Package 'FuzzyClass'

May 27, 2022

Title Fuzzy and Non-Fuzzy Classifiers

Version 0.1.1

Description Provides classifiers that can be used for discrete variables and for continuous variables based on the idea of Naive Bayes and Fuzzy Naive Bayes considering some statistical distributions of articles published in the literature developed in the LabTEVE and LEAPIG research laboratories. Among the proposed classification methods is a with the Gamma distribution, proposed by Moraes, Soares and Machado (2018) <doi:10.1142/9789813273238_0088>.

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.2

Imports caTools, datasets, doParallel, e1071, EnvStats, foreach, MASS, mlbench, parallel, Rdpack, rootSolve, stats, trapezoid

RdMacros Rdpack

Depends R (>= 2.10)

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

URL https://github.com/Jodavid/FuzzyClass

BugReports https://github.com/Jodavid/FuzzyClass/issues

NeedsCompilation no

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Repository CRAN

Date/Publication 2022-05-27 08:40:15 UTC

R topics documented:

ExpNBFuzzyParam . . . 2
FuzzyBetaNaiveBayes . . . 3
FuzzyBinomialNaiveBayes . . . 4
FuzzyExponentialNaiveBayes . . . 5
FuzzyGammaNaiveBayes . . . 7
FuzzyGaussianNaiveBayes . . . 8
FuzzyNaiveBayes . . . 9
FuzzyPoissonNaiveBayes . . . 10
FuzzyTriangularNaiveBayes . . . 11
GauNBFuzzyParam . . . 12
PoiNBFuzzyParam . . . 14
SimulatedData . . . 15
VirtualRealityData . . . 15

Index **16**

`ExpNBFuzzyParam` *Fuzzy Exponential Naive Bayes Classifier with Fuzzy parameters*

Description

`ExpNBFuzzyParam` Fuzzy Exponential Naive Bayes Classifier with Fuzzy parameters

Usage

```
ExpNBFuzzyParam(train, cl, metd = 1, cores = 2)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`metd`	Method of transforming the triangle into scalar, It is the type of data entry for the test sample, use metd 1 if you want to use the Baricentro technique and use metd 2 if you want to use the Q technique of the uniformity test (article: Directional Statistics and Shape analysis).
`cores`	how many cores of the computer do you want to use (default = 2)

Value

A vector of classifications

References

Rodrigues AK, Batista TV, Moraes RM, Machado LS (2016). "A new exponential naive bayes classifier with fuzzy parameters." In *2016 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 1188–1194. IEEE.

Examples

```
set.seed(1) # determining a seed
data(VirtualRealityData)

# Splitting into Training and Testing
split <- caTools::sample.split(t(VirtualRealityData[, 1]), SplitRatio = 0.7)
Train <- subset(VirtualRealityData, split == "TRUE")
Test <- subset(VirtualRealityData, split == "FALSE")

# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -4]
fit_FENB <- ExpNBFuzzyParam(
  train = Train[, -4],
  cl = Train[, 4], metd = 1, cores = 2
)

pred_FENB <- predict(fit_FENB, test)

head(pred_FENB)
head(Test[, 4])
```

`FuzzyBetaNaiveBayes` `FuzzyBetaNaiveBayes` *Fuzzy Beta Naive Bayes*

Description

`FuzzyBetaNaiveBayes` Fuzzy Beta Naive Bayes

Usage

```
FuzzyBetaNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`cores`	how many cores of the computer do you want to use (default = 2)
`fuzzy`	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Rodrigues AKG, Soares EAMG, Machado LS (2020). "A new fuzzy beta naive Bayes classifier." In *Developments of Artificial Intelligence Technologies in Computation and Robotics: Proceedings of the 14th International FLINS Conference (FLINS 2020)*, 437–445. World Scientific.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
#----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_NBT <- FuzzyBetaNaiveBayes(
  train = Train[, -5],
  cl = Train[, 5], cores = 2
)

pred_NBT <- predict(fit_NBT, test)

head(pred_NBT)
head(Test[, 5])
```

`FuzzyBinomialNaiveBayes`

`FuzzyBinomialNaiveBayes` *Fuzzy Binomial Naive Bayes*

Description

`FuzzyBinomialNaiveBayes` Fuzzy Binomial Naive Bayes

Usage

```
FuzzyBinomialNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`cores`	how many cores of the computer do you want to use (default = 2)
`fuzzy`	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Machado LS (2016). "A Fuzzy Binomial Naive Bayes classifier for epidemiological data." In *2016 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 745–750. IEEE.

Examples

```
set.seed(1) # determining a seed
class1 <- data.frame(vari1 = rbinom(100,size = 10, prob = 0.2),
                     vari2 = rbinom(100,size = 10, prob = 0.2),
                    vari3 = rbinom(100,size = 10, prob = 0.2), class = 1)
class2 <- data.frame(vari1 = rbinom(100,size = 10, prob = 0.5),
                     vari2 = rbinom(100,size = 10, prob = 0.5),
                    vari3 = rbinom(100,size = 10, prob = 0.5), class = 2)
class3 <- data.frame(vari1 = rbinom(100,size = 10, prob = 0.8),
                     vari2 = rbinom(100,size = 10, prob = 0.8),
                     vari3 = rbinom(100,size = 10, prob = 0.8), class = 3)
data <- rbind(class1,class2,class3)

# Splitting into Training and Testing
split <- caTools::sample.split(t(data[, 1]), SplitRatio = 0.7)
Train <- subset(data, split == "TRUE")
Test <- subset(data, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -4]
fit_NBT <- FuzzyBinomialNaiveBayes(
  train = Train[, -4],
  cl = Train[, 4], cores = 2
)

pred_NBT <- predict(fit_NBT, test)

head(pred_NBT)
head(Test[, 4])
```

FuzzyExponentialNaiveBayes

Fuzzy Exponential Naive Bayes

Description

FuzzyExponentialNaiveBayes Fuzzy Exponential Naive Bayes

Usage

```
FuzzyExponentialNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

train	matrix or data frame of training set cases.
cl	factor of true classifications of training set
cores	how many cores of the computer do you want to use (default = 2)
fuzzy	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Machado LS (2016). "A fuzzy exponential naive bayes classifier." In *Uncertainty Modelling in Knowledge Engineering and Decision Making: Proceedings of the 12th International FLINS Conference*, 207–212. World Scientific.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_NBT <- FuzzyExponentialNaiveBayes(
  train = Train[, -5],
  cl = Train[, 5], cores = 2
)

pred_NBT <- predict(fit_NBT, test)

head(pred_NBT)
head(Test[, 5])
```

FuzzyGammaNaiveBayes FuzzyGammaNaiveBayes *Fuzzy Gamma Naive Bayes*

Description

FuzzyGammaNaiveBayes Fuzzy Gamma Naive Bayes

Usage

```
FuzzyGammaNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

train	matrix or data frame of training set cases.
cl	factor of true classifications of training set
cores	how many cores of the computer do you want to use (default = 2)
fuzzy	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Soares EAMG, Machado LS (2018). "A Fuzzy Gamma Naive Bayes Classifier." In *Data Science and Knowledge Engineering for Sensing Decision Support: Proceedings of the 13th International FLINS Conference (FLINS 2018)*, 691–699. World Scientific.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_NBT <- FuzzyGammaNaiveBayes(
  train = Train[, -5],
  cl = Train[, 5], cores = 2
)

pred_NBT <- predict(fit_NBT, test)
```

```
head(pred_NBT)
head(Test[, 5])
```

`FuzzyGaussianNaiveBayes`

Gaussian Naive Bayes Classifier

Description

`FuzzyGaussianNaiveBayes` Gaussian Naive Bayes Classifier Zadeh-based

Usage

```
FuzzyGaussianNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`cores`	how many cores of the computer do you want to use (default = 2)
`fuzzy`	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Machado LS (2012). "Online Assessment in Medical Simulators Based on Virtual Reality Using Fuzzy Gaussian Naive Bayes." *Journal of Multiple-Valued Logic & Soft Computing*, **18**.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_GNB <- FuzzyGaussianNaiveBayes(
```

```
  train = Train[, -5],
  cl = Train[, 5], cores = 2
)

pred_GNB <- predict(fit_GNB, test)

head(pred_GNB)
head(Test[, 5])
```

FuzzyNaiveBayes *Fuzzy Naive Bayes*

Description

FuzzyNaiveBayes Fuzzy Naive Bayes

Usage

```
FuzzyNaiveBayes(train, cl, fuzzy = TRUE, m = NULL, Pi = NULL)
```

Arguments

train	matrix or data frame of training set cases.
cl	factor of true classifications of training set
fuzzy	boolean variable to use the membership function
m	is M/N, where M is the number of classes and N is the number of train lines
Pi	is 1/M, where M is the number of classes

Value

A vector of classifications

References

Moraes RM, Machado LS (2009). "Another approach for fuzzy naive bayes applied on online training assessment in virtual reality simulators." In *Proceedings of Safety Health and Environmental World Congress*, 62–66.

Examples

```
set.seed(1) # determining a seed
data(HouseVotes84, package = "mlbench")

# Splitting into Training and Testing
split <- caTools::sample.split(t(HouseVotes84[, 1]), SplitRatio = 0.7)
Train <- subset(HouseVotes84, split == "TRUE")
Test <- subset(HouseVotes84, split == "FALSE")
```

```
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -1]
fit_FNB <- FuzzyNaiveBayes(
  train = Train[, -1],
  cl = Train[, 1]
)

pred_FNB <- predict(fit_FNB, test)

head(pred_FNB)
head(Test[, 1])
```

`FuzzyPoissonNaiveBayes` *Fuzzy Poisson Naive Bayes*

Description

`FuzzyPoissonNaiveBayes` Fuzzy Poisson Naive Bayes

Usage

```
FuzzyPoissonNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`cores`	how many cores of the computer do you want to use (default = 2)
`fuzzy`	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Machado LS (2015). "A fuzzy poisson naive bayes classifier for epidemiological purposes." In *2015 7th International Joint Conference on Computational Intelligence (IJCCI)*, volume 2, 193–198. IEEE.

Examples

```
set.seed(1) # determining a seed
class1 <- data.frame(vari1 = rpois(100,lambda = 2),
                     vari2 = rpois(100,lambda = 2),
                     vari3 = rpois(100,lambda = 2), class = 1)
class2 <- data.frame(vari1 = rpois(100,lambda = 1),
                     vari2 = rpois(100,lambda = 1),
                     vari3 = rpois(100,lambda = 1), class = 2)
class3 <- data.frame(vari1 = rpois(100,lambda = 5),
                     vari2 = rpois(100,lambda = 5),
                     vari3 = rpois(100,lambda = 5), class = 3)
data <- rbind(class1,class2,class3)

# Splitting into Training and Testing
split <- caTools::sample.split(t(data[, 1]), SplitRatio = 0.7)
Train <- subset(data, split == "TRUE")
Test <- subset(data, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -4]
fit_NBT <- FuzzyPoissonNaiveBayes(
  train = Train[, -4],
  cl = Train[, 4], cores = 2
)

pred_NBT <- predict(fit_NBT, test)

head(pred_NBT)
head(Test[, 4])
```

FuzzyTriangularNaiveBayes

FuzzyTriangularNaiveBayes *Naive Bayes Trianglar Classifier*

Description

FuzzyTriangularNaiveBayes Naive Bayes Trianglar Classifier

Usage

```
FuzzyTriangularNaiveBayes(train, cl, cores = 2, fuzzy = TRUE)
```

Arguments

train	matrix or data frame of training set cases.
cl	factor of true classifications of training set
cores	how many cores of the computer do you want to use (default = 2)
fuzzy	boolean variable to use the membership function

Value

A vector of classifications

References

Moraes RM, Silva ILA, Machado LS (2020). "Online skills assessment in training based on virtual reality using a novel fuzzy triangular naive Bayes network." In *Developments of Artificial Intelligence Technologies in Computation and Robotics: Proceedings of the 14th International FLINS Conference (FLINS 2020)*, 446–454. World Scientific.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_NBT <- FuzzyTriangularNaiveBayes(
  train = Train[, -5],
  cl = Train[, 5], cores = 2
)

pred_NBT <- predict(fit_NBT, test)

head(pred_NBT)
head(Test[, 5])
```

GauNBFuzzyParam *Fuzzy Gaussian Naive Bayes Classifier with Fuzzy parameters*

Description

`GauNBFuzzyParam` Fuzzy Gaussian Naive Bayes Classifier with Fuzzy parameters

Usage

```
GauNBFuzzyParam(train, cl, metd = 1, cores = 2)
```

Arguments

train	matrix or data frame of training set cases.
cl	factor of true classifications of training set
metd	Method of transforming the triangle into scalar, It is the type of data entry for the test sample, use metd 1 if you want to use the Baricentro technique and use metd 2 if you want to use the Q technique of the uniformity test (article: Directional Statistics and Shape analysis).
cores	how many cores of the computer do you want to use (default = 2)

Value

A vector of classifications

References

Moraes RM, Ferreira JA, Machado LS (2021). "A New Bayesian Network Based on Gaussian Naive Bayes with Fuzzy Parameters for Training Assessment in Virtual Simulators." *International Journal of Fuzzy Systems*, **23**(3), 849–861.

Examples

```
set.seed(1) # determining a seed
data(iris)

# Splitting into Training and Testing
split <- caTools::sample.split(t(iris[, 1]), SplitRatio = 0.7)
Train <- subset(iris, split == "TRUE")
Test <- subset(iris, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -5]
fit_FGNB <- GauNBFuzzyParam(
  train = Train[, -5],
  cl = Train[, 5], metd = 1, cores = 2
)

pred_FGNB <- predict(fit_FGNB, test)

head(pred_FGNB)
head(Test[, 5])
```

`PoiNBFuzzyParam` *Fuzzy Poisson Naive Bayes Classifier with Fuzzy parameters*

Description

`PoiNBFuzzyParam` Fuzzy Poisson Naive Bayes Classifier with Fuzzy parameters

Usage

```
PoiNBFuzzyParam(train, cl, metd = 1, cores = 2)
```

Arguments

`train`	matrix or data frame of training set cases.
`cl`	factor of true classifications of training set
`metd`	Method of transforming the triangle into scalar, It is the type of data entry for the test sample, use metd 1 if you want to use the Baricentro technique and use metd 2 if you want to use the Q technique of the uniformity test (article: Directional Statistics and Shape analysis).
`cores`	how many cores of the computer do you want to use (default = 2)

Value

A vector of classifications

References

Soares E, Machado L, Moraes R (2016). "Assessment of poisson naive bayes classifier with fuzzy parameters using data from different statistical distributions." In *IV Bazilian Congress on Fuzzy Sistems (CBSF 2016)*, volume 1, 57–68.

Examples

```
set.seed(1) # determining a seed
class1 <- data.frame(vari1 = rpois(100,lambda = 2),
                     vari2 = rpois(100,lambda = 2),
                     vari3 = rpois(100,lambda = 2), class = 1)
class2 <- data.frame(vari1 = rpois(100,lambda = 1),
                     vari2 = rpois(100,lambda = 1),
                     vari3 = rpois(100,lambda = 1), class = 2)
class3 <- data.frame(vari1 = rpois(100,lambda = 5),
                     vari2 = rpois(100,lambda = 5),
                     vari3 = rpois(100,lambda = 5), class = 3)
data <- rbind(class1,class2,class3)

# Splitting into Training and Testing
split <- caTools::sample.split(t(data[, 1]), SplitRatio = 0.7)
```

```
Train <- subset(data, split == "TRUE")
Test <- subset(data, split == "FALSE")
# ----------------
# matrix or data frame of test set cases.
# A vector will be interpreted as a row vector for a single case.
test <- Test[, -4]
fit_FPoiNB <- PoiNBFuzzyParam(
  train = Train[, -4],
  cl = Train[, 4], metd = 1, cores = 2
)

pred_FPoiNB <- predict(fit_FPoiNB, test)

head(pred_FPoiNB)
head(Test[, 4])
```

`SimulatedData` *Simulated Data*

Description

A dataset containing training data from Gammma Distribuition

Usage

```
SimulatedData
```

Format

A dataset with 600 rows and 4 variables with 1 label.

`VirtualRealityData` *Virtual Reality Simulator Data*

Description

A dataset containing training data from a virtual reality simulator

Usage

```
VirtualRealityData
```

Format

A dataset with 600 rows and 4 variables with 1 label.

Index

∗ **datasets**
SimulatedData, 15
VirtualRealityData, 15

ExpNBFuzzyParam, 2

FuzzyBetaNaiveBayes, 3
FuzzyBinomialNaiveBayes, 4
FuzzyExponentialNaiveBayes, 5
FuzzyGammaNaiveBayes, 7
FuzzyGaussianNaiveBayes, 8
FuzzyNaiveBayes, 9
FuzzyPoissonNaiveBayes, 10
FuzzyTriangularNaiveBayes, 11

GauNBFuzzyParam, 12

PoiNBFuzzyParam, 14

SimulatedData, 15

VirtualRealityData, 15