and "lnorm". "norm" is the name for the Normal distribution. "lnorm" is the name for the Lognormal distribution.

**Details**

The Weibull ("weibull") and the Gamma ("gamma") distributions have parameters `shape` and `scale`. The Normal ("norm") distribution has parameters `mean` and `sd`. The Lognormal ("lnorm") distribution has parameters `meanlog` and `sdlog`.

**Value**

A list with the following components:

par	best estimate of the parameter vector found by the <code>nmkb</code> function.
value	value of the likelihood at termination.
feval	number of times the likelihood was evaluated.
restarts	number of times the algorithm had to be restarted when it stagnated.
convergence	an integer code indicating type of convergence. 0 indicates successful convergence. Positive integer codes indicate failure to converge.
message	a text message indicating the type of convergence or failure.

**Note**

Vector `par` has the structure:  
`par[1:2]` are parameters of the first marginal distribution.  
`par[3:4]` are parameters of the second marginal distribution.  
`par[5]` is the parameter of the copula.

**Author(s)**

Josef Brejcha

**Examples**

```
rodinka <- c("weibull", "norm")
kopule <- "frank"
xweib <- c(1.75, 145, 1.30, 80, 3.5)
BcG <- BiCopGen(x = xweib, rodiny = rodinka, rodina = kopule, No=30,
```

```

cens = TRUE, bicens = FALSE, digi = 2)
Nxyd <- data.frame(X=BcG$X, Y=BcG$Y, dX=BcG$dX, dY=BcG$dY)
Bivar <- BiVarEst(Nxyd, kopule = kopule, rodiny = rodinka)
Bivar
plot(Nxyd$Y, Nxyd$X, type="n", xlab="Y", ylab="X",
xlim=c(min(0, min(Nxyd$Y)), max(Nxyd$Y)),
ylim=c(min(0, min(Nxyd$X)),max(Nxyd$X)))
points(Nxyd$Y, Nxyd$X, col=ifelse(Nxyd$dX==1 & Nxyd$dY==1, "black",
ifelse(Nxyd$dX==0 & Nxyd$dY==1, "red", ifelse(Nxyd$dX==1 & Nxyd$dY==0,
"blue", "green"))), pch=20)
legend("topleft",c("dX, dY","1,1", "0,1", "1,0", "0,0"),
text.col=c("black", "black", "red", "blue", "green"), bty = "n")
grid(col = "grey50")

```

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dibivar

*Probability distribution function values based the Archimedean copula*


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### Description

Computes the probability distribution function values based the Archimedean copula on the grid of x and y vectors.

### Usage

```
dibivar(x, y, par, afa, rodina, fam)
```

### Arguments

x	numeric vector
y	numeric vector
par	vector of this values: par[1], par[3] are shape for the Weibull and the Gamma distributions or mean for the Normal distribution or meanlog for the Lognormal ditribution. par[2], par[4] are scale for the Weibull and the Gamma distributions or sd for the Normal distribution or sdlog for the Lognormal ditribution.
afa	copula parameter
rodina	vector of length 2 of names of the marginal distributions. Distributions can be "weibull", "gamma", "norm", "lnorm". "norm" is the name for the Normal distribution. "lnorm" is the name for the Lognormal distribution.
fam	name of copula. It can be "gumbel", "clayton", "frank".

### Value

Returns an array of values of the probability distribution function.

### Author(s)

Josef Brejcha

**Examples**

```
x <- seq(0, 100, 5)
y <- seq(0, 100, 4)
pxy <- dibivar(x, y, c(1.5, 50, 1.3, 50), 5, c("weibull", "weibull"), "gumbel")
colnames(pxy) <- x
rownames(pxy) <- y
contour(y, x, pxy, xlab="y", ylab="x")
```

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gammafit

*Estimation of parameters of the Gamma distribution*


---

**Description**

Likelihood estimation of parameters of the Gamma distribution. Data can be right censored.

**Usage**

```
gammafit(time, event)
```

**Arguments**

time	numeric vector. For right censored data, this is the follow up time.
event	status indicator vector, 0=alive, 1=dead.

**Value**

A list with the following components:

par	best estimate of parameter vector c(shape, scale)
value	value of the likelihood at termination.
feval	number of times the likelihood was evaluated.
restarts	number of times the algorithm had to be restarted when it stagnated.
convergence	an integer code indicating type of convergence. 0 indicates successful convergence. Positive integer codes indicate failure to converge.
message	a text message indicating the type of convergence or failure.

**Author(s)**

Josef Breycha

**Examples**

```
n <- 30
t <- rgamma(n, shape=2, scale=100)
ev <- round(runif(n), 0)
gammafit(t, ev)
```

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pibivar

*The CDF values based the Archimedean copula*

---

### Description

Computes the cumulative distribution function values based the Archimedean copula on the grid of x and y vectors.

### Usage

```
pibivar(x, y, par, afa, rodina, fam)
```

### Arguments

x	numeric vector
y	numeric vector
par	vector of this values: par[1], par[3] are shape for the Weibull and the Gamma distributions or mean for the Normal distribution or meanlog for the Lognormal ditribution. par[2], par[4] are scale for the Weibull and the Gamma distributions or sd for the Normal distribution or sdlog for the Lognormal ditribution.
afa	copula parameter
rodina	vector of length 2 of names of the marginal distributions. Distributions can be "weibull", "gamma", "norm", "lnorm". "norm" is the name for the Normal distribution. "lnorm" is the name for the Lognormal distribution.
fam	name of copula. It can be "gumbel", "clayton", "frank".

### Value

Returns an array of values of the cumulative distribution function.

### Author(s)

Josef Brejcha

### Examples

```
x <- seq(0, 100, 5)
y <- seq(0, 100, 4)
Fxy <- pibivar(x, y, c(1.5, 50, 1.3, 50), 5, c("weibull", "weibull"), "gumbel")
colnames(Fxy) <- x
rownames(Fxy) <- y
contour(y, x, Fxy, xlab="y", ylab="x")
```

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subivar

*Survival function values based the Archimedean copula*


---

**Description**

Computes the survival function values based the Archimedean copula on the grid of x and y vectors.

**Usage**

```
subivar(x, y, par, afa, rodina, fam)
```

**Arguments**

x	numeric vector
y	numeric vector
par	vector of this values: par[1], par[3] are shape for the Weibull and the Gamma distributions or mean for the Normal distribution or meanlog for the Lognormal ditribution. par[2], par[4] are scale for the Weibull and the Gamma distributions or sd for the Normal distribution or sdlog for the Lognormal ditribution.
afa	copula parameter
rodina	vector of length 2 of names of the marginal distributions. Distributions can be "weibull", "gamma", "norm", "lnorm". "norm" is the name for the Normal distribution. "lnorm" is the name for the Lognormal distribution.
fam	name of copula. It can be "gumbel", "clayton", "frank".

**Value**

Returns an array of values of the survival function.

**Author(s)**

Josef Brejcha

**Examples**

```
x <- seq(0, 100, 5)
y <- seq(0, 100, 4)
Sxy <- subivar(x, y, c(1.5, 50, 1.3, 50), 5, c("weibull", "weibull"), "gumbel")
colnames(Sxy) <- x
rownames(Sxy) <- y
contour(y, x, Sxy, xlab="y", ylab="x")
```



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