

Package ‘plac’

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Type Package

Title A Pairwise Likelihood Augmented Cox Estimator for Left-Truncated Data

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Description A semi-parametric estimation method for the Cox model with left-truncated data using augmented information from the marginal of truncation times.

Depends R (>= 3.2.0), survival (>= 2.38-3)

License GPL-3

LazyData TRUE

Imports Rcpp (>= 0.12.1),

URL <https://github.com/942kid/plac>

BugReports <https://github.com/942kid/plac/issues>

LinkingTo Rcpp, RcppEigen

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Suggests testthat

NeedsCompilation yes

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plac-package	<i>A Package for Computing the Pairwise Likelihood Augmented Cox Estimator for Left-Truncated Data.</i>
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Description

This package provides both lower-level C++ functions (PLAC_TI(), PLAC_TV() and PLAC_TvR()) and an R wrapper function PLAC() to calculate the pairwise likelihood augmented Cox estimator for left-truncated survival data as proposed by Wu et al. (2015).

Wrapper Function PLAC()

This R wrapper function calls different C++ function depending on the covariate types data has.

C++ Functions

The three C++ functions PLAC_TI(), PLAC_TV() and PLAC_TvR() provide a direct interface to the algorithm in case that users need to supply more flexible time-dependent covariates other than indicator functions.

References

Wu, F., Kim, S., Qin, J., Saran, R. and Li, Y. (2016) "A Pairwise-Likelihood Augmented Estimator for the Cox Model Under Left-Truncation." (Submitted to *Journal of American Statistical Association*.)

cum.haz	<i>Calculate the Values of the cumulative Hazard at Fixed Times</i>
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Description

Calculate the Values of the cumulative Hazard at Fixed Times

Usage

```
cum.haz(est, t.eval = c(0.25, 0.75))
```

Arguments

est	an object of the class <code>plac.fit</code> .
t.eval	time points at which the $\Lambda(t)$ is evaluated (for both conditional approach and the PLAC estimator).

Value

a list containing the estimates and SEs of $\Lambda(t)$ for both conditional approach and the PLAC estimator.

Examples

```
dat1 = sim.ltrc(n = 100)$dat
est = PLAC(ltrc.formula = Surv(As, Ys, Ds) ~ Z1 + Z2,
           ltrc.data = dat1, td.type = "none")
H = cum.haz(est, t.eval = seq(0.1, 0.9, 0.1))
H$L
H$se.L
```

PLAC	<i>Calculate the PLAC estimator when a time-dependent indicator presents</i>
------	--

Description

Both a conditional approach Cox model and a pairwise likelihood augmented estimator are fitted and the corresponding results are returned in a list.

Usage

```
PLAC(ltrc.formula, ltrc.data, id.var = "ID", td.var = NULL,
     td.type = "none", t.jump = NULL, init.val = NULL, max.iter = 100,
     print.result = TRUE, ...)
```

Arguments

<code>ltrc.formula</code>	a formula of the form $\text{Surv}(A, Y, D) \sim Z$, where Z only include the time-invariant covariates.
<code>ltrc.data</code>	a data.frame of the LTRC dataset including the responses, time-invariant covariates and the jump times for the time-dependent covariate.
<code>id.var</code>	a name of the subject id in data.
<code>td.var</code>	a name of the time-dependent covariate in the output.
<code>td.type</code>	the type of the time-dependent covariate. Either one of <code>c("none", "independent", "post-trunc", "pre-post-trunc")</code> . See Details.
<code>t.jump</code>	a name of the jump time variable in data.
<code>init.val</code>	a list of the initial values of the coefficients and the baseline hazard function for the PLAC estimator.
<code>max.iter</code>	the maximal number of iteration for the PLAC estimator
<code>print.result</code>	logical, if a brief summary of the regression coefficient estimates should be printed out.
<code>...</code>	other arguments

Details

`ltrc.formula` should have the same form as used in `coxph()`; e.g., $\text{Surv}(A, Y, D) \sim Z_1 + Z_2$, where A is the truncation time (t_{start}), Y is the survival time (t_{stop}) and D is the status indicator (event). `td.type` is used to determine which C++ function will be invoked: either `PLAC_TI` (if `td.type = "none"`), `PLAC_TD` (if `td.type = "independent"`) or `PLAC_TDR` (if `td.type %in% c("post-trunc", "pre-post-trunc")`). For `td.type = "post-trunc"`, the pre-truncation values for the time-dependent covariate will be set to be zero for all subjects.

Value

a list of model fitting results for both conditional approach and the PLAC estimators.

`Event.Time` Ordered distinct observed event times

`b` Regression coefficients estimates

`se.b` Model-based SEs of the regression coefficients estimates

`H0` Estimated cumulative baseline hazard function

`se.H0` Model-based SEs of the estimated cumulative baseline hazard function

`sandwich` The sandwich estimator for (β, λ)

`k` The number of iteration for used for the PLAC estimator

`summ` A brief summary of the covariates effects

References

Wu, F. Kim, S. and Li, Y. "A Pairwise Likelihood Augmented Estimator for Left-Truncated Data with Time-Dependent Covariates." (*in preparation*)

Wu, F., Kim, S., Qin, J., Saran, R. and Li, Y. (2015) "A Pairwise-Likelihood Augmented Estimator for the Cox Model Under Left-Truncation." (Submitted to *Journal of American Statistical Association*.) <http://biostats.bepress.com/umichbiostat/paper118/>

Examples

```

# When only time-invariant covariates are involved
dat1 = sim.ltrc(n = 50)$dat
PLAC(ltrc.formula = Surv(As, Ys, Ds) ~ Z1 + Z2,
     ltrc.data = dat1, td.type = "none")
# When there is a time-dependent covariate that is independent of the truncation time
dat2 = sim.ltrc(n = 50, time.dep = TRUE,
               distr.A = "binomial", p.A = 0.8, Cmax = 5)$dat
PLAC(ltrc.formula = Surv(As, Ys, Ds) ~ Z,
     ltrc.data = dat2, td.type = "independent",
     td.var = "Zv", t.jump = "zeta")
# When there is a time-dependent covariate that depends on the truncation time
dat3 = sim.ltrc(n = 50, time.dep = TRUE, Zv.depA = TRUE, Cmax = 5)$dat
PLAC(ltrc.formula = Surv(As, Ys, Ds) ~ Z,
     ltrc.data = dat3, td.type = "post-trunc",
     td.var = "Zv", t.jump = "zeta")

```

 PLAC_TD

C++ Function for Solving the PLAC Estimator. (with time-dependent covariates independent of A^{})*

Description

C++ Function for Solving the PLAC Estimator. (with time-dependent covariates independent of A^{*})

Usage

```
PLAC_TD(Z, ZFV_, X, W, Ind1, Ind2, Dn, b, h, K = 100L)
```

Arguments

Z	matrix for all the covariates history.
ZFV_	matrix for all covariates at the each individual's observed survival time.
X	the response matrix (As, Xs, Ds).
W	the ordered observed event times.
Ind1	risk-set indicators.
Ind2	truncation pair indicators.
Dn	number of ties at each observed event time.
b	initial values of the regression coefficients.
h	initial values of the baseline hazard function.
K	maximal iteration number, the default is $K = 100$.

Value

list of model fitting results for both conditional approach and the PLAC estimator.

PLAC_TDR	<i>C++ Function for Solving the PLAC Estimator. (with time-dependent covariates depending on A^{*})</i>
----------	--

Description

C++ Function for Solving the PLAC Estimator. (with time-dependent covariates depending on A^{*})

Usage

PLAC_TDR(ZF, ZFV_, Z, X, W, Ind1, Ind2, Dn, b, h, K = 100L)

Arguments

ZF	matrix for all the time-invariant covariates.
ZFV_	matrix for all covariates at the each individual's observed survival time.
Z	matrix for all the covariates history.
X	the response matrix (As, Xs, Ds).
W	the ordered observed event times.
Ind1	risk-set indicators.
Ind2	truncation pair indicators.
Dn	number of ties at each observed event time.
b	initial values of the regression coefficients.
h	initial values of the baseline hazard function.
K	maximal iteration number, the default is K = 100.

Value

list of model fitting results for both conditional approach and the PLAC estimator.

PLAC_TI	<i>C++ Function for Solving the PLAC Estimator. (with time-invariant covariates only)</i>
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Description

C++ Function for Solving the PLAC Estimator. (with time-invariant covariates only)

Usage

PLAC_TI(Z, X, W, Ind1, Ind2, Dn, b, h, K = 100L)

Arguments

Z	matrix for all the covariates history.
X	the response matrix (As, Xs, Ds).
W	the ordered observed event times.
Ind1	risk-set indicators.
Ind2	truncation pair indicators.
Dn	number of ties at each observed event time.
b	initial values of the regression coefficients.
h	initial values of the baseline hazard function.
K	maximal iteration number, the default is $K = 100$.

Value

list of model fitting results for both conditional approach and the PLAC estimator.

plr	<i>Perform the paired log-rank test.</i>
-----	--

Description

Perform the paired log-rank test on the truncation times and the residual survival times to check the stationarity assumption (uniform truncation assumption) of the left-truncated right-censored data.

Usage

```
plr(dat, A.name = "As", Y.name = "Ys", D.name = "Ds")
```

Arguments

dat	a data.frame of left-truncated right-censored data.
A.name	the name of the truncation time variable in dat.
Y.name	the name of the survival time variable in dat.
D.name	the name of the event indicator in dat.

Value

a list containing the test statistic and the p-value of the paired log-rant test.

References

Jung, S.H. (1999). Rank tests for matched survival data. *Lifetime Data Analysis*, 5(1):67-79.

Examples

```
dat = sim.ltrc(n = 100, distr.A = "weibull")$dat
plr(dat)
```

 PwInd

Generate truncation-pair indicators

Description

Generate truncation-pair indicators

Usage

PwInd(X, W)

Arguments

X the response matrix (As, Xs, Ds).
 W the ordered observed event times.

Value

the truncation-pair indicators of the form $I(w_k \leq A_i) - I(w_k \leq XA_j)$.

SgInd

Generate risk-set indicators

Description

Generate risk-set indicators

Usage

SgInd(X, W)

Arguments

X the response matrix (As, Xs, Ds).
 W the ordered observed event times.

Value

risk-set indicators $Y_i(w_k)$ of the form $I(A_i \leq w_k \leq X_i)$.

sim.ltrc	<i>Generate left-truncated (and right-censored) data from the Cox model.</i>
----------	--

Description

Various baseline survival functions and truncation distribution are available. Censoring rate can be designated through tuning the parameter Cmax; Cmas = Inf means no censoring.

Usage

```
sim.ltrc(n = 200, b = c(1, 1), time.dep = FALSE, Zv.depA = FALSE,
  distr.T = "weibull", shape.T = 2, scale.T = 1, meanlog.T = 0,
  sdlog.T = 1, distr.A = "weibull", shape.A = 1, scale.A = 5,
  p.A = 0.3, Cmax = Inf, fix.seed = NULL)
```

Arguments

n	the sample size.
b	a numeric vector for true regression coefficients.
time.dep	logical, whether there is the time-dependent covariate (only one indicator function $Z_v = I(t \geq \zeta)$ is supported); the default is FALSE.
Zv.depA	logical, whether the time-dependent covariate Z_v depends on A^{*} (the only form supported is $Z_v = I(t \geq \zeta + A^{*})$); the default is FALSE.
distr.T	the baseline survival time (T^{*}) distribution ("exp" or "weibull").
shape.T	the shape parameter for the Weibull distribution of T^{*} .
scale.T	the scale parameter for the Weibull distributiof of T^{*} .
meanlog.T	the mean for the log-normal distribution of T^{*} .
sdlog.T	the sd for the log-normal distribution of T^{*} .
distr.A	the baseline truncation time (A^{*}) distribution: either of "weibull" (the default), "unif" (Length-Biased Sampling), "binomial" or "dunif"). Note: If distribution name other than these are provided, "unif" will be used.
shape.A	the shape parameter for the Weibull distribution of A^{*} .
scale.A	the scale parameter for the Weibull distribution of A^{*} .
p.A	the success probability for the binomial distribution of A^{*} .
Cmax	the upper bound of the uniform distribution of the censoring time (C).
fix.seed	an optional random seed for simulation.

Value

a list with a data.frame containing the observed survival times (Ys), the observed truncation times (As), the event indicator (Ds) and the covariates (Zs); a vector of certain quantiles of Ys (τ aus); the censoring proportion (PC) and the truncation proportiona (PT).

Examples

```

# With time-invariant covariates only
sim1 = sim.ltrc(n = 100)
head(sim1$dat)
# With one time-dependent covariate
sim2 = sim.ltrc(n = 100, time.dep = TRUE,
               distr.A = "binomial", p.A = 0.8, Cmax = 5)
head(sim2$dat)
# With one time-dependent covariate with dependence on the truncation time
sim3 = sim.ltrc(n = 100, time.dep = TRUE, Zv.depA = TRUE, Cmax = 5)
head(sim3$dat)

```

TvInd *Generate time-depedent covariate indicators*

Description

Generate time-dependent covariate indicators

Usage

TvInd(zeta, W)

Arguments

zeta the change point (jump time) of $Z_v(t)$.
W the ordered observed event times.

Value

the time-dependent covariate of the form $Z_v(t) = I(w_k > \text{zeta})$.

TvInd2 *Generate time-dependent covariate indicators*

Description

Generate time-dependent covariate indicators

Usage

TvInd2(eta, zeta, W)

Arguments

eta a random variable of the $Z_v(t)$ value before the change point.
zeta the change point (jump time).
w the ordered observed event times.

Value

the time-dependent covariate indicators of the form $Z_v(t) = \text{eta} * I(w_k \leq \text{zeta})$.

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