Package 'tranSurv'

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Type Package

Title Estimating a Survival Distribution in the Presence of Dependent Left Truncation and Right Censoring

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Description A structural transformation model for a latent, quasi-independent truncation time as a function of the observed dependent truncation time and the event time, and an unknown dependence parameter. The dependence parameter is chosen to minimize the conditional Kendall's tau (Martin and Betensky, 2005) <doi:10.1198/016214504000001538>. The marginal distribution for the truncation time and the event time are completely left unspecified.

License GPL (>= 3)

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tranSurv-package *Transformation Model Based Survival Curve Estimation with Dependent Left Truncation*

Description

A package that estimates survival curve under a dependent truncation and independent right censoring via a structural transformation method. The package also includes hypothesis test of quasi-independence based on the conditional Kendall's tau of Martin and Betensky (2005) or two versions of the inverse probability weighted Kendall's tau of Austin and Betensky (2014).

Details

Package: tranSurv Type: Package Version: 1.1-4 Date: 2017-02-05 License: GPL(>=3) LazyLoad: yes

Author(s)

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References

Martin E. and Betensky R. A. (2005), Testing quasi-independence of failure and truncation times via conditional Kendall's tau, *Journal of the American Statistical Association*, **100** (470): 484-492.

Austin, M. D. and Betensky R. A. (2014), Eliminating bias due to censoring in Kendall's tau estimators for quasi-independence of truncation and failure, *Computational Statistics & Data Analysis*, **73**: 16-26.

Chiou, S., Austin, M., Qian, J. and Betensky R. A. (2016), Transformation model estimation of survival under dependent truncation and independent censoring, an unpublished manuscript.

condKendall *Test for quasi-independence on truncated survival data*

Description

This function performs statistical test for quasi-independence between truncation and failure time. The hypothesis test is based on the conditional Kendall's tau of Martin and Betensky (2005) or two versions of the inverse probability weighted Kendall's tau of Austin and Betensky (2014).

Usage

```
condKendall(trun, obs, delta = NULL, method = "MB", weights = NULL,
a = 0, trans = "linear", ...)
```

Arguments

`trun`	left truncation time, satisfying trun <= obs
`obs`	observed failure time, must be the same length as `trun`, might be right-censored.
`delta`	an optional vector of censoring indicator (0 = censored,1 = event) for obs. When this vector is not specified, the function assumes there is no censoring and all observed failure time experienced an event.
`method`	a character string specifying the different version of conditional Kendall's tau. The following are permitted: `MB`: conditional Kendall's tau proposed in Martin and Betensky (2005) as $\hat{\tau}_c$, `IPW1`: inverse probability weighted estimator proposed in Austin and Betensky (2014) as $\hat{\tau_{c2}}$, `IPW2`: restricted inverse probability weighted estimator proposed in Austin and Betensky (2014) as $\hat{\tau_{c3}}$.
`weights`	an optional vector of sampling weights used when `weights=IPW1` or `weights=IPW2`. Default weights will be computed when leaving it as null.
`a`	a numeric transformation parameter. The default value is 0, which applies no transformation. This parameter must be greater than -1. See `?tranSurvfit` for the transformation model structure.
`trans`	a character string specifying the transformation structure. The following are permitted: `linear`: linear transformation structure, `log`: log-linear transformation structure, `exp`: exponential transformation structure.
`...`	for future methods.

Value

The output contains the following components:

`PE`	consistent point estimate of conditional Kendall's tau.
`SE`	asymptotic standard error the conditional Kendall's tau estimator.
`STAT`	the value of the normal test statistic.
`p.value`	the p-value for the test.
`trans`	the transformation model.
`a`	transformation parameter.

References

Martin E. and Betensky R. A. (2005), Testing quasi-independence of failure and truncation times via conditional Kendall's tau, *Journal of the American Statistical Association*, **100** (470): 484-492.

Austin, M. D. and Betensky R. A. (2014), Eliminating bias due to censoring in Kendall's tau estimators for quasi-independence of truncation and failure, *Computational Statistics & Data Analysis*, **73**: 16-26.

Examples

```
## Generate simulated data from transformation model
datgen <- function(n) {
    a <- -0.3
    X <- rweibull(n, 2, 4) ## failure times
    U <- rweibull(n, 2, 1) ## latent truncation time
    T <- (1 + a) * U - a * X ## apply transformation
    C <- rlnorm(n, .8, 1) ## censoring
    dat <- data.frame(trun = T, obs = pmin(X, C), delta = 1 * (X <= C))
    return(subset(dat, trun <= obs))
}

set.seed(123)
dat <- datgen(300)

with(dat, condKendall(trun, obs, delta))
with(dat, condKendall(trun, obs, delta, method = "IPW1"))
with(dat, condKendall(trun, obs, delta, method = "IPW2"))
```

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pmcc *Conditional product-moment correlation coefficient*

Description

This function computes the conditional product-moment correlation coefficient proposed by Chen et al. (1996). The conditional product-moment correlation coefficient uses only the uncensored events.

Usage

```
pmcc(trun, obs, a = 0, trans = "linear", ...)
```

Arguments

trun	left truncation time, satisfying trun <= obs
obs	observed failure time, must be the same length as trun, might be right-censored.
a	a numeric transformation parameter. The default value is 0, which applies no transformation. This parameter must be greater than -1. See ?tranSurvfit for the transformation model structure.
trans	a character string specifying the transformation structure. The following are permitted: linear: linear transformation structure, log: log-linear transformation structure, exp: exponential transformation structure.
...	for future methods.

Value

The output contains the following components:

PE	consistent point estimate of conditional Kendall's tau.
SE	asymptotic standard error the conditional Kendall's tau estimator.
STAT	the value of the normal test statistic.
p.value	the p-value for the test.
trans	the transformation model.
a	transformation parameter.

References

Chen, Chen-Hsin and Tsai, Wei-Yann and Chao, Wei-Hsiung (1996), The product-moment correlation coefficient and linear regression for truncated data, *Journal of the American Statistical Association*, **91**436: 1181-1186.

Examples

```
## Generate simulated data from transformation model
datgen <- function(n) {
    a <- -0.3
    X <- rweibull(n, 2, 4) ## failure times
    U <- rweibull(n, 2, 1) ## latent truncation time
    T <- (1 + a) * U - a * X ## apply transformation
    C <- Inf ## assuming no censoring
    dat <- data.frame(trun = T, obs = pmin(X, C), delta = 1 * (X <= C))
    return(subset(dat, trun <= obs))
}

set.seed(123)
dat <- datgen(300)

with(dat, pmcc(trun, obs))
```

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tranSurv.control *Auxiliary for Controlling tranSurvfit Fitting*

Description

Auxiliary function as user interface for `tranSurvfit` fitting.

Usage

```
tranSurv.control(interval, lower = min(interval), upper = max(interval))
```

Arguments

interval	a vector containing the end-points of the interval to be searched the transformation parameter.
lower	the lower end point of the interval to be searched.
upper	the upper end point of the interval to be searched.

Value

A list with the arguments as components.

Author(s)

Sy Han Chiou

See Also

tranSurvfit.

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tranSurvfit *This function creates survival curves under dependent truncation and independent censoring via a structural transformation model.*

Description

A structural transformation model for a latent, quasi-independent truncation time as a function of the observed dependent truncation time and the event time, and an unknown dependence parameter. The dependence parameter is chosen to either minimize the absolute value of the restricted inverse probability weighted Kendall's tau or maximize the corresponding p-value. The marginal distribution for the truncation time and the event time are completely left unspecified.

Usage

```
tranSurvfit(trun, obs, delta = NULL, trans = "linear", plots = FALSE,
covariate = NULL, control = tranSurv.control(), ...)
```

Arguments

trun	left truncation time, satisfying trun <= obs.
obs	observed failure time, must be the same length as trun, might be right-censored.
delta	an optional vector of censoring indicator (0 = censored,1 = event) for obs. When this vector is not specified, the function assumes there is no censoring and all observed failure time experienced an event.
trans	a character string specifying the transformation structure. The following are permitted: linear: linear transformation structure, log: log-linear transformation structure, exp: exponential transformation structure.

plots	an optional logical value; if TRUE, a series of diagnostic plots as well as the survival curve for the observed failure time will be plotted.
covariate	an optional logical value; if TRUE, covariates will be included in the output data.frame qind.
control	controls lower and upper bounds when trans is an user specified function.
...	for future methods.

Details

The structure of the transformation model is of the form:

$$h(U) = (1 + a)^{-}1 * (h(T) + ah(X)),$$

where T is the truncation time, X is the observed failure time, U is the transformed truncation time that is quasi-independent from X and h(.) is a monotonic transformation function. The condition, T < X, is assumed to be satisfied. The quasi-independent truncation time, U, is obtained by inverting the test for quasi-independence by either minimizing the absolute value of the restricted inverse probability weighted Kendall's tau or maximize the corresponding p-value.

At the current version, three transformation structures can be specified. trans = "linear" corresponds to h(X) = 1; trans = "log" corresponds to h(X) = log(X); trans = "exp" corresponds to h(X) = exp(X).

Value

The output contains the following components:

Sy	estiamted survival function at the (ordered) observed points.
byTau	a list contains the estimator of transformation parameter. The following are the components: par: the best set of transformation parameter found. obj: the value of the inverse probability weighted Kendall's tau corresponding to 'par'.
byP	a list contains the estimator of transformation parameter. The following are the components: par: the best set of transformation parameter found. obj: the value of p-value based on the inverse probability weighted Kendall's tau corresponding to 'par'.
qind	a data frame consists of two quasi-independent variables: trun: the transformed truncation time. obs: the corresponding uncensored failure time.

References

Martin E. and Betensky R. A. (2005), Testing quasi-independence of failure and truncation times via conditional Kendall's tau, *Journal of the American Statistical Association*, **100** (470): 484-492.

Austin, M. D. and Betensky R. A. (2014), Eliminating bias due to censoring in Kendall's tau estimators for quasi-independence of truncation and failure, *Computational Statistics & Data Analysis*, **73**: 16-26.

Chiou, S., Austin, M., Qian, J. and Betensky R. A. (2016), Transformation model estimation of survival under dependent truncation and independent censoring, an unpublished manuscript.

Examples

```
## Generate simulated data from a transformation model
datgen <- function(n) {
    a <- -0.3
    X <- rweibull(n, 2, 4) ## failure times
    U <- rweibull(n, 2, 1) ## latent truncation time
    T <- (1 + a) * U - a * X ## apply transformation
    C <- rlnorm(n, .8, 1) ## censoring
    dat <- data.frame(trun = T, obs = pmin(X, C), delta = 1 * (X <= C))
    return(subset(dat, trun <= obs))
}

set.seed(123)
dat <- datgen(300)
fit <- with(dat, tranSurvfit(trun, obs, delta))
fit

## Checking the transformation parameter
fit$byTau$par
fit$byTau$obj
with(dat, condKendall(trun, obs, delta, method = "IPW2", a = fit$byTau$par))$PE

fit$byP$par
fit$byP$obj
with(dat, condKendall(trun, obs, delta, method = "IPW2", a = fit$byP$par))$p.value
```

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uncondKendall *Computes the unconditional Kendall's tau*

Description

This function computes the unconditional Kendall's tau, or the Kendall rank correlation coefficient for two variables. The implementation is done in C and performs a lot faster than `cor` with `method = "kendall"`.

Usage

```
uncondKendall(x, y)
```

Arguments

x	a numeric vector
y	a numeric vector with compatible length to 'y'

Value

The output is a numeric value for the unconditional Kendall's tau.

References

Kendall, M. G. (1938), A new measure of rank correlation, *Biometrika*, 81-93.

Examples

```
## Prepare to generate from normal copula
pho <- .25
A <- matrix(c(1, pho, pho, sqrt(1 - pho^2)), 2)

## Generating truncated survival data from normal copula
set.seed(123)
n <- 10000
dat <- matrix(NA, n, 2)
for (i in 1:n) dat[i,] <- pnorm(A %*% rnorm(2))
dat <- data.frame(dat)
colnames(dat) <- c("x", "y")
system.time(print(uncondKendall(dat$x, dat$y)))
system.time(print(cor(dat$x, dat$y, method = "kendall")))
```

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