Package 'MannWhitneyCopula'

November 3, 2025

Type Package

Title Computing Mann-Whitney Effect Based on Copulas

Version 0.1.1

Description Computing the Mann-Whitney effect based on copula models.
Estimation of the association parameter in survival copula models.
A description of the underlying methods is described in Nakazono et al. (2024) <doi:10.3390/math12101453> and Nakazono et al. (accepted for publication in Statistical Papers).

License MIT + file LICENSE

Encoding UTF-8

RoxygenNote 7.3.2

Imports survival, tidyverse, ggplot2, purrr, dplyr, tidyr

Suggests spelling

Language en-US

NeedsCompilation no

Author Kosuke Nakazono [aut, cre]

Maintainer Kosuke Nakazono <nakazono@ism.ac.jp>

Repository CRAN

Date/Publication 2025-11-03 08:50:02 UTC

Contents

`MW.comp` *Parametric calculation for the Mann-Whitney effect under survival copula models*

Description

`MW.comp` provides a parametric estimator for the Mann-Whitney effect under the parametric survival functions and copulas. See Nakazono, et al.(2024) for details.

Usage

```
MW.comp(
copula = c("clayton", "gumbel", "frank", "fgm", "gb"),
copula.param = 1,
s1 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
S1.param,
s2 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
S2.param
)
```

Arguments

`copula`	copula family. Available options include; "clayton", "gumbel", "frank", "fgm", "gb".
`copula.param`	the copula parameter.
`s1`	a parametric survival function for S1. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
`S1.param`	the distribution parameter for S1.
`s2`	a parametric survival function for S2. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
`S2.param`	the distribution parameter for S2.

Details

copula.param is restricted as below:

- "clayton"; copula.param >= 0
- "gumbel"; copula.param >= 0
- "frank"; -Inf < copula.param < Inf
- "fgm"; -1 =< copula.param =< 1
- "gb"; -1 =< copula.param =< 1

Value

estimate of the Mann-Whitney effect.

References

Nakazono, K., Lin, Y. C., Liao, G. Y., Uozumi, R., & Emura, T. (2024). Computation of the Mann–Whitney effect under parametric survival copula models. Mathematics, 12(10), 1453.

Examples

```
# Under the exponential survival functions and Clayton copula
MW.comp(
  copula = "clayton",
  copula.param = 1,
  s1 = "exponential",
  S1.param = 1,
  s2 = "exponential",
  S2.param = 2
)
```

`MW.Copula` *Parametric calculation for the Mann-Whitney effect under the parametric copulas*

Description

`MW.Copula` provides a parametric estimator and confidence interval for the Mann-Whitney effect under the parametric survival functions and copulas. The result of this function includes results for logit-transformed estimators. See Nakazono, et al. (2025) for details.

Usage

```
MW.Copula(
t.event, event, group,
copula = c("clayton", "gumbel", "frank", "fgm", "gb"),
copula.param = 1,
s1 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
s2 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
par1 = c(0, 0),
par2 = c(0, 0),
alpha = 0.05,
logit = FALSE
)
```

Arguments

`t.event`	a vector of time-to-event data.
`event`	a vector for event indicator.
`group`	a vector for group indicator.

copula	copula family.
copula.param	the copula parameter.
s1	a parametric survival function for S1. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
s2	a parametric survival function for S2. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
par1	initial value(s) for the parameters of S1.
par2	initial value(s) for the parameters of S2.
alpha	significance level.
logit	logical; if TRUE, the estimator and CI is logit-transformed.

Value

parameter: a vector of MLE.

estimate: the Mann-Whitney effect estimator

SE: the standard error

CI: the 1-alpha% confidence interval for Mann-Whitney effect

P.value: the P-value for testing the null hypothesis H0: p=1/2.

kendall: Kendall's tau

logit: the estimator and CI are logit-transformed or not.

References

Nakazono, K., Uozumi, R., & Emura, T. (2025). Parametric inference for the Mann-Whitney effect under survival copula models, Statistical Papers, in press.

Examples

```
##Mann-Whitney effect under exponential distributions
#set distribution parameter
lambda1 = 1
lambda2 = 2

#generate time to event
u = runif(100)
t.event1 = -log(u) / lambda1
t.event1 = sort(t.event1)

v = runif(100)
t.event2 = -log(v) / lambda2
t.event2 = sort(t.event2)

#censoring indicator
t1c = runif(100, 0, 1.5)
t.event1 = (t1c >= t.event1) * t.event1 + (t1c < t.event1) * t1c
event1 = 1 * (t1c > t.event1)
```

```
t2c = runif(100, 0, 0.8)
t.event2 = (t2c >= t.event2) * t.event2 + (t2c < t.event2) * t2c
event2 = 1 * (t2c > t.event2)

t.event = c(t.event1, t.event2)
event = c(event1, event2)

#group indicator
group = rep(c(1, 0), each = 100)

MW.Copula(t.event, event, group,
          copula = "clayton", copula.param = 1,
       s1 = "exponential", s2 = "exponential", par1 = c(0, 0), par2 = c(0, 0), logit = FALSE)
```

`MW.plot` *Plot method for Mann-Whitney effect under parametric copula models*

Description

`MW.plot` plots the results, the parametric estimator and their confidence intervals, for the Mann-Whitney effect under parametric survival functions and copulas.

Usage

```
MW.plot(t.event, event, group,
copula = c("clayton", "gumbel", "frank", "fgm", "gb"),
lower = 0, upper = 1,
s1 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
s2 = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
par1 = c(0, 0),
par2 = c(0, 0),
alpha = 0.05,
logit = FALSE,
xaxis = 2
)
```

Arguments

`t.event`	a vector for time-to-event.
`event`	a vector for event indicator.
`group`	a vector for group indicator.
`copula`	copula family.
`lower`	the lower end points of the interval of the copula parameter.
`upper`	the lower end points of the interval of the copula parameter.

s1	a parametric survival function for S1. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
s2	a parametric survival function for S2. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
par1	initial value(s) for the parameters of S1.
par2	initial value(s) for the parameters of S2.
alpha	significance level.
logit	logical; if TRUE, the estimator and CI is logit-transformed.
xaxis	a indicator specifying whether the xaxis is the copula parameter (xaxis = 1) or Kendall's tau (xaxis = 2).

Value

No return value, called for side effects (generates a plot).

Examples

```
##Exponential distributions
#set distribution parameter
lambda1 = 1
lambda2 = 2

#generate time to event
u = runif(100)
t.event1 = -log(u) / lambda1
t.event1 = sort(t.event1)

v = runif(100)
t.event2 = -log(v) / lambda2
t.event2 = sort(t.event2)

#censoring indicator
t1c = runif(100, 0, 1.5)
t.event1 = (t1c >= t.event1) * t.event1 + (t1c < t.event1) * t1c
event1 = 1 * (t1c > t.event1)

t2c = runif(100, 0, 0.8)
t.event2 = (t2c >= t.event2) * t.event2 + (t2c < t.event2) * t2c
event2 = 1 * (t2c > t.event2)

t.event = c(t.event1, t.event2)
event = c(event1, event2)

#group indicator
group = rep(c(1, 0), each = 100)

MW.plot(t.event, event, group,
          copula = "clayton",
          lower = 0.2, upper = 0.8,
          s1 = "exponential", s2 = "exponential",
```

```
par1 = c(0, 0), par2 = c(0, 0), alpha = 0.05, logit = FALSE, xaxis = 2)
```

---

survival.mle *Maximum likelihood estimation under parametric survival function*

Description

survival.mle provides the maximum likelihood estimator and their variance-covariance matrix under parametric survival functions. This function also provides AIC and Kolmogorov-Smirnov distance to evaluate the model fitting.

Usage

```
survival.mle(
t.event,
event,
distribution = c("exponential", "weibull", "gamma", "log-normal", "burr3"),
par = c(0,0))
```

Arguments

t.event	a vector for time-to-event.
event	a vector for event indicator.
distribution	a parametric distribution for survival function. Available options include; "exponential", "weibull", "gamma", "log-normal", "burr3".
par	initial value(s) for the distribution parameters.

Value

estimate: a vector of MLE.

var: variance-covariance matrix of MLE.

AIC: Akaike information criteria.

KS: Kolmogorov-Smirnov distance between MLE and KM estimator.

Examples

```
#MLE under exponential distribution
#set distribution parameter
lambda = 1

#generate time to event
u = runif(100)
t.event = -log(u)/lambda
t.event = sort(t.event)
```

```
#censoring indicator
tc = runif(100, 0, 1.5)
t.event = (tc >= t.event) * t.event + (tc < t.event) * tc
event = 1 * (tc > t.event)

survival.mle(t.event, event, distribution = "exponential")
```

Index