Package: Copula.Markov.survival (via r-universe)

October 21, 2024

Type Package

Title Copula Markov Model with Dependent Censoring

Version 1.0.0

Author Xin-Wei Huang, Takeshi Emura

Maintainer Xin-Wei Huang <xinweihuang@hotmail.com>

Description Perform likelihood estimation and corresponding analysis under the copula-based Markov chain model for serially dependent event times with a dependent terminal event. Available are statistical methods in Huang, Wang and Emura (2020, JJSD accepted).

License GPL-3

Depends survival

Imports stats, graphics

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

NeedsCompilation no

Date/Publication 2020-07-20 09:12:18 UTC

Repository https://xinweihuang-stat.r-universe.dev

RemoteUrl https://github.com/cran/Copula.Markov.survival

RemoteRef HEAD

RemoteSha 06efa665f89dacb08289843841a978e2ef9ce85a

Contents

ClaytonClayton.Weibull.data 2
ClaytonClayton.Weibull.MLE 3
ClaytonFrank.Weibull.data 5

ClaytonFrank.Weibull.MLE 6
Copula.Markov.survival 8
FrankClayton.Weibull.data 9
FrankClayton.Weibull.MLE 10
FrankFrank.Weibull.data 12
FrankFrank.Weibull.MLE 13

Index **15**

`ClaytonClayton.Weibull.data`

Generate data from the Clayton copula for serial dependence and the Clayton copula for dependent censoring with the Weibull distributions

---

Description

The data generation process is based on the Clayton copula C_theta for serial dependence and the Clayton copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). Censoring percentage can be controlled by constant b. This function is used when doing parametric bootstrap. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
ClaytonClayton.Weibull.data(N, scale1, shape1, theta, scale2, shape2, alpha,  b, l)
```

Arguments

`N`	sample size
`scale1`	scale parameter for Weib(scale1, shape1), scale1 > 0
`shape1`	shape parameter for Weib(scale1, shape1), shape1 > 0
`theta`	copula parameter for C_theta, theta > 0
`scale2`	scale parameter for Weib(scale2, shape2), scale2 > 0
`shape2`	shape parameter for Weib(scale2, shape2), shape2 > 0
`alpha`	copula parameter for tilde(C)_alpha, alpha > 0
`b`	parameter of Unif(0, b) for controlling censoring percentage
`l`	length for data generation (default = 300)

Value

A list with the following elements:

`Subject`	a vector for numbers of subject
`T_ij`	a vector for event times
`delta_ij`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`T_i_star`	a vector for death times
`delta_i_star`	a vector for death indicator (=1 if death; =0 if censoring)

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
Y = ClaytonClayton.Weibull.data(N = 100, scale1 = 1, shape1 =0.5, theta = 2,
                                scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)
```

ClaytonClayton.Weibull.MLE
Parameter estimation based on the Clayton copula for serial dependence and the Clayton copula for dependent censoring with the Weibull distributions

---

Description

Perform two-stage estimation based on the Clayton copula C_theta for serial dependence and the Clayton copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). The jackknife method estimates the asymptotic covariance matrix. Parametric bootstrap is applied while doing Kolmogorov-Smirnov tests and Cramer-von Mises test. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
ClaytonClayton.Weibull.MLE(subject, t.event, event, t.death, death, stageI, Weibull.plot,
                           jackknife, plot, GOF, GOF.plot, rep.GOF, digit)
```

Arguments

`subject`	a vector for numbers of subject
`t.event`	a vector for event times
`event`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`t.death`	a vector for death times
`death`	a vector for death indicator (=1 if death; =0 if censoring)
`stageI`	an option to select MLE or LSE method for the 1st-stage optimization
`Weibull.plot`	if TRUE, show the Weibull probability plot
`jackknife`	if TRUE, the jackknife method is used for estimate covariance matrix (default = TRUE)

plot	if TRUE, the plots for marginal distributions are shown (default = FALSE)
GOF	if TRUE, show the p-values for KS-test and CvM-test
GOF.plot	if TRUE, show the model diagnostic plot
rep.GOF	repetition number of parametric bootstrap
digit	accurate to some decimal places

Details

When jackknife=FALSE, the corresponding standard error and confidence interval values are shown as NA.

Value

A list with the following elements:

Sample_size	Sample size N
Case	Count for event occurences
scale1	Scale parameter for Weib(scale1, shape1)
shape1	Shape parameter for Weib(scale1, shape1)
scale2	Scale parameter for Weib(scale2, shape2)
shape2	Shape parameter for Weib(scale2, shape2)
theta	Copula parameter for the Clayton copula C_theta
alpha	Copula parameter for the Clayton copula tilde(C)_alpha
COV	Asymptotic covariance estimated by the jackknife method
KS	Kolmogorov-Smirnov test statistics
p.KS	P-values for Kolmogorov-Smirnov tests
CM	Cramer-von Mises test statistics
p.CM	P-values for Cramer-von Mises tests
Convergence	Convergence results for each stage
Jackknife_error	Count for error in jackknife repititions
Log_likelihood	Log-likelihood values

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
data = ClaytonClayton.Weibull.data(N = 30, scale1 = 1, shape1 =0.5, theta = 2,
                                  scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)

ClaytonClayton.Weibull.MLE(subject = data$Subject,
                           t.event = data$T_ij, event = data$delta_ij,
                           t.death = data$T_i_star, death = data$delta_i_star,
                           jackknife= TRUE, plot = TRUE)
```

ClaytonFrank.Weibull.data

Generate data from the Clayton copula for serial dependence and the Frank copula for dependent censoring with the Weibull distributions

---

Description

The data generation process is based on the Clayton copula C_theta for serial dependence and the Frank copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). Censoring percentage can be controlled by constant b. This function is used when doing parametric bootstrap. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
ClaytonFrank.Weibull.data(N, scale1, shape1, theta, scale2, shape2, alpha, b, l)
```

Arguments

`N`	sample size
`scale1`	scale parameter for Weib(scale1, shape1), scale1 > 0
`shape1`	shape parameter for Weib(scale1, shape1), shape1 > 0
`theta`	copula parameter for C_theta, theta > 0
`scale2`	scale parameter for Weib(scale2, shape2), scale2 > 0
`shape2`	shape parameter for Weib(scale2, shape2), shape2 > 0
`alpha`	copula parameter for tilde(C)_alpha, alpha $\neq 0$
`b`	parameter of Unif(0, b) for controlling censoring percentage
`l`	length for data generation (default = 300)

Value

A list with the following elements:

Subject	a vector for numbers of subject
T_ij	a vector for event times
delta_ij	a vector for event indicator (=1 if recurrent; =0 if censoring)
T_i_star	a vector for death times
delta_i_star	a vector for death indicator (=1 if death; =0 if censoring)

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
Y = ClaytonFrank.Weibull.data(N = 100, scale1 = 1, shape1 =0.5, theta = 2,
                              scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)
```

ClaytonFrank.Weibull.MLE

Parameter estimation based on the Clayton copula for serial dependence and the Frank copula for dependent censoring with the Weibull distributions

---

Description

Perform two-stage estimation based on the Clayton copula C_theta for serial dependence and the Frank copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). The jackknife method estimates the asymptotic covariance matrix. Parametric bootstrap is applied while doing Kolmogorov-Smirnov tests and Cramer-von Mises test. The guide for using this function shall be explained by Huang (2019) and Huang, Wang and Emura (2020).

Usage

```
ClaytonFrank.Weibull.MLE(subject, t.event, event, t.death, death, stageI, Weibull.plot,
                         jackknife, plot, GOF, GOF.plot, rep.GOF, digit)
```

Arguments

`subject`	a vector for numbers of subject
`t.event`	a vector for event times
`event`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`t.death`	a vector for death times
`death`	a vector for death indicator (=1 if death; =0 if censoring)
`stageI`	an option to select MLE or LSE method for the 1st-stage optimization
`Weibull.plot`	if TRUE, show the Weibull probability plot
`jackknife`	if TRUE, the jackknife method is used for estimate covariance matrix (default = TRUE)
`plot`	if TRUE, the plots for marginal distributions are shown (default = FALSE)
`GOF`	if TRUE, show the p-values for KS-test and CvM-test
`GOF.plot`	if TRUE, show the model diagnostic plot
`rep.GOF`	repetition number of parametric bootstrap
`digit`	accurate to some decimal places

Details

When jackknife=FALSE, the corresponding standard error and confidence interval values are shown as NA.

Value

A list with the following elements:

`Sample_size`	Sample size N
`Case`	Count for event occurences
`scale1`	Scale parameter for Weib(scale1, shape1)
`shape1`	Shape parameter for Weib(scale1, shape1)
`scale2`	Scale parameter for Weib(scale2, shape2)
`shape2`	Shape parameter for Weib(scale2, shape2)
`theta`	Copula parameter for the Clayton copula C_theta
`alpha`	Copula parameter for the Frank copula tilde(C)_alpha
`COV`	Asymptotic covariance estimated by the jackknife method
`KS`	Kolmogorov-Smirnov test statistics
`p.KS`	P-values for Kolmogorov-Smirnov tests
`CM`	Cramer-von Mises test statistics
`p.CM`	P-values for Cramer-von Mises tests
`Convergence`	Convergence results for each stage
`Jackknife_error`	Count for error in jackknife repititions
`Log_likelihood`	Log-likelihood values

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
data = ClaytonFrank.Weibull.data(N = 30, scale1 = 1, shape1 =0.5, theta = 2,
                                 scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)

ClaytonFrank.Weibull.MLE(subject = data$Subject,
                              t.event = data$T_ij, event = data$delta_ij,
                              t.death = data$T_i_star, death = data$delta_i_star,
                              jackknife= TRUE, plot = TRUE)
```

`Copula.Markov.survival`
Copula.Markov.survival

Description

Perform likelihood estimation and corresponding analysis under the copula-based Markov chain model for serially dependent event times with a dependent terminal event. A two stage estimation method is applied for estimating model parameters. Two copula functions are used for measuring dependence. One is used for modeling serial dependence in recurrent event times. The other one is for modeling dependent censoring. The baseline hazard functions are modeled by the Weibull distributions. See Huang (2019) <https://etd.lib.nctu.edu.tw/cgi-bin/gs32/ncugsweb.cgi?o=dncucdr&s=id=

Author(s)

Xinwei Huang <xinweihuang@hotmail.com>

References

Huang, X.-W. (2019). Likelihood-based inference for copula-based Markov chain models for continuous, discrete, and survival data. NCU library.

`FrankClayton.Weibull.data`

Generate data from the Frank copula for serial dependence and the Clayton copula for dependent censoring with the Weibull distributions

---

Description

The data generation process is based on the Frank copula C_theta for serial dependence and the Clayton copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). Censoring percentage can be controlled by constant c. This function is used when doing parametric bootstrap. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
FrankClayton.Weibull.data(N, scale1, shape1, theta, scale2, shape2, alpha, b, l)
```

Arguments

`N`	sample size
`scale1`	scale parameter for Weib(scale1, shape1), scale1 > 0
`shape1`	shape parameter for Weib(scale1, shape1), shape1 > 0
`theta`	copula parameter for C_theta, theta $\neq 0$
`scale2`	scale parameter for Weib(scale2, shape2), scale2 > 0
`shape2`	shape parameter for Weib(scale2, shape2), shape2 > 0
`alpha`	copula parameter for tilde(C)_alpha, alpha > 0
`b`	parameter of Unif(0, b) for controlling censoring percentage
`l`	length for data generation (default = 300)

Value

A list with the following elements:

`Subject`	a vector for numbers of subject
`T_ij`	a vector for event times
`delta_ij`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`T_i_star`	a vector for death times
`delta_i_star`	a vector for death indicator (=1 if death; =0 if censoring)

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
Y = FrankClayton.Weibull.data(N = 100, scale1 = 1, shape1 =0.5, theta = 2,
                              scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)
```

FrankClayton.Weibull.MLE

Parameter estimation based on the Frank copula for serial dependence and the Clayton copula for dependent censoring with the Weibull distributions

---

Description

Perform two-stage estimation based on the Frank copula C_theta for serial dependence and the Clayton copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). The jackknife method estimates the asymptotic covariance matrix. Parametric bootstrap is applied while doing Kolmogorov-Smirnov tests and Cramer-von Mises test. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
FrankClayton.Weibull.MLE(subject, t.event, event, t.death, death, stageI, Weibull.plot,
                         jackknife, plot, GOF, GOF.plot, rep.GOF, digit)
```

Arguments

`subject`	a vector for numbers of subject
`t.event`	a vector for event times
`event`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`t.death`	a vector for death times
`death`	a vector for death indicator (=1 if death; =0 if censoring)
`stageI`	an option to select MLE or LSE method for the 1st-stage optimization
`Weibull.plot`	if TRUE, show the Weibull probability plot
`jackknife`	if TRUE, the jackknife method is used for estimate covariance matrix (default = TRUE)
`plot`	if TRUE, the plots for marginal distributions are shown (default = FALSE)
`GOF`	if TRUE, show the p-values for KS-test and CvM-test
`GOF.plot`	if TRUE, show the model diagnostic plot
`rep.GOF`	repetition number of parametric bootstrap
`digit`	accurate to some decimal places

Details

When jackknife=FALSE, the corresponding standard error and confidence interval values are shown as NA.

Value

A list with the following elements:

`Sample_size`	Sample size N
`Case`	Count for event occurences
`scale1`	Scale parameter for Weib(scale1, shape1)
`shape1`	Shape parameter for Weib(scale1, shape1)
`scale2`	Scale parameter for Weib(scale2, shape2)
`shape2`	Shape parameter for Weib(scale2, shape2)
`theta`	Copula parameter for the Frank copula C_theta
`alpha`	Copula parameter for the Clayton copula tilde(C)_alpha
`COV`	Asymptotic covariance estimated by the jackknife method
`KS`	Kolmogorov-Smirnov test statistics
`p.KS`	P-values for Kolmogorov-Smirnov tests
`CM`	Cramer-von Mises test statistics
`p.CM`	P-values for Cramer-von Mises tests
`Convergence`	Convergence results for each stage
`Jackknife_error`	Count for error in jackknife repititions
`Log_likelihood`	Log-likelihood values

Author(s)

Xinwei Huang

Examples

```
data = FrankClayton.Weibull.data(N = 30, scale1 = 1, shape1 =0.5, theta = 2,
                                 scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)


FrankClayton.Weibull.MLE(subject = data$Subject,
                         t.event = data$T_ij, event = data$delta_ij,
                         t.death = data$T_i_star, death = data$delta_i_star,
                         jackknife= TRUE, plot = TRUE)
```

FrankFrank.Weibull.data   *Generate data from the Frank copula for serial dependence and the Frank copula for dependent censoring with the Weibull distributions*

Description

The data generation process is based on the Frank copula C_theta for serial dependence and the Frank copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). Censoring percentage can be controlled by constant c. This function is used when doing parametric bootstrap. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
FrankFrank.Weibull.data(N, scale1, shape1, theta, scale2, shape2, alpha, b, l)
```

Arguments

N	sample size
scale1	scale parameter for Weib(scale1, shape1), scale1 > 0
shape1	shape parameter for Weib(scale1, shape1), shape1 > 0
theta	copula parameter for C_theta, theta $\neq$ 0
scale2	scale parameter for Weib(scale2, shape2), scale2 > 0
shape2	shape parameter for Weib(scale2, shape2), shape2 > 0
alpha	copula parameter for tilde(C)_alpha, alpha $\neq$ 0
b	parameter of Unif(0, b) for controlling censoring percentage
l	length for data generation (default = 300)

Value

A list with the following elements:

Subject	a vector for numbers of subject
T_ij	a vector for event times
delta_ij	a vector for event indicator (=1 if recurrent; =0 if censoring)
T_i_star	a vector for death times
delta_i_star	a vector for death indicator (=1 if death; =0 if censoring)

Author(s)

Xinwei Huang

References

Huang XW, Wang W, Emura T (2020) A copula-based Markov chain model for serially dependent event times with a dependent terminal event. Japanese Journal of Statistics & Data Science. Accepted.

Examples

```
Y = FrankFrank.Weibull.data(N = 100, scale1 = 1, shape1 =0.5, theta = 2,
                              scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)
```

`FrankFrank.Weibull.MLE`

Parameter estimation based on the Frank copula for serial dependence and the Frank copula for dependent censoring with the Weibull distributions

---

Description

Perform two-stage estimation based on the Frank copula C_theta for serial dependence and the Frank copula tilde(C)_alpha for dependent censoring with the marginal distributions Weib(scale1, shape1) and Weib(scale2, shape2). The jackknife method estimates the asymptotic covariance matrix. Parametric bootstrap is applied while doing Kolmogorov-Smirnov tests and Cramer-von Mises test. The guide for using this function shall be explained by Huang (2019), and Huang, Wang and Emura (2020).

Usage

```
FrankFrank.Weibull.MLE(subject, t.event, event, t.death, death, stageI, Weibull.plot,
                              jackknife, plot, GOF, GOF.plot, rep.GOF, digit)
```

Arguments

`subject`	a vector for numbers of subject
`t.event`	a vector for event times
`event`	a vector for event indicator (=1 if recurrent; =0 if censoring)
`t.death`	a vector for death times
`death`	a vector for death vindicator (=1 if death; =0 if censoring)
`stageI`	an option to select MLE or LSE method for the 1st-stage optimization
`Weibull.plot`	if TRUE, show the Weibull probability plot
`jackknife`	if TRUE, the jackknife method is used for estimate covariance matrix (default = TRUE)
`plot`	if TRUE, the plots for marginal distributions are shown (default = FALSE)
`GOF`	if TRUE, show the p-values for KS-test and CvM-test
`GOF.plot`	if TRUE, show the model diagnostic plot
`rep.GOF`	repetition number of parametric bootstrap
`digit`	accurate to some decimal places

Details

When jackknife=FALSE, the corresponding standard error and confidence interval values are shown as NA.

Value

A list with the following elements:

`Sample_size`	Sample size N
`Case`	Count for event occurences
`scale1`	Scale parameter for Weib(scale1, shape1)
`shape1`	Shape parameter for Weib(scale1, shape1)
`scale2`	Scale parameter for Weib(scale2, shape2)
`shape2`	Shape parameter for Weib(scale2, shape2)
`theta`	Copula parameter for the Frank copula C_theta
`alpha`	Copula parameter for the Frank copula tilde(C)_alpha
`COV`	Asymptotic covariance estimated by the jackknife method
`KS`	Kolmogorov-Smirnov test statistics
`p.KS`	P-values for Kolmogorov-Smirnov tests
`CM`	Cramer-von Mises test statistics
`p.CM`	P-values for Cramer-von Mises tests
`Convergence`	Convergence results for each stage
`Jackknife_error`	Count for error in jackknife repititions
`Log_likelihood`	Log-likelihood values

Author(s)

Xinwei Huang

Examples

```
data = FrankFrank.Weibull.data(N = 300, scale1 = 1, shape1 =0.5, theta = 2,
                               scale2 = 0.45, shape2 = 0.5, alpha = 2, b = 10, l = 300)


FrankFrank.Weibull.MLE(subject = data$Subject,
                           t.event = data$T_ij, event = data$delta_ij,
                           t.death = data$T_i_star, death = data$delta_i_star,
                           jackknife= TRUE, plot = TRUE)
```

Index

ClaytonClayton.Weibull.data, 2
ClaytonClayton.Weibull.MLE, 3
ClaytonFrank.Weibull.data, 5
ClaytonFrank.Weibull.MLE, 6
Copula.Markov.survival, 8

FrankClayton.Weibull.data, 9
FrankClayton.Weibull.MLE, 10
FrankFrank.Weibull.data, 12
FrankFrank.Weibull.MLE, 13