Package: cox.rvph (via r-universe)

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Type Package

Title Remedy the Violation of the Proportional Hazards Assumption of Cox Regression

Version 0.1.1

Description Remedying proportional hazards assumption violations of a Cox proportional hazards model using stepwise changepoint and time-varying coefficient methods based on Cox (1972) <doi:10.1111/j.2517-6161.1972.tb00899.x> and Grambsch and Therneau (1994) <doi:10.1093/biomet/81.3.515>.

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RoxygenNote 7.3.3

Imports survival

Suggests KMsurv

NeedsCompilation no

Author Hamin Kim [aut, cre]

Maintainer Hamin Kim <siru9170@naver.com>

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cox.rvph *cox.rvph (Remedy for Violations of the Proportional Hazards Assumption of Cox regression)*

Description

Stepwise or time-varying remedies for proportional hazards assumption violations of a cox regression model

Usage

```
cox.rvph(
  data,
  time,
  event,
  covariate,
  adjust_vars = NULL,
  method = c("step", "timev"),
  g_candidates = NULL,
  max_K = 4,
  p_threshold = 0.05,
  verbose = TRUE
)
```

Arguments

data	dataset
time	time variable
event	event indicator
covariate	covariate that violates the proportional hazards assumption
adjust_vars	optional adjustment variables
method	"step" or "timev"
g_candidates	A list of candidate time functions used in the time-varying coefficient method. If NULL, a default set of candidate functions (linear, log, sqrt, quadratic, inverse, and scaled) is used. Users may also supply custom transformation functions.
max_K	maximum number of segments
p_threshold	threshold for PH test
verbose	logical; whether to print progress messages

Details

Users should first assess the proportional hazards (PH) assumption using `cox.zph()` before applying `cox.rvph()`. Variables showing evidence of non-proportional hazards may then be modeled using stepwise or time-varying remedies.

The step method performs segmented modeling by searching for optimal cut points in time by maximizing the partial likelihood. If the resulting model satisfies the PH assumption with relatively few cut points, hazard ratios (HRs) may be interpreted separately within each time interval.

However, if many cut points are required or PH violations persist, a smooth time-varying effect may be more appropriate. In such cases, the timev method fits several candidate time-transformation functions $g(t)$ and selects the model with the smallest AIC. By default, the following candidate functions are evaluated: linear (t), log ($\log(t+1)$), sqrt ($\sqrt{t}$), quadratic (t^2), inverse ($1/(t+1)$), and scaled ($t/\max(t)$). Users may alternatively provide their own candidate functions through the g_candidates argument.

For the selected time-varying model, the hazard ratio at time t is given by:

$$HR(t) = \exp(\beta + \gamma g(t))$$

where β is the baseline coefficient and γ represents the time-varying interaction effect. Users may evaluate this expression at clinically relevant time points to interpret how the hazard ratio changes over time.

Interpretation: For the step method, hazard ratios are interpreted separately within each estimated time interval.

Example output (method: step):

```
$K
[1] 2

$tau
[1] 5

$fit

                coef exp(coef)      p
covariate_seg1 0.946     2.576  <0.001
covariate_seg2 -0.351    0.704   0.127
```

Interpretation (method: step):

For the step method, hazard ratios are interpreted separately within each estimated time interval.
Interpretation:
covariate_seg1 HR = 2.58
covariate_seg2 HR = 0.70

If the estimated cut point is $\tau = 5$, this indicates that before time 5 the hazard is approximately 2.58 times higher, whereas after time 5 the hazard ratio decreases to approximately 0.70.

Example output (method: timev):

```
$selected_g
[1] "sqrt"

$fit
```

```
              coef exp(coef)      p
protime      2.961    19.319 <0.001
interaction -0.086     0.918 <0.001
bili         0.022     1.022 0.211
.
.
```

Interpretation (method: timev):

For the `timev` method, hazard ratios vary continuously over time.

Example model:

$$HR(t) = \exp(2.96 - 0.086\sqrt{t})$$

This indicates that the hazard ratio decreases gradually over time. Users may substitute clinically meaningful values of t to estimate hazard ratios at specific time points.

Value

list containing model results

Examples

```
if (requireNamespace("KMsurv", quietly = TRUE)) {
  data(larynx, package = "KMsurv")

  cox.rvph(
    data = larynx,
    time = "time",
    event = "delta",
    covariate = "stage",
    adjust_vars = "age",
    method = "step"
  )
}
```

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