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` *A Package for Computating the Pairwise Likelihood Augmented Cox Estimator for Left-Truncated Data.*

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 coavriates 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 — *Calulate the Values of the cumulative Hazard at Fixed Times*

Description

Calulate 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 plac.fit.
t.eval	time points at which the Lambda(t) is evaluated (for both conditional apporach and the PLAC estimator).

Value

a list containing the estiamtes and SEs of Lambda(t) for both conditional apporach 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 — *Calculate the PLAC estimator when a time-dependent indicator presents*

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

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

Details

`ltrc.formula` should have the same form as used in `coxph()`; e.g., `Surv(A, Y, D) ~ Z1 + Z2`. where `A` is the truncation time (`tstart`), `Y` is the survival time (`tstop`) 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-` 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 estiamtes

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

`H0` Estimated cumulative baseline hazard function

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

`sandwich` The sandwich estimator for (beta, lambda)

`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 convariates independent of A^*)*

Description

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

Description

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

Description

C++ Function for Solving the PLAC Estimator. (with time-invariant convariates 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.

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plr — *Perform the paired log-rank test.*

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 <= A_i) - I(w_k <= 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 <= w_k <= X_i).

sim.ltrc *Generate left-truncated (and right-cencored) data from the Cox model.*

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 Zv = I(t >= zeta) is supported); the default is FALSE.
Zv.depA	logical, whether the time-dependent covariate Zv depends on A^* (the only form supported is Zv = I(t >= 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 (taus); 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-depependent covariate indicators*

Description

Generate time-depependent 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-depependent covariate of the form Z_v(t) = I(w_k > zeta).

`TvInd2` *Generate time-depependent covariate indicators*

Description

Generate time-depependent 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-depependent covariate indicators of the form Z_v(t) = eta * I(w_k <= zeta).

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