# Package 'PPtreeViz'

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**Title** Projection Pursuit Classification Tree Visualization

**Description** Tools for exploring projection pursuit classification tree using various projection pursuit indexes.

**Version** 2.0.4

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**Depends** R (>= 2.10), gridExtra, ggplot2, partykit, Rcpp

**Suggests** MASS (>= 3.1-20), stats

**LinkingTo** Rcpp, RcppArmadillo

**License** GPL (>= 2)

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## Contents

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`ENTROPYindex1D` *ENTROPY PPindex*

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## Description

ENTROPY projection pursuit index

## Usage

```
ENTROPYindex1D(origclass,origdata,proj)
```

## Arguments

| | |
|---|---|
| `origclass` | class information vector |
| `origdata` | data matrix without class information |
| `proj` | projection matrix |

## Details

Calculate ENTROPY projection pursuit index value

## Examples

```
data(iris)
ENTROPYindex1D(iris[,5],as.matrix(iris[,1,drop=FALSE]))
```

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`GINIindex1D` *GINI PPindex*

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## Description

GINI projection pursuit index

## Usage

```
GINIindex1D(origclass,origdata,proj)
```

## Arguments

| | |
|---|---|
| `origclass` | class information vector |
| `origdata` | data matrix without class information |
| `proj` | projection matrix |

## Details

Calculate GINI projection pursuit index value

## Examples

```
data(iris)
GINIindex1D(iris[,5],as.matrix(iris[,1,drop=FALSE]))
```

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`Huberplot` *Huber plot*

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## Description

Huber plot for 2D data

## Usage

```
Huberplot(origdata2D,origclass,PPmethod="LDA",weight=TRUE,r=1,
          lambda=0.5,opt.proj=TRUE,UserDefFtn=NULL,...)
```

## Arguments

| | |
|---|---|
| `origdata2D` | 2-dimensional numerical data for Huber plot |
| `origclass` | class information vector of data |
| `PPmethod` | method for projection pursuit; "LDA", "PDA", "Lr", "GINI", "ENTROPY", and "UserDef" |
| `weight` | weight flag in LDA, PDA and Lr index |
| `r` | r in Lr index |
| `lambda` | lambda in PDA index |
| `opt.proj` | flag to show the best projection in the plot |
| `UserDefFtn` | User defined index function when PPmethod="UserDef" |
| `...` | arguments to be passed to methods |

## Details

Draw Huber plot for 2-dimensional data with various PP indices and the histogram of the projected data onto the optimal projection to explore the behavior of the projection prsuit indices

## References

Lee, EK., Cook, D., Klinke, S., and Lumley, T.(2005) Projection Pursuit for Exploratory Supervised Classification, Journal of Computational and Graphical Statistics, 14(4):831-846.

## Examples

```
data(iris)
Huberplot(iris[,1:2],iris[,5],PPmethod="LDA")
```

## LDAindex *LDA PPindex*

### Description

LDA projection pursuit index

### Usage

```
LDAindex(origclass,origdata,proj,weight=TRUE)
```

### Arguments

| | |
|---|---|
| origclass | class information vector |
| origdata | data matrix without class information |
| proj | projection matrix |
| weight | weight flag in LDA |

### Details

Calculate LDA projection pursuit index value

### References

Lee, EK., Cook, D., Klinke, S., and Lumley, T.(2005) Projection Pursuit for exploratory supervised classification, Journal of Computational and Graphical statistics, 14(4):831-846.

### Examples

```
data(iris)
LDAindex(iris[,5],as.matrix(iris[,1:4]))
```

## LDAopt *PP optimization using LDA index*

### Description

PP optimization using LDA index

### Usage

```
LDAopt(origclass,origdata,q=1,weight=TRUE,...)
```

### Arguments

| | |
|---|---|
| origclass | class information vector of data |
| origdata | data matrix without class information |
| q | dimension of projection vector |
| weight | weight flag in LDA index |
| ... | arguments to be passed to methods |

### Details

Find the q-dimensional optimal projection using LDA projectin pursuit index

### Value

indexbest maximum LDA index value

projbest optimal q-dimensional projection matrix

origclass original class information vector

origdata original data matrix without class information

### References

Lee, EK., Cook, D., Klinke, S., and Lumley, T.(2005) Projection Pursuit for Exploratory Supervised Classification, Journal of Computational and Graphical Statistics, 14(4):831-846.

### Examples

```
data(iris)
LDA.proj.result <- LDAopt(iris[,5],iris[,1:4])
LDA.proj.result$indexbest
LDA.proj.result$projbest
```

---

## Lrindex *Lr PPindex*

---

### Description

Lr projection pursuit index

### Usage

```
Lrindex(origclass,origdata,proj,weight=TRUE,r=1)
```

### Arguments

| | |
|---|---|
| origclass | class information vector |
| origdata | data matrix without class information |
| proj | projection matrix |
| weight | weight flag in Lr index |
| r | r in Lr index |

### Details

Calculate Lr projection pursuit index value

### References

Lee, EK., Cook, D., Klinke, S., and Lumley, T.(2005) Projection Pursuit for exploratory supervised classification, Journal of Computational and Graphical statistics, 14(4):831-846.

### Examples

```
data(iris)
Lrindex(iris[,5],as.matrix(iris[,1:4]),r=1)
```

---

## PDAindex *PDA PPindex*

---

### Description

PDA projection pursuit index

### Usage

```
PDAindex(origclass,origdata,proj,weight=TRUE,lambda=0.1)
```

### Arguments

| | |
|---|---|
| origclass | class information vector |
| origdata | data matrix without class information |
| proj | projection matrix |
| weight | weight flag in PDA |
| lambda | lambda in PDA index |

### Details

Calculate PDA projection pursuit index value

## References

Lee, EK., Cook, D.(2010) A projection pursuit index for large p small n data, Statistics and Computing, 20:381-392.

## Examples

```
data(iris)
PDAindex(iris[,5],as.matrix(iris[,1:4]),lambda=0.2)
```

---

PDAopt *PP optimization using PDA index*

---

## Description

PP optimization using PDA index

## Usage

```
PDAopt(origclass,origdata,q=1,weight=TRUE,lambda=0.1,...)
```

## Arguments

| | |
|---|---|
| origclass | class information vector of data |
| origdata | data matrix without class information |
| q | dimension of projection vector |
| weight | weight flag in PDA index |
| lambda | lambda in PDA index |
| ... | arguments to be passed to methods |

## Details

Find the q-dimensional optimal projection using PDA projectin pursuit index

## Value

indexbest maximum PDA index value

projbest optimal q-dimensional projection matrix

origclass original class information vector

origdata original data matrix without class information

## References

Lee, EK, Cook, D.(2010) A Projection Pursuit Index for Large p Small n Data, Statistics and Computing, 20:381-392.

## Examples

```
data(iris)
PDA.proj.result <- PDAopt(iris[,5],iris[,1:4],weight=TRUE,q=2,lambda=0.1)
PDA.proj.result$indexbest
PDA.proj.result$projbest
```

---

`plot.PPtreeclass` *PPtree plot*

---

## Description

projection pursuit classification tree plot

## Usage

```
## S3 method for class 'PPtreeclass'
plot(
  x,
  font.size = 17,
  width.size = 1,
  main = "Projection Pursuit Classification Tree",
  sub = NULL,
  ...
)
```

## Arguments

| | |
|---|---|
| `x` | PPtreeclass object |
| `font.size` | font size of plot |
| `width.size` | size of eclipse in each node. |
| `main` | main title |
| `sub` | sub title |
| `...` | arguments to be passed to methods |

## Details

Draw projection pursuit classification tree with tree structure. It is modified from a function in party library.

## References

Lee, EK(2017) PPtreeViz: An R Package for Visualizing Projection Pursuit Classification Trees, Journal of Statistical Software <doi:10.18637/jss.v083.i08>

## Examples

```
data(iris)
Tree.result <- PPTreeclass(Species~., data = iris,"LDA")
Tree.result
plot(Tree.result)
```

---

PPclassify *predict PPtree*

---

## Description

predict projection pursuit classification tree

## Usage

```
PPclassify(Tree.result,test.data,Rule,true.class=NULL,...)
```

## Arguments

| | |
|---|---|
| Tree.result | PPtreeclass object |
| test.data | the test dataset |
| Rule | split rule 1: mean of two group means 2: weighted mean of two group means - weight with group size 3: weighted mean of two group means - weight with group sd 4: weighted mean of two group means - weight with group se 5: mean of two group medians 6: weighted mean of two group medians - weight with group size 7: weighted mean of two group median - weight with group IQR 8: weighted mean of two group median - weight with group IQR and size |
| true.class | true class of test dataset if available |
| ... | arguments to be passed to methods |

## Details

Predict class for the test set with the fitted projection pursuit classification tree and calculate prediction error.

## Value

predict.class predicted class

predict.error number of the prediction errors

## References

Lee, YD, Cook, D., Park JW, and Lee, EK(2013) PPtree: Projection Pursuit Classification Tree, Electronic Journal of Statistics, 7:1369-1386.

## Examples

```
data(iris)
n <- nrow(iris)
tot <- c(1:n)
n.train <- round(n*0.9)
train <- sample(tot,n.train)
test <- tot[-train]
Tree.result <- PPTreeclass(Species~.,data=iris[train,],"LDA")
PPclassify(Tree.result,iris[test,1:4],1,iris[test,5])
```

---

PPclassNodeViz *PPtree node visualization*

---

## Description

Visualization tools to explore each node of PPtree

## Usage

```
PPclassNodeViz(PPclassOBJ,node.id,Rule,legend,std,image,diff.prop)
```

## Arguments

| | |
|---|---|
| PPclassOBJ | PPregclass object |
| node.id | node ID |
| Rule | cutoff rule |
| legend | flag to represent legend in the plot. Default value is TRUE |
| std | flag to standardize data before drawing plot |
| image | flag to draw image plot of correlation matrix |
| diff.prop | percentage of number of variables with significant differences and shown in red in the bar chart style means |

## Details

For the inner node, four plots are provided - the bar chart style plot with projection pursuit coefficients of each variable, the histogram of the projected data, the bar chart style plots with means of each variables for the left and the right group, and the image plot of correlations.

## References

Lee, YD, Cook, D., Park JW, and Lee, EK(2013) PPtree: Projection Pursuit Classification Tree, Electronic Journal of Statistics, 7:1369-1386.

## Examples

```
data(iris)
Tree.result <- PPTreeclass(Species~., data = iris,"LDA")
Tree.result
PPclassNodeViz(Tree.result,1,1)
```

---

PPopt *Projection pursuit optimization*

---

## Description

PP optimization using various projection pursuit indices

## Usage

```
PPopt(origclass,origdata,q=1,PPmethod="LDA",weight=TRUE,r=1,
             lambda=0.1,energy=0,cooling=0.999,TOL=0.0001,maxiter = 50000)
```

## Arguments

| | |
|---|---|
| origclass | class information vector |
| origdata | data matrix without class information |
| q | dimension of projection matrix |
| PPmethod | method for projection pursuit; "LDA", "PDA", "Lr", "GINI", and "ENTROPY" |
| weight | weight flag in LDA, PDA and Lr index |
| r | r in Lr index |
| lambda | lambda in PDA index |
| energy | energy parameter |
| cooling | cooling parameter |
| TOL | tolerance |
| maxiter | number of maximum iteration |

## Details

Find the q-dim optimal projection using various projectin pursuit indices with class information

## Value

indexbest maximum LDA index value

projbest optimal q-dim projection matrix

origclass original class information vector

origdata original data matrix without class information

## References

Lee, EK., Cook, D., Klinke, S., and Lumley, T.(2005) Projection Pursuit for exploratory supervised classification, Journal of Computational and Graphical statistics, 14(4):831-846.

## Examples

```
data(iris)
PP.proj.result <- PPopt(iris[,5],as.matrix(iris[,1:4]))
PP.proj.result
```

---

`PPoptViz` *PPopt visualization*

---

## Description

Visualize PPopt result

## Usage

```
PPoptViz(PPoptOBJ)
```

## Arguments

| | |
|---|---|
| `PPoptOBJ` | PPoptim object. result from LDAopt, PDAopt, and PPopt |

## Details

Visualize the result of projection pursuit optimization

## References

Lee, EK(2017) PPtreeViz: An R Package for Visualizing Projection Pursuit Classification Trees, Journal of Statistical Software <doi:10.18637/jss.v083.i08>

## Examples

```
data(iris)
PPoptViz(LDAopt(iris[,5],iris[,1:4],q=1))
PPoptViz(LDAopt(iris[,5],iris[,1:4],q=2))
```

PPTreeclass *Projection pursuit classification tree*

## Description

Construct the projection pursuit classification tree

## Usage

```
PPTreeclass(formula,data, PPmethod="LDA",weight=TRUE,
                    r=1,lambda=0.1,energy=0,maxiter=50000,...)
```

## Arguments

| | |
|---|---|
| formula | an object of class "formula" |
| data | data frame |
| PPmethod | method for projection pursuit; "LDA", "PDA", "Lr", "GINI", and "ENTROPY" |
| weight | weight flag in LDA, PDA and Lr index |
| r | r in Lr index |
| lambda | lambda in PDA index |
| energy | parameter for the probability to take new projection |
| maxiter | maximum iteration number |
| ... | arguments to be passed to methods |

## Details

Find tree structure using various projection pursuit indices of classification in each split.

## Value

Tree.Struct tree structure of projection pursuit classification tree

projbest.node 1 dimensional optimal projections of each node split

splitCutoff.node cutoff values of each node split

origclass original class

origdata original data

## References

Lee, YD, Cook, D., Park JW, and Lee, EK(2013) PPtree: Projection Pursuit Classification Tree, Electronic Journal of Statistics, 7:1369-1386.

## Examples

```
data(iris)
Tree.result <- PPTreeclass(Species~.,data = iris,"LDA")
Tree.result
```

`predict.PPtreeclass` *predict PPtree*

## Description

predict projection pursuit classification tree

## Usage

```
## S3 method for class 'PPtreeclass'
predict(object, newdata = NULL, Rule = 1, ...)
```

## Arguments

| | |
|---|---|
| `object` | a fitted object of class inheriting from "PP.Tree.class" |
| `newdata` | the test dataset |
| `Rule` | split rule 1: mean of two group means 2: weighted mean of two group means - weight with group size 3: weighted mean of two group means - weight with group sd 4: weighted mean of two group means - weight with group se 5: mean of two group medians 6: weighted mean of two group medians - weight with group size 7: weighted mean of two group median - weight with group IQR 8: weighted mean of two group median - weight with group IQR and size |
| `...` | arguments to be passed to methods |

## Details

Predict class for the test set with the fitted projection pursuit classification tree and calculate prediction error.

## References

Lee, YD, Cook, D., Park JW, and Lee, EK(2013) PPtree: Projection Pursuit Classification Tree, Electronic Journal of Statistics, 7:1369-1386.

## Examples

```
data(iris)
n <- nrow(iris)
tot <- c(1:n)
n.train <- round(n*0.9)
train <- sample(tot,n.train)
test <- tot[-train]
Tree.result <- PPTreeclass(Species~., data=iris[train,],"LDA")
predict(Tree.result)
```

`print.PPtreeclass` *Print PP.Tree.class result*

## Description

Print PP.Tree.class result

## Usage

```
## S3 method for class 'PPtreeclass'
print(x, coef.print = FALSE, cutoff.print = FALSE, verbose = TRUE, ...)
```

## Arguments

| | |
|---|---|
| `x` | PPtreeclass object |
| `coef.print` | print projection coefficients in each node ifTRUE |
| `cutoff.print` | print cutoff values in each node if TRUE |
| `verbose` | print if TRUE, no output if FALSE |
| `...` | arguments to be passed to methods |

## Details

Print the projection pursuit classification tree result

## References

Lee, EK(2017) PPtreeViz: An R Package for Visualizing Projection Pursuit Classification Trees, Journal of Statistical Software <doi:10.18637/jss.v083.i08>

## Examples

```
data(iris)
Tree.result <- PPTreeclass(Species~.,data = iris,"LDA")
Tree.result
print(Tree.result,coef.print=TRUE,cutoff.print=TRUE)
```

# Index