

# Package ‘bnnSurvival’

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**Type** Package

**Title** Bagged k-Nearest Neighbors Survival Prediction

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**Description** Implements a bootstrap aggregated (bagged) version of the k-nearest neighbors survival probability prediction method (Lowsky et al. 2013). In addition to the bootstrapping of training samples, the features can be subsampled in each baselearner to break the correlation between them. The Rcpp package is used to speed up the computation.

**Imports** prodlim, pec, Rcpp (>= 0.11.2), parallel, methods

**LinkingTo** Rcpp

**Suggests** survival, testthat

**License** GPL-3

**RoxygenNote** 5.0.1

**NeedsCompilation** yes

**Repository** CRAN

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## Contents

bnnSurvival . . . . .	2
get_best_k . . . . .	4
predict,bnnSurvivalBaseLearner-method . . . . .	4
predict,bnnSurvivalEnsemble-method . . . . .	5
predictions . . . . .	5
predictions,bnnSurvivalResult-method . . . . .	6
predictSurvProb.bnnSurvivalEnsemble . . . . .	6
print,bnnSurvivalEnsemble-method . . . . .	7
print,bnnSurvivalResult-method . . . . .	7

show,bnnSurvivalEnsemble-method . . . . .	8
show,bnnSurvivalResult-method . . . . .	8
timepoints . . . . .	9
timepoints,bnnSurvivalResult-method . . . . .	9

<b>Index</b>	<b>10</b>
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bnnSurvival	<i>Bagged k-nearest neighbors survival prediction</i>
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## Description

Bootstrap aggregated (bagged) version of the k-nearest neighbors survival probability prediction method (Lowsky et al. 2013). In addition to the bootstrapping of training samples, the features can be subsampled in each base learner.

## Usage

```
bnnSurvival(formula, data, k = max(1, nrow(data)/10),
  num_base_learners = 50, num_features_per_base_learner = NULL,
  metric = "mahalanobis", weighting_function = function(x) { x * 0 + 1
}, replace = TRUE, sample_fraction = NULL)
```

## Arguments

formula	Object of class formula or character describing the model to fit.
data	Training data of class data.frame.
k	Number nearest neighbors to use. If a vector is given, the optimal k of these values is found using 5-fold cross validation.
num_base_learners	Number of base learners to use for bootstrapping.
num_features_per_base_learner	Number of features randomly selected in each base learner. Default: all.
metric	Metric $d(x,y)$ used to measure the distance between observations. Currently only "mahalanobis".
weighting_function	Weighting function $w(d(x,y))$ used to weight the observations based on their distance.
replace	Sample with or without replacement.
sample_fraction	Fraction of observations to sample in $[0,1]$ . Default is 1 for <code>replace=TRUE</code> , and 0.6321 for <code>replace=FALSE</code> .

## Details

For a description of the k-nearest neighbors survival probability prediction method see (Lowsky et al. 2013). Please note, that parallel processing, as currently implemented, does not work on Microsoft Windows platforms.

The weighting function needs to be defined for all distances  $\geq 0$ . The default function is constant 1, a possible alternative is  $w(x) = 1/(1+x)$ .

To use the non-bagged version as in Lowsky et al. 2013, use `num_base_learners=1`, `replace=FALSE` and `sample_fraction=1`.

## Value

`bnnSurvivalEnsemble` object. Use `predict()` with a new data set to predict survival probabilities.

## Author(s)

Marvin N. Wright

## References

Lowsky, D.J. et al. (2013). A K-nearest neighbors survival probability prediction method. *Stat Med*, 32(12), 2062-2069.

## See Also

[predict](#)

## Examples

```
require(bnnSurvival)

## Use only 1 core
options(mc.cores = 1)

## Load a dataset and split in training and test data
require(survival)
n <- nrow(veteran)
idx <- sample(n, 2/3*n)
train_data <- veteran[idx, ]
test_data <- veteran[-idx, ]

## Create model with training data and predict for test data
model <- bnnSurvival(Surv(time, status) ~ trt + karno + diagtime + age + prior, train_data,
                    k = 20, num_base_learners = 10, num_features_per_base_learner = 3)
result <- predict(model, test_data)

## Plot survival curve for the first observations
plot(timepoints(result), predictions(result)[1, ])
```

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get_best_k	<i>Get optimal number of neighbors</i>
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**Description**

Get optimal number of neighbors for bnnSurvival by cross validation

**Usage**

```
get_best_k(formula, data, k, ...)
```

**Arguments**

formula	Formula
data	Data
k	Number of neighbors
...	Further arguments passed to bnnSurvival

**Value**

Optimal k

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predict,bnnSurvivalBaseLearner-method	<i>Compute prediction for all samples.</i>
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**Description**

Compute prediction for all samples.

**Usage**

```
## S4 method for signature 'bnnSurvivalBaseLearner'
predict(object, train_data, test_data,
        timepoints, metric, weighting_function, k)
```

**Arguments**

object	bnnSurvivalBaseLearner object
train_data	Training data (with response)
test_data	Test data (without response)
timepoints	Timepoint to predict at
metric	Metric used
weighting_function	Weighting function used
k	Number of nearest neighbors

---

predict,bnnSurvivalEnsemble-method

*Predict survival probabilities with bagged k-nearest neighbors survival prediction.*

---

### **Description**

Predict survival probabilities with bagged k-nearest neighbors survival prediction.

### **Usage**

```
## S4 method for signature 'bnnSurvivalEnsemble'  
predict(object, test_data)
```

### **Arguments**

object	Object of class <code>bnnSurvivalEnsemble</code> , created with <code>bnnSurvival()</code> .
test_data	Data set containing data to predict survival.

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predictions

*Get Predictions*

---

### **Description**

Get Predictions

### **Usage**

```
predictions(object, ...)
```

### **Arguments**

object	Object to extract predictions from
...	further arguments passed to or from other methods.

---

predictions, bnnSurvivalResult-method  
*Get Predictions*

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**Description**

Get Predictions

**Usage**

```
## S4 method for signature 'bnnSurvivalResult'
predictions(object)
```

**Arguments**

object            bnnSurvivalResult object to extract predictions from

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predictSurvProb.bnnSurvivalEnsemble  
*Function to extract survival probability predictions from bnnSurvivalEnsemble. Use with pec package.*

---

**Description**

Function to extract survival probability predictions from bnnSurvivalEnsemble. Use with pec package.

**Usage**

```
## S3 method for class 'bnnSurvivalEnsemble'
predictSurvProb(object, newdata, times, ...)
```

**Arguments**

object            bnnSurvivalEnsemble object.  
newdata           Data used for prediction.  
times             Not used.  
...                Not used.

**Value**

survival probability predictions

---

`print,bnnSurvivalEnsemble-method`  
*Generic print method for bnnSurvivalEnsemble*

---

### **Description**

Generic print method for bnnSurvivalEnsemble

### **Usage**

```
## S4 method for signature 'bnnSurvivalEnsemble'  
print(x)
```

### **Arguments**

x                    bnnSurvivalEnsemble object to print

---

`print,bnnSurvivalResult-method`  
*Generic print method for bnnSurvivalResult*

---

### **Description**

Generic print method for bnnSurvivalResult

### **Usage**

```
## S4 method for signature 'bnnSurvivalResult'  
print(x)
```

### **Arguments**

x                    bnnSurvivalResult object to print

---

show,bnnSurvivalEnsemble-method

*Generic show method for bnnSurvivalEnsemble*

---

### **Description**

Generic show method for bnnSurvivalEnsemble

### **Usage**

```
## S4 method for signature 'bnnSurvivalEnsemble'  
show(object)
```

### **Arguments**

object            bnnSurvivalEnsemble object to show

---

show,bnnSurvivalResult-method

*Generic show method for bnnSurvivalResult*

---

### **Description**

Generic show method for bnnSurvivalResult

### **Usage**

```
## S4 method for signature 'bnnSurvivalResult'  
show(object)
```

### **Arguments**

object            bnnSurvivalResult object to show

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timepoints	<i>Get Timepoints</i>
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**Description**

Get Timepoints

**Usage**

```
timepoints(object, ...)
```

**Arguments**

object	Object to extract timepoints from
...	further arguments passed to or from other methods.

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timepoints, bnnSurvivalResult-method	<i>Get timepoints</i>
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**Description**

Get timepoints

**Usage**

```
## S4 method for signature 'bnnSurvivalResult'  
timepoints(object)
```

**Arguments**

object	bnnSurvivalResult object to extract timepoints from
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# Index

bnnSurvival, [2](#)

get\_best\_k, [4](#)

predict, [3](#)

predict, bnnSurvivalBaseLearner-method, [4](#)

predict, bnnSurvivalEnsemble-method, [5](#)

predictions, [5](#)

predictions, bnnSurvivalResult-method, [6](#)

predictSurvProb.bnnSurvivalEnsemble, [6](#)

print, bnnSurvivalEnsemble-method, [7](#)

print, bnnSurvivalResult-method, [7](#)

show, bnnSurvivalEnsemble-method, [8](#)

show, bnnSurvivalResult-method, [8](#)

timepoints, [9](#)

timepoints, bnnSurvivalResult-method, [9](#)