

Package ‘isoSurv’

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Type Package

Title Isotonic Regression on Survival Analysis

Version 0.3.0

Date 2023-9-1

Description Nonparametric estimation on survival analysis under order-restrictions.

Depends R ($\geq 3.6.0$), Iso, survival, stats, graphics

License GPL (≥ 2)

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NeedsCompilation no

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Description

Nonparametric estimation on survival analysis under order restrictions

Details

Package: isoph
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 Version: 0.3.0
 Date: 2023-9-1
 License: GPL (>= 2)

Author(s)

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References

Yunro Chung, Anastasia Ivanova, Michael G. Hudgens, Jason P. Fine (2018), Partial likelihood estimation of isotonic proportional hazards models, *Biometrika*, 105(1), 133-148. doi:10.1093/biomet/asx064

 disoph

Fit Double Isotonic Proportional Hazards Model

Description

Nonparametric estimation of monotone baseline hazard and monotone covariate effect functions in the proportional hazards model.

Usage

```
disoph(formula, bshape, data, maxiter, eps)
```

Arguments

formula	formula object: $\text{response} \sim \text{iso}(z, \text{shape} = \text{"increasing"}) + x_1 + x_2 + \dots + x_p$. The response must be right-censored survival outcome using the Surv function in the survival package. The iso function attributes the covariate z ' name, shape and anchor point.
bshape	direction of the baseline hazard function ($bshape = \text{"increasing"}$ or "decreasing").
data	data.frame includes variables named in the formula argument.
maxiter	maximum number of iteration (default is 10^4).
eps	stopping convergence criteria (default is 10^{-3}).

Details

The `disoph` function computes (λ_0, ψ, β) in the isotonic proportional hazards model, defined as

$$\lambda(t|z, x) = \lambda_0(t) \exp(\psi(z) + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p),$$

based on the full likelihood, where λ_0 is a monotone increasing (or decreasing) baseline hazard function, ψ is a monotone increasing (or decreasing) covariate effect function, z is a univariate variable, (x_1, x_2, \dots, x_p) is a set of covariates, and $\beta = (\beta_1, \beta_2, \dots, \beta_p)$ is a set of corresponding regression parameters. It allows to estimate (λ_0, β) only if `iso(z, shape="increasing")` is removed in the formula object. Likewise, It allows to estimate (λ_0, ψ) only if `x` is removed in the formula object. Using the nonparametric maximum likelihood approaches, estimated λ_0 and ψ are right continuous increasing (or left continuous decreasing) step functions. Compared to the standard partial likelihood approach, the full likelihood approach in the `disoph` function additionally use shape-information on λ_0 , resulting in more efficient estimators especially for a finite sample size.

For the anchor constraint, one point has to be fixed with $\psi(K) = 0$ to solve the identifiability problem, e.g. $\lambda_0(t) \exp(\psi(z)) = (\lambda_0(t) \exp(-c)) (\exp(\psi(z) + c))$ for any constant c . K is called an anchor point. By default, we set K as a median of values of z 's. The choice of anchor points are not important because, for example, different anchor points results in the same hazard ratios.

Value

A list of class `disoph`:

<code>iso.bh</code>	data.frame with t and estimated $\lambda_0(t)$.
<code>iso.cov</code>	data.frame with z and estimated $\psi(z)$.
<code>beta</code>	estimated $\beta_1, \beta_2, \dots, \beta_p$.
<code>conv</code>	algorithm convergence status.
<code>iter</code>	total number of iterations.
<code>Zk</code>	anchor satisfying estimated $\psi(Zk)=0$.
<code>shape.bh</code>	order restriction on λ_0 .
<code>shape.cov</code>	order restriction on ψ .

Author(s)

Yunro Chung [auth, cre]

References

Yunro Chung, Double Isotonic Proportional Hazards Models with Applications to Dose-Finding Studies. In preparation.

Examples

```
#test1
test1=data.frame(
  time= c(2, 5, 1, 7, 9, 5, 3, 6, 8, 9, 7, 4, 5, 2, 8),
  status=c(0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1),
  z=    c(2, 1, 1, 3, 5, 6, 7, 9, 3, 0, 2, 7, 3, 9, 4)
```

```

)
disoph.fit1=disoph(Surv(time, status)~iso(z,shape="inc"),bshape="inc",data=test1)
print(disoph.fit1)
plot(disoph.fit1)

#test2
test2=data.frame(
  time= c(2, 5, 1, 7, 9, 5, 3, 6, 8, 9, 7, 4, 5, 2, 8),
  status=c(0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1),
  z=     c(2, 1, 1, 3, 5, 6, 7, 9, 3, 0, 2, 7, 3, 9, 4),
  trt=   c(1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0),
  x=     c(1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, 4, 5, 6)
)
disoph.fit2=disoph(Surv(time, status)~iso(z,shape="inc")+trt+x,bshape="inc",data=test2)
print(disoph.fit2)
plot(disoph.fit2)

```

 iso

Attributions of isotonic covariate effect

Description

attributes the covariate with respect to the name, direction, anchor point, and class.

Usage

```
iso(z, shape)
```

Arguments

`z` a univariate covariate.
`shape` a direction of z (*shape*="increasing" or "decreasing").

Details

Internal function. The iso function attributes the covariate z for its name, shape, anchor point and class, where the anchor point is set to a median of z 's, and class is set to "iso covariate"

Value

The value z with attribution of its name, shape and median anchor point.

Author(s)

Yunro Chung [cre]

isoph

*Fit Isotonic Proportional Hazards Model***Description**

Nonparametric estimation of a monotone covariate effect under the proportional hazards model.

Usage

```
isoph(formula, data, maxiter, eps)
```

Arguments

formula	a formula object: $\text{response} \sim \text{iso}(z, \text{shape} = \text{"increasing"}) + x_1 + x_2 + \dots + x_p$. The response must be right-censored survival outcome using the <code>Surv</code> function in the survival package. The <code>iso</code> function attributes the covariate <code>z</code> ' name, shape and anchor point.
data	data.frame includes variables named in the formula argument.
maxiter	maximum number of iteration (default is 10^4).
eps	stopping convergence criteria (default is 10^{-3}).

Details

The `isoph` function estimates (ψ, β) in the isotonic proportional hazards model, defined as

$$\lambda(t|z, x) = \lambda_0(t) \exp(\psi(z) + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p),$$

based on the partial likelihood with unspecified baseline hazard function λ_0 , where ψ is a monotone increasing (or decreasing) covariate effect function, z is a univariate variable, $x = (x_1, x_2, \dots, x_p)$ is a set of covariates, and $\beta = (\beta_1, \beta_2, \dots, \beta_p)$ is a set of corresponding regression parameters. It allows to estimate ψ only if x is removed in the formula object. Using the nonparametric maximum likelihood approaches, estimated ψ is a right continuous increasing (or left continuous decreasing) step function.

For the anchor constraint, one point has to be fixed with $\psi(K) = 0$ to solve the identifiability problem, e.g. $\lambda_0(t) \exp(\psi(z)) = (\lambda_0(t) \exp(-c)) (\exp(\psi(z) + c))$ for any constant c . K is called an anchor point. By default, we set K as a median of values of z 's. The choice of anchor points are not important because, for example, different anchor points results in the same hazard ratios.

Value

A list of class `isoph`:

<code>iso.cov</code>	data.frame with z and estimated ψ .
<code>beta</code>	estimated $\beta_1, \beta_2, \dots, \beta_p$.
<code>conv</code>	algorithm convergence status.
<code>iter</code>	total number of iterations.
<code>Zk</code>	anchor point satisfying $\psi(Zk) = 0$.
<code>shape</code>	Order-restriction imposed on ψ .

Author(s)

Yunro Chung [aut, cre]

References

Yunro Chung, Anastasia Ivanova, Michael G. Hudgens, Jason P. Fine, Partial likelihood estimation of isotonic proportional hazards models, *Biometrika*. 2018, 105 (1), 133-148. doi:10.1093/biomet/asx064

Examples

```
# test1
test1=data.frame(
  time= c(2, 5, 1, 7, 9, 5, 3, 6, 8, 9, 7, 4, 5, 2, 8),
  status=c(0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1),
  z=     c(2, 1, 1, 3, 5, 6, 7, 9, 3, 0, 2, 7, 3, 9, 4)
)
isoph.fit1=isoph(Surv(time, status)~iso(z,shape="inc"),data=test1)
print(isoph.fit1)
plot(isoph.fit1)

# test2
test2=data.frame(
  time= c(2, 5, 1, 7, 9, 5, 3, 6, 8, 9, 7, 4, 5, 2, 8),
  status=c(0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1),
  z=     c(2, 1, 1, 3, 5, 6, 7, 9, 3, 0, 2, 7, 3, 9, 4),
  trt=   c(1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0)
)
isoph.fit2=isoph(Surv(time, status)~iso(z,shape="inc")+trt, data=test2)
print(isoph.fit2)
plot(isoph.fit2)
```

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