Package ‘quantregForest’

October 13, 2022

Type Package
Title Quantile Regression Forests
Version 1.3-7
Date 2017-12-16
Author Nicolai Meinshausen
Maintainer Loris Michel <michel@stat.math.ethz.ch>
Depends randomForest, RColorBrewer
Imports stats, parallel
Suggests gss, knitr, rmarkdown
Description Quantile Regression Forests is a tree-based ensemble
method for estimation of conditional quantiles. It is
particularly well suited for high-dimensional data. Predictor
variables of mixed classes can be handled. The package is
dependent on the package 'randomForest', written by Andy Liaw.
License GPL
NeedsCompilation yes
URL http://github.com/lorismichel/quantregForest
BugReports http://github.com/lorismichel/quantregForest/issues
RoxygenNote 6.0.1
Repository CRAN
Date/Publication 2017-12-19 20:23:39 UTC

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predict.quantregForest

Prediction method for class quantregForest

Description

Prediction of test data with quantile regression forests.

Usage

## S3 method for class 'quantregForest'
predict(object, newdata = NULL,
       what = c(0.1, 0.5, 0.9), ...
)

Arguments

object

An object of class quantregForest

newdata

A data frame or matrix containing new data.

If left at default NULL, the out-of-bag predictions (OOB) are returned, for which the option keep.inbag has to be set to TRUE at the time of fitting the object.

what

Can be a vector of quantiles or a function.

Default for what is a a vector of quantiles (with numerical values in [0,1]) for which the conditional quantile estimates should be returned.

If a function it has to take as argument a numeric vector and return either a summary statistic (such as mean,median or sd to get conditional mean, median or standard deviation) or a vector of values (such as with quantiles or via sample) or a function (for example with ecdf).

... Additional arguments (currently not in use).

Value

A vector, matrix or list.

If what is a vector with desired quantiles (the default is what=c(0.1,0.5,0.9)), a matrix with one column per requested quantile returned.

If just a single quantile is specified (for example via what=0.5), a vector is returned.

If what is a function with numerical return value (for example via what=function(x) sample(x,10,replace=TRUE) to sample 10 new observations from conditional distribution), the output is also a matrix (or vector if just a scalar is returned).

If what has a function as output (such as what=ecdf), a list will be returned with one element per new sample point (and the element contains the desired function).

Author(s)

Nicolai Meinshausen, Christina Heinze
predict.quantregForest

See Also

quantregForest, predict.quantregForest

Examples

#########################################################
## Load air-quality data (and preprocessing) ##
#########################################################
data(airquality)
set.seed(1)

## remove observations with missing values
airquality <- airquality[ !apply(is.na(airquality), 1, any), ]

## number of remaining samples
n <- nrow(airquality)

## divide into training and test data
indextrain <- sample(1:n, round(0.6*n), replace=FALSE)
Xtrain <- airquality[,indextrain,2:6]
Xtest <- airquality[-indextrain,2:6]
Ytrain <- airquality[,indextrain,1]
Ytest <- airquality[-indextrain,1]

#########################################################
## compute Quantile Regression Forests ##
#########################################################
qrf <- quantregForest(x=Xtrain, y=Ytrain)
qrf <- quantregForest(x=Xtrain, y=Ytrain, nodesize=10, sampsize=30)

## predict 0.1, 0.5 and 0.9 quantiles for test data
conditionalQuantiles <- predict(qrf, Xtest)
print(conditionalQuantiles[1:4,])

## predict 0.1, 0.2,..., 0.9 quantiles for test data
conditionalQuantiles <- predict(qrf, Xtest, what=0.1*(1:9))
print(conditionalQuantiles[1:4,])

## estimate conditional standard deviation
conditionalSd <- predict(qrf, Xtest, what=sd)
print(conditionalSd[1:4])
## estimate conditional mean (as in original RF)
conditionalMean <- predict(qrf, Xtest, what=mean)
print(conditionalMean[1:4])

## sample 10 new observations from conditional distribution at each new sample
newSamples <- predict(qrf, Xtest, what = function(x) sample(x,10,replace=TRUE))
print(newSamples[1:4,])

## get ecdf-function for each new test data point
## (output will be a list with one element per sample)
condEcdf <- predict(qrf, Xtest, what=ecdf)
condEcdf[[10]][(30)] ## get the conditional distribution at value 30 for i=10
## or, directly, for all samples at value 30 (returns a vector)
condEcdf30 <- predict(qrf, Xtest, what=function(x) ecdf(x)(30))
print(condEcdf30[1:4])

## to use other functions of the package randomForest, convert class back
class(qrf) <- "randomForest"
importance(qrf) ## importance measure from the standard RF

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**quantregForest**  
*Quantile Regression Forests*

**Description**

Quantile Regression Forests infer conditional quantile functions from data

**Usage**

```r
quantregForest(x,y, nthreads=1, keep.inbag=FALSE, ...)
```

**Arguments**

- `x`  
  A matrix or data.frame containing the predictor variables.

- `y`  
  The response variable.

- `nthreads`  
  The number of threads to use (for parallel computation).

- `keep.inbag`  
  Keep information which observations are in and out-of-bag? For out-of-bag predictions, this argument needs to be set to TRUE.

- `...`  
  Other arguments passed to `randomForest` such as `nodesize` or `mtry` etc.
Details

The object can be converted back into a standard randomForest object and all the functions of the randomForest package can then be used (see example below).

The response y should in general be numeric. However, some use cases exists if y is a factor (such as sampling from conditional distribution when using for example what=function(x) sample(x,10)). Trying to generate quantiles will generate an error if y is a factor, though.

Parallel computation is invoked by setting the value of nthreads to values larger than 1 (for example to the number of available CPUs). The argument only has an effect under Linux and Mac OS and is without effect on Windows due to restrictions on forking.

Value

A value of class quantregForest, for which print and predict methods are available. Class quantregForest is a list of the following components additional to the ones given by class randomForest:

- call: the original call to quantregForest
- valuesNodes: a matrix that contains per tree and node one subsampled observation

Author(s)

Nicolai Meinshausen, Christina Heinze

References


See Also

predict.quantregForest

Examples

```r
# Load air-quality data (and preprocessing)

data(airquality)
sample(airquality)

# remove observations with mising values
airquality <- airquality[!apply(is.na(airquality), 1, any),]

# number of reming samples
n <- nrow(airquality)

# divide into training and test data
```
indextrain <- sample(1:n,round(0.6*n),replace=FALSE)
Xtrain <- airquality[indextrain,2:6]
Xtest <- airquality[-indextrain,2:6]
Ytrain <- airquality[indextrain,1]
Ytest <- airquality[-indextrain,1]

# compute Quantile Regression Forests
qrf <- quantregForest(x=Xtrain, y=Ytrain)
qrf <- quantregForest(x=Xtrain, y=Ytrain, nodesize=10, sampsize=30)
## for parallel computation use the nthread option
## qrf <- quantregForest(x=Xtrain, y=Ytrain, nthread=8)

## predict 0.1, 0.5 and 0.9 quantiles for test data
conditionalQuantiles <- predict(qrf, Xtest)
print(conditionalQuantiles[1:4,])

## predict 0.1, 0.2,..., 0.9 quantiles for test data
conditionalQuantiles <- predict(qrf, Xtest, what=0.1*(1:9))
print(conditionalQuantiles[1:4,])

## estimate conditional standard deviation
conditionalSd <- predict(qrf, Xtest, what=sd)
print(conditionalSd[1:4])

## estimate conditional mean (as in original RF)
conditionalMean <- predict(qrf, Xtest, what=mean)
print(conditionalMean[1:4])

## sample 10 new observations from conditional distribution at each new sample
newSamples <- predict(qrf, Xtest,what = function(x) sample(x,10,replace=TRUE))
print(newSamples[1:4,])

## get ecdf-function for each new test data point
## (output will be a list with one element per sample)
condEcdf <- predict(qrf, Xtest, what=ecdf)
condEcdf[[10]](30) ## get the conditional distribution at value 30 for i=10
## or, directly, for all samples at value 30 (returns a vector)
condEcdf30 <- predict(qrf, Xtest, what=function(x) ecdf(x)(30))
print(condEcdf30[1:4])

## to use other functions of the package randomForest, convert class back
class(qrf) <- "randomForest"
importance(qrf) ## importance measure from the standard RF
## out-of-bag predictions and sampling

```r
# for with option keep.inbag=TRUE
qrf <- quantregForest(x=Xtrain, y=Ytrain, keep.inbag=TRUE)

# or use parallel version
# qrf <- quantregForest(x=Xtrain, y=Ytrain, nthread=8)

# get quantiles
oobQuantiles <- predict( qrf, what= c(0.2,0.5,0.8))

# sample from oob-distribution
oobSample <- predict( qrf, what= function(x) sample(x,1))
```
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