Package ‘obliqueRSF’

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Title Oblique Random Forests for Right-Censored Time-to-Event Data

Version 0.1.2

Description Oblique random survival forests incorporate linear combinations of input variables into random survival forests (Ishwaran, 2008 <DOI:10.1214/08-AOAS169>). Regularized Cox proportional hazard models (Simon, 2016 <DOI:10.18637/jss.v039.i05>) are used to identify optimal linear combinations of input variables.

Depends R (>= 3.5.0)

Imports Rcpp, pec, data.table, stats, missForest, purrr, glmnet, survival, dplyr, rlang, prodlim, ggthemes, tidyr, ggplot2, scales

License GPL-3

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Oblique random survival forest are ensembles for right-censored survival data that incorporate linear combinations of input variables into random survival forests (see Ishwaran et al., 2008 <doi:10.1214/08-AOAS169>). Regularized Cox proportional hazard models (see Simon et al., 2016 <doi:10.18637/jss.v039.i05>) identify optimal linear combinations of input variables in each recursive partitioning step while building survival trees (see Bou-hamad et al., 2011 <doi: 10.1214/09-SS047>).

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Usage
ORSF(
data,  
alpha = 0.5,  
ntree = 100,  
time = "time",  
status = "status",  
eval_times = NULL,  
features = NULL,  
min_events_to_split_node = 5,  
min_obs_to_split_node = 10,  
min_obs_in_leaf_node = 5,  
min_events_in_leaf_node = 1,  
nsplit = 25,  
gamma = 0.5,  
max_pval_to_split_node = 0.5,  
mtry = ceiling(sqrt(ncol(data) - 2)),  
dfmax = mtry,  
use.cv = FALSE,  
verbose = TRUE,  
compute_oob_predictions = FALSE,  
random_seed = NULL  
)
Arguments

data
The data used to grow the forest.

alpha
The elastic net mixing parameter. A value of 1 gives the lasso penalty, and a value of 0 gives the ridge penalty. If multiple values of alpha are given, then a penalized model is fit using each alpha value prior to splitting a node.

ntree
The number of trees to grow.

time
A character value indicating the name of the column in the data that measures time.

status
A character value indicating the name of the column in the data that measures participant status. A value of zero indicates censoring and a value of 1 indicates that the event occurred.

eval_times
A numeric vector holding the time values where ORSF out-of-bag predictions should be computed and evaluated.

features
A character vector giving the names of columns in the data set that will be used as features. If NULL, then all of the variables in the data apart from the time and status variable are treated as features. None of these names should contain special characters or spaces.

min_events_to_split_node
The minimum number of events required to split a node.

min_obs_to_split_node
The minimum number of observations required to split a node.

min_obs_in_leaf_node
The minimum number of observations in child nodes.

min_events_in_leaf_node
The minimum number of events in child nodes.

nsplit
The number of random cut-points assessed for each variable.

gamma
numeric value that must be greater than 0. This parameter penalizes complexity in the linear combinations. Higher values of gamma lead to more conservative linear combinations of input variables.

max_pval_to_split_node
The maximum p-value corresponding to the log-rank test for splitting a node. If the p-value exceeds this cut-point, the node will not be split.

mtry
Number of variables randomly selected as candidates for splitting a node. The default is the square root of the number of features.

dfmax
Maximum number of variables used in a linear combination for node splitting.

use.cv
if TRUE, cross-validation is used to identify optimal values of lambda, a hyper-parameter in penalized regression. if FALSE, a set of candidate lambda values are used. The set of candidate lambda values is built by picking the maximum value of lambda such that the penalized regression model has k degrees of freedom, where k is between 1 and mtry.

verbose
If verbose=TRUE, then the ORSF function will print output to console while it grows the tree.

compute_oob_predictions
If TRUE, then out-of-bag predictions will be included in the ORSF object.
random_seed If a number is given, then that number is used as a random seed prior to growing the forest. Use this seed to replicate a forest if needed.

Value
An oblique random survival forest.

Examples
data("pbc", package='survival')
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$id=NULL
fctrs<-c('trt','ascites','spiders','edema','hepato','stage')
for(f in fctrs)pbc[[f]]=as.factor(pbc[[f]])
pbc=na.omit(pbc)
orsf=ORSF(data=pbc, ntree=5)

pdplot object, xlab = NULL, xvar_units = NULL, xvals = NULL, nxpts = 10, ytype = "nonevent", event_lab = "death", nonevent_lab = "survival", fvar = NULL, flab = NULL, flvls = NULL, time_units = "years", xlvl = NULL, sub_times = NULL, separate_panels = TRUE, color_palette = "Dark2"

Description
Plot partial variable dependence using an oblique random survival forest

Usage
pdplot(object, xvar, xlab = NULL, xvar_units = NULL, xvals = NULL, nxpts = 10, ytype = "nonevent", event_lab = "death", nonevent_lab = "survival", fvar = NULL, flab = NULL, flvls = NULL, time_units = "years", xlvl = NULL, sub_times = NULL, separate_panels = TRUE, color_palette = "Dark2"
Arguments

object
an ORSF object (i.e. object returned from the ORSF function)
xvar
a string giving the name of the x-axis variable
xlab
the label to be printed describing the x-axis variable
xvar_units
the unit of measurement for the x-axis variable. For example, age is usually measured in years.
xvals
a vector containing the values that partial dependence will be computed with.
xnpts
instead of specifying xvals, you can specify how many points on the x-axis you would like to plot predicted responses for, and a set of nxpts equally spaced percentile values from the distribution of xvar will be used.
ytype
String. Use ‘event’ if you would like to plot the probability of the event, and ‘nonevent’ if you prefer to plot the probability of a non-event.
event_lab
string that describes the event
nonevent_lab
string that describes a non-event.
fvar
a string indicating a variable to facet the plot with
flab
a label describing the facet variable.
flvls
the labels to be printed describing the facet variable. For a facet variable with k categories, flab should be a vector with k labels, given in the same order as the levels of the facet variable.
time_units
the unit of time, e.g. days, since baseline.
xlvls
A character vector with descriptions of each category in the x-variable. This is only relevant if x is categorical.
sub_times
a vector of times to compute predicted survival probabilities. Note that the eval_times from the ORSF object are used to compute predictions, and sub_times must be a subset of those times.
separate_panels
true or false. If true, the plot will display predictions in two separate panels, determined by the facet variable.
color_palette
Palette to use for colors in the figure. Options are Diverging (BrBG, PiYG, PRGn, PuOr, RdBu, RdGy, RdYlBu, RdYlGn, Spectral), Qualitative (Accent, Dark2, Paired, Pastel1, Pastel2, Set1, Set2, Set3), Sequential (Blues, BuGn, BuPu, GnBu, Greens, Greens, Oranges, OrRd, PuBu, PuBuGn, PuRd, Purples, RdPu, Reds, YlGn, YlGnBu, YlOrBr, YlOrRd), and viridis.

Value

A ggplot2 object showing partial dependence according to the oblique random survival forest object.

Examples

## Not run:
data("pbc", package='survival')
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$time=pbc$time/365.25
predict.orsf

Compute predictions using an oblique random survival forest.

Description

Compute predictions using an oblique random survival forest.

Usage

## S3 method for class 'orsf'
predict(object, newdata, times, ...)

Arguments

object

An object fitted using the ORSF function.

newdata

A data frame containing observations to predict.

times

A vector of times in the range of the response variable, e.g. times when the response is a survival object, at which to return the survival probabilities.

...

Other arguments passed to or from other functions.

Value

A matrix of survival probabilities containing 1 row for each observation and 1 column for each value in times.

Examples

data("pbc", package='survival')
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$id=NULL
fctrs<-c('trt','ascites','spiders','edema','hepato','stage')
for(f in fctrs)pbc[[f]]=as.factor(pbc[[f]])
pbc=na.omit(pbc)

orsf=ORSF(data=pbc, eval_time=1:10, ntree=30)

pdplot(object=orsf, xvar='bili', xlab='Bilirubin',
       xvar_units='mg/dl', sub_times=10)

## End(Not run)

predict.orsf
predictSurvProb.orsf  Compute predictions using an oblique random survival forest.

Description
Compute predictions using an oblique random survival forest.

Usage
## S3 method for class 'orsf'
predictSurvProb(object, newdata, times, ...)

Arguments
object  A fitted model from which to extract predicted survival probabilities
newdata A data frame containing predictor variable combinations for which to compute predicted survival probabilities.
times  A vector of times in the range of the response variable, e.g. times when the response is a survival object, at which to return the survival probabilities.
...  Additional arguments that are passed on to the current method.

Value
A matrix of survival probabilities containing 1 row for each observation and 1 column for each value in times.

Examples
## Not run:
data("pbc",package="survival")
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$id=NULL
fctrs<-c("trt","ascites","spiders","edema","hepato","stage")
for(f in fctrs)pbc[[f]]=as.factor(pbc[[f]])
pbc=na.omit(pbc)
orsf=ORSF(data=pbc,ntree=30)
times=seq(365, 365*4,length.out = 10)
predict(orsf,newdata=pbc[c(1:5),],times=times)
## End(Not run)
print.orsf  

*Grow an oblique random survival forest (ORSF)*

**Description**

Grow an oblique random survival forest (ORSF)

**Usage**

```r
## S3 method for class 'orsf'
print(x, ...)
```

**Arguments**

- `x` an ORSF object (i.e. the object returned from the ORSF function)
- `...` additional arguments passed to print

**Value**

A printed summary of the oblique random survival forest.

**Examples**

```r
## Not run:
data("pbc", package="survival")
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$id=NULL
fctrs<-c("trt","ascites","spiders","edema","hepato","stage")
for(f in fctrs)pbc[[f]]=as.factor(pbc[[f]])
pbc=na.omit(pbc)
orsf=ORSF(data=pbc, ntree=30)
print(orsf)

## End(Not run)
```

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**Plot variable dependence using an oblique random survival forest**

**Description**

Plot variable dependence using an oblique random survival forest

**Usage**

```r
theme_Publication(base_size = 16)
```
vdplot

Arguments

Base_size how big to make the text

Description

Plot variable dependence using an oblique random survival forest

Usage

vdplot(
  object,  # an ORSF object (i.e. object returned from the ORSF function)
  xvar,    # a string giving the name of the x-axis variable
  include.hist = TRUE,  # if true, a histogram showing the distribution of values for the x-axis variable will be included at the bottom of the plot.
  include.points = FALSE,  # if true, the predictions for each observation are plotted along with a smoothed population estimate. Note that points are always included if xvar is categorical.
 .ptsize = 0.75,  # only relevant if include.points = TRUE. The size of the points in the plot are determined by this numeric value.
  ytype = "nonevent",  # String. Use 'event' if you would like to plot the probability of the event, and 'nonevent' if you prefer to plot the probability of a non-event.
  event_lab = "death",  # string that describes the event
  nonevent_lab = "survival",  # string that describes the event
  fvar = NULL,  # string that describes the event
  flab = NULL,  # string that describes the event
  time_units = "years",  # string that describes the event
  xlab = xvar,  # string that describes the event
  xvar_units = NULL,  # string that describes the event
  xlvls = NULL,  # string that describes the event
  sub_times = NULL,  # string that describes the event
  se.show = FALSE  # string that describes the event
)
nonevent_lab  string that describes a non-event.

fvar (optional) a string indicating a variable to facet the plot with

flab the labels to be printed describing the facet variable. For a facet variable with k categories, flab should be a vector with k labels, given in the same order as the levels of the facet variable.

time_units the unit of time, e.g. days, since baseline.

xlab the label to be printed describing the x-axis variable

xvar_units the unit of measurement for the x-axis variable. For example, age is usually measured in years.

xlvs a character vector giving the labels that correspond to categorical xvar. This does not need to be specified if xvar is continuous.

sub_times the times you would like to plot predicted values for. If left unspecified, the ORSF function will use all of the times in oob_times.

se.show if true, standard errors of the population estimate will be included in the plot.

Value
A ggplot2 object

Examples

## Not run:
data("pbc", package='survival')
pbc$status[pbc$status>=1]=pbc$status[pbc$status>=1]-1
pbc$time=pbc$time/365.25
pbc$id=NULL
fctrs<-c('trt', 'ascites', 'spiders', 'edema', 'hepato', 'stage')
for(f in fctrs)pbc[[f]]=as.factor(pbc[[f]])
pbc=na.omit(pbc)
orsf=ORSF(data=pbc, eval_time=5, ntree=30)

vdplot(object=orsf, xvar='bili', xlab='Bilirubin', xvar_units='mg/dl')

## End(Not run)