Package 'Copula.surv'

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Copul	surv-package Analysis of Bivariate Survival Data

Description

Simulating bivariate survival data from copula models (Emura et al. 2019). Estimation of the association parameter in copula models. Two different ways to estimate the association parameter in copula models are implemented. A goodness-of-fit test for a given copula model is implemented. See Emura, Lin and Wang (2010) <doi:10.1016/j.csda.2010.03.013> for details. Also, Weibull regression is implemented (Section 2.6.3 of Emura et al. (2019)).

Details

Details are seen from the references.

Author(s)

Takeshi Emura Maintainer: Takeshi Emura <takeshi emura@gmail.com>

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Simulating data from the BB1 copt	31	simu.BB1

Description

n pairs of (U,V) are generated from the BB1 copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

simu.BB1

Usage

```
simu.BB1(n,alpha,d=0,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
d	BB1 copula's departure parameter from the Clayton (d=0 is the default)
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

U	uniformly distributed on (0,1)
٧	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.BB1(n=n,alpha=1,d=2,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

4 simu.CC

simu.CC	Simulating data from the Celebioglu-Cuadras (CC) copula

Description

n pairs of (U,V) are generated from the CC copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.CC(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter, -1<=alpha<=1
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

U	uniformly distributed on (0,1)
٧	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

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Examples

```
n=100
Dat=simu.CC(n=n,alpha=-1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.Clayton

Simulating data from the Clayton copula

Description

n pairs of (U,V) are generated from the Clayton copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.Clayton(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

```
U uniformly distributed on (0,1)
V uniformly distributed on (0,1)
X Weibull distributed (scale1, shape1)
Y Weibull distributed (scale2, shape2)
```

Author(s)

Takeshi Emura

6 simu.FGM

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.Clayton(n=n,alpha=1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.FGM

Simulating data from the FGM copula

Description

n pairs of (U,V) are generated from the FGM copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.FGM(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter; -1<=alpha<=1
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

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Value

U	uniformly distributed on $(0,1)$
V	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.FGM(n=n,alpha=1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.Frank

Simulating data from the Frank copula

Description

n pairs of (U,V) are generated from the Frank copula. n pairs of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.Frank(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

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Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

U	uniformly distributed on (0,1)
V	uniformly distributed on (0,1)
X	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.Frank(n=n,alpha=10,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.GB

Simulating data from the Gumbel-Barnett (GB) copula

Description

n pairs of (U,V) are generated from the GB copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.GB(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

simu.GB

Arguments

n	sample size
alpha	association (copula) parameter, 0<=alpha<=1
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

U	uniformly distributed on (0,1)
V	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.GB(n=n,alpha=1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

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Stilla. Guilloet Simulating data from the Gumbet copula	simu.Gumbel	Simulating data from the Gumbel copula	
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Description

n pairs of (U,V) are generated from the Gumbel copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.Gumbel(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

U	uniformly distributed on (0,1)
V	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

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Examples

```
n=100
Dat=simu.Gumbel(n=n,alpha=1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.Joe

Simulating data from the Joe copula

Description

n pairs of (U,V) are generated from the Joe copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.Joe(n,alpha,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

Value

```
    U uniformly distributed on (0,1)
    V uniformly distributed on (0,1)
    X Weibull distributed (scale1, shape1)
    Y Weibull distributed (scale2, shape2)
```

Author(s)

Takeshi Emura

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References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.Joe(n=n,alpha=1,scale1=1,scale2=2,shape1=0.5,shape2=2)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

simu.t

Simulating data from the t-copula

Description

n pairs of (U,V) are generated from the t-copula. n paris of (X,Y) are generated from the corresponding bivariate survival model with the Weibull marginal distributions. The default parameters (scale1=scale2=shape1=shape2=1) give the unit exponential distributions.

Usage

```
simu.t(n,alpha,df=1,scale1=1,scale2=1,shape1=1,shape2=1,Print=FALSE)
```

Arguments

n	sample size
alpha	association (copula) parameter
df	degrees of freedom (d=1 is the default)
scale1	scale parameter for X
scale2	scale parameter for Y
shape1	shape parameter for X
shape2	shape parameter for Y
Print	print Kendall's tau and means of X and Y if "TRUE"

Details

See Section 2.6 of Emura et al.(2019) for copulas and bivariate survival times.

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Value

U	uniformly distributed on $(0,1)$
٧	uniformly distributed on (0,1)
Χ	Weibull distributed (scale1, shape1)
Υ	Weibull distributed (scale2, shape2)

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

```
n=100
Dat=simu.t(n=n,alpha=0.8,df=1,scale1=1,scale2=2,shape1=0.5,shape2=2,Print=TRUE)
plot(Dat[,"U"],Dat[,"V"])
cor(Dat[,"U"],Dat[,"V"],method="kendall")
plot(Dat[,"X"],Dat[,"Y"])
cor(Dat[,"X"],Dat[,"Y"],method="kendall")
```

Test.Clayton

A goodness-of-fit test for the Clayton copula

Description

Perform a goodness-of-fit test for the Clayton copula based on Emura, Lin and Wang (2010). The test is asymptotically equivalent to the test of Shih (1998).

Usage

```
Test.Clayton(x.obs,y.obs,dx,dy,lower=0.001,upper=50,U.plot=TRUE)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y

lower lower bound for the association parameter upper upper bound for the association parameter U.plot if TRUE, draw the plot of U_1(theta)

Test.Clayton

Details

See the references.

Value

theta1 association parameter by the pseudo-likelihood estimator
theta2 association parameter by the unweighted estimator
Stat log(theta1)-log(theta2)

Z -value of the goodness-of-fit for the Clayton copula

P -value of the goodness-of-fit for the Clayton copula

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Shih JH (1998) A goodness-of-fit test for association in a bivariate survival model. Biometrika 85: 189-200

Examples

```
n=20
theta_true=2 ## association parameter ##
r1_true=2 ## hazard for X
r2_true=2 ## hazard for Y

set.seed(1)
V1=runif(n)
V2=runif(n)
X=-1/r1_true*log(1-V1)
W=(1-V1)^(-theta_true)
Y=1/theta_true/r2_true*log( 1-W+W*(1-V2)^(-theta_true/(theta_true+1)) )
C=runif(n,min=0,max=5)

x.obs=pmin(X,C)
y.obs=pmin(Y,C)
dx=X<=C
dy=Y<=C</pre>
Test.Clayton(x.obs,y.obs,dx,dy)
```

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Test.Gumbel A goodness-of-fit test for the Gumbel copula
--

Description

Perform a goodness-of-fit test for the Gumbel copula based on Emura, Lin and Wang (2010).

Usage

```
Test.Gumbel(x.obs,y.obs,dx,dy,lower=0.01,upper=50,U.plot=TRUE)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y
lower	lower bound for the association parameter
upper	upper bound for the association parameter
U.plot	if TRUE, draw the plot of U_1(theta) and U_2(theta)

Details

See the references.

Value

theta1	association parameter by the pseudo-likelihood estimator
theta2	association parameter by the unweighted estimator
Stat	log(theta1)-log(theta2)
Z	Z-value of the goodness-of-fit for the Clayton copula
Р	P-value of the goodness-of-fit for the Clayton copula

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

U1.Clayton

Examples

```
 \begin{array}{l} \text{x.obs=c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)} \\ \text{y.obs=c(2,1,4,5,6,8,3,7,10,9,11,12,13,14,15)} \\ \text{dx=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1)} \\ \text{dy=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)} \\ \text{Test.Gumbel(x.obs,y.obs,dx,dy)} \end{array}
```

U1.Clayton

Estimation of an association parameter via the pseudo-likelihood

Description

Estimate the association parameter of the Clayton copula using bivariate survival data. The estimator was derived by Clayton (1978) and reformulated by Emura, Lin and Wang (2010).

Usage

```
U1.Clayton(x.obs,y.obs,dx,dy,lower=0.001,upper=50,U.plot=TRUE)
```

Arguments

x.obs

y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y
lower	lower bound for the association parameter
upper	upper bound for the association parameter
U.plot	if TRUE, draw the plot of U_1(theta)

censored times for X

Details

Details are seen from the references.

Value

theta association parameter

tau Kendall's tau (=theta/(theta+2))

Author(s)

Takeshi Emura

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References

Clayton DG (1978). A model for association in bivariate life tables and its application to epidemiological studies of familial tendency in chronic disease incidence. Biometrika 65: 141-51.

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Examples

```
n=200
theta_true=2 ## association parameter ##
r1_true=1 ## hazard for X
r2_true=1 ## hazard for Y
set.seed(1)
V1=runif(n)
V2=runif(n)
X=-1/r1_true*log(1-V1)
W=(1-V1)^(-theta_true)
Y=1/theta_true/r2_true*log( 1-W+W*(1-V2)^(-theta_true/(theta_true+1)) )
C=runif(n,min=0,max=5)
x.obs=pmin(X,C)
y.obs=pmin(Y,C)
dx=X<=C
dy=Y<=C
U1.Clayton(x.obs,y.obs,dx,dy)
```

U1.Gumbel

Estimation of an association parameter via the unweighted estimator

Description

Estimate the association parameter of the Gumbel copula using bivariate survival data. The estimator was derived by Emura, Lin and Wang (2010).

Usage

```
U1.Gumbel(x.obs,y.obs,dx,dy,lower=0.01,upper=50,U.plot=TRUE)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y

U2.Clayton

lower	lower bound for the association parameter
upper	upper bound for the association parameter
U.plot	if TRUE, draw the plot of U_1(theta)

Details

Details are seen from the references.

Value

theta association parameter

tau Kendall's tau (=theta/(theta+2))

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Examples

```
 \begin{array}{l} \text{x.obs=c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)} \\ \text{y.obs=c(2,1,4,5,6,8,3,7,10,9,11,12,13,14,15)} \\ \text{dx=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1)} \\ \text{dy=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)} \\ \text{U1.Gumbel(x.obs,y.obs,dx,dy)} \end{array}
```

U2.Clayton

Estimation of an association parameter via the unweighted estimator

Description

Estimate the association parameter of the Clayton copula using bivariate survival data. The estimator was defined as the unweighted estimator in Emura, Lin and Wang (2010).

Usage

```
U2.Clayton(x.obs,y.obs,dx,dy)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y

U2.Gumbel

Details

Details are seen from the references.

Value

theta association parameter

tau Kendall's tau (=theta/(theta+2))

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Examples

```
n=200
theta_true=2 ## association parameter ##
r1_true=1 ## hazard for X
r2_true=1 ## hazard for Y
set.seed(1)
V1=runif(n)
V2=runif(n)
X=-1/r1_true*log(1-V1)
W=(1-V1)^(-theta_true)
Y=1/theta_true/r2_true*log( 1-W+W*(1-V2)^(-theta_true/(theta_true+1)) )
C=runif(n,min=0,max=5)
x.obs=pmin(X,C)
y.obs=pmin(Y,C)
dx=X<=C
dy=Y<=C
U2.Clayton(x.obs,y.obs,dx,dy)
```

U2.Gumbel

Estimation of an association parameter via the pseudo-likelihood

Description

Estimate the association parameter of the Gumbel copula using bivariate survival data. The estimator was derived by Emura, Lin and Wang (2010).

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Usage

```
U2.Gumbel(x.obs,y.obs,dx,dy,lower=0.01,upper=50,U.plot=TRUE)
```

Arguments

x.obs

y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y
lower	lower bound for the association parameter
upper	upper bound for the association parameter

censored times for X

U.plot if TRUE, draw the plot of U_1 (theta)

Details

Details are seen from the references.

Value

theta association parameter

tau Kendall's tau (=theta/(theta+1))

Author(s)

Takeshi Emura

References

Emura T, Lin CW, Wang W (2010) A goodness-of-fit test for Archimedean copula models in the presence of right censoring, Compt Stat Data Anal 54: 3033-43

Examples

```
x.obs=c(1,2,3,4,5)
y.obs=c(2,1,4,5,6)
dx=c(1,1,1,1,1)
dy=c(1,1,1,1,1)
U2.Gumbel(x.obs,y.obs,dx,dy)
```

Weib.reg.BB1 21

Weib.reg.BB1	Weibull regression under the BB1 copula
--------------	---

Description

See Section 2.6.3 of Emura et al. (2019).

Usage

```
Weib.reg.BB1(x.obs,y.obs,dx,dy,zx,zy,convergence.par=FALSE)
```

Arguments

x.obs	censored times for X	
y.obs	censored times for Y	
dx	censoring indicators for X	
dy	censoring indicators for Y	
zx	matrix of covariates for X	
zy	matrix of covariates for Y	
convergence.par		
	if TRUE, show the details	

Details

Details are seen from the references.

Value

```
regression coefficients for X
beta_x
                  regression coefficients for Y
beta_y
```

Author(s)

Takeshi Emura

References

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

Weib.reg.BB1.0

Weib.reg.BB1.0

Weibull regression under the BB1 copula with known "delta"

Description

See Section 2.6.3 of Emura et al. (2019).

Usage

```
Weib.reg.BB1.0(x.obs,y.obs,dx,dy,zx,zy,delta=0,convergence.par=FALSE)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y
zx	matrix of covariates for X
zy	matrix of covariates for Y
delta	known copula parameter (d>=0)
convergence.par	•
	if TRUE, show the details

Details

Details are seen from the references.

Value

beta_x regression coefficients for X beta_y regression coefficients for Y

Author(s)

Takeshi Emura

References

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

Weib.reg.Clayton 23

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Weibull regression under the Clayton copula

Description

See Section 2.6.3 of Emura et al. (2019).

Usage

```
Weib.reg.Clayton(x.obs,y.obs,dx,dy,zx,zy,convergence.par=FALSE)
```

Arguments

x.obs	censored times for X	
y.obs	censored times for Y	
dx	censoring indicators for X	
dy	censoring indicators for Y	
zx	matrix of covariates for X	
zy	matrix of covariates for Y	
convergence.par		
	if TRUE, show the details	

Details

Details are seen from the references.

Value

```
beta_x regression coefficients for X
beta_y regression coefficients for Y
```

Author(s)

Takeshi Emura

References

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

Examples

24 Weib.reg.Gumbel

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Weibull regression under the Gumbel copula

Description

See Section 2.6.3 of Emura et al. (2019).

Usage

```
Weib.reg.Gumbel(x.obs,y.obs,dx,dy,zx,zy,convergence.par=FALSE)
```

Arguments

x.obs	censored times for X
y.obs	censored times for Y
dx	censoring indicators for X
dy	censoring indicators for Y
ZX	matrix of covariates for X
zy	matrix of covariates for Y
convergence.par	
	if TRUE show the details

if TRUE, show the details

Details

Details are seen from the references.

Value

```
regression coefficients for X
beta_x
                  regression coefficients for Y
beta_y
```

Author(s)

Takeshi Emura

References

Emura T, Matsui S, Rondeau V (2019), Survival Analysis with Correlated Endpoints, Joint Frailty-Copula Models, JSS Research Series in Statistics, Springer

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