

# Package ‘MiPP’

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**Title** Misclassification Penalized Posterior Classification

**Author** HyungJun Cho <hj4cho@korea.ac.kr>,  
Sukwoo Kim <s4kim@korea.ac.kr>,  
Mat Soukup <soukup@fda.gov>, and  
Jae K. Lee <jaeklee@virginia.edu>

**Maintainer** Sukwoo Kim <s4kim@korea.ac.kr>

**Depends** R (>= 2.4)

**Imports** Biobase, e1071, MASS, stats

**Description** This package finds optimal sets of genes that separate samples into two or more classes.

**License** GPL (>= 2)

**URL** <http://www.healthsystem.virginia.edu/internet/hes/biostat/bioinformatics/>

**biocViews** Microarray, Classification

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colon	<i>Gene expression data for colon cancer</i>
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**Description**

This data set consists of gene expression of colon cancer study.

**Usage**

data(colon)

**Format**

A matrix containing 2000 probe sets and 2 classes (T, F)

**Source**

Alon, U., Barkai, N., Notterman, D.A., Gish, K., Ybarra, S., Mack, D., Levine, A.J. (1999). Broad Patterns of Gene Expression Revealed by Clustering Analysis of Tumor and Normal Colon Tissues probed by Oligonucleotide Arrays, PNAS, 96(12), 6745–6750.

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cv.mipp.rule	<i>Fitting cross-validation MiPP</i>
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**Description**

Fits cross-validation MiPP

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get.mipp	<i>Choosing a rule</i>
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---

**Description**

Choose a rule to compute MiPP

---

get.mipp.lda                      *Fitting LDA to compute MiPP*

---

**Description**

Fits LDA to compute MiPP

---

get.mipp.logistic                *Fitting logistic model to compute MiPP*

---

**Description**

Fits logistic model to compute MiPP

---

get.mipp.qda                      *Fitting QDA to compute MiPP*

---

**Description**

Fits QDA to compute MiPP

---

get.mipp.svm.linear              *Fitting SVM (linear) to compute MiPP*

---

**Description**

Fits SVM (linear) to compute MiPP

---

get.mipp.svm.rbf                 *Fitting SVM (RBF) to compute MiPP*

---

**Description**

Fits SVM (RBF) to compute MiPP

---

leuk1

*Gene expression data for leukemia*

---

**Description**

This data set consists of gene expression of leukemia study.

**Usage**

```
data(leukemia)
```

**Format**

A matrix containing 6817 probe sets and 38 samples (2 classes: AML, ALL)

**Source**

Golub, T.R., Slonim, D.K., Tamayo, P., Huard, C., Gaasenbeek, M., Mesirov, P., Coller, H., Loh, M.L., Downing, J.R., Caliguri, M.A., Bloomfield, C.D., and Lander, E.S. (1999) Molecular classification of cancer: class discovery and class prediction by gene expression monitoring. *Science*, 286, 531-537.

---

leuk2

*Gene expression data for leukemia*

---

**Description**

This data set consists of gene expression of leukemia study.

**Usage**

```
data(leukemia)
```

**Format**

A matrix containing 6817 probe sets and 34 samples (2 classes: AML, ALL)

**Source**

Golub, T.R., Slonim, D.K., Tamayo, P., Huard, C., Gaasenbeek, M., Mesirov, P., Coller, H., Loh, M.L., Downing, J.R., Caliguri, M.A., Bloomfield, C.D., and Lander, E.S. (1999) Molecular classification of cancer: class discovery and class prediction by gene expression monitoring. *Science*, 286, 531-537.

---

leukemia

*Gene expression data for leukemia*


---

**Description**

This data set consists of gene expression of leukemia study.

**Usage**

```
data(leukemia)
```

**Format**

A matrix containing 6817 probe sets and 2 classes (AML, ALL)

**Source**

Golub, T.R., Slonim, D.K., Tamayo, P., Huard, C., Gaasenbeek, M., Mesirov, P., Coller, H., Loh, M.L., Downing, J.R., Caligiuri, M.A., Bloomfield, C.D., and Lander, E.S. (1999) Molecular classification of cancer: class discovery and class prediction by gene expression monitoring. *Science*, 286, 531-537.

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linearkernel.decision.function

*SVM (linear) kernel to compute MiPP*


---

**Description**

SVM (linear) kernel to compute MiPP

---

mipp

*MiPP-based Classification*


---

**Description**

Finds optimal sets of genes for classification

**Usage**

```
mipp(x, y, x.test = NULL, y.test = NULL, probe.ID = NULL,
     rule = "lda", method.cut = "t.test", percent.cut = 0.01,
     model.sMiPP.margin = 0.01, min.sMiPP = 0.85, n.drops = 2,
     n.fold = 5, p.test = 1/3, n.split = 20,
     n.split.eval = 100)
```

**Arguments**

<code>x</code>	data matrix
<code>y</code>	class vector
<code>x.test</code>	test data matrix if available
<code>y.test</code>	test class vector if available
<code>probe.ID</code>	probe set IDs; if NULL, row numbers are assigned.
<code>rule</code>	classification rule: "lda","qda","logistic","svmlin","svmrbf"; the default is "lda".
<code>method.cut</code>	method for pre-selection; t-test is available.
<code>percent.cut</code>	proportion of pre-selected genes; the default is 0.01.
<code>model.sMiPP.margin</code>	smallest set of genes s.t. $sMiPP \leq (\max sMiPP - \text{model.sMiPP.margin})$ ; the default is 0.01.
<code>min.sMiPP</code>	Adding genes stops if max sMiPP is at least min.sMiPP; the default is 0.85.
<code>n.drops</code>	Adding genes stops if sMiPP decreases (n.drops) times, in addition to min.sMiPP criterion.; the default is 2.
<code>n.fold</code>	number of folds; default is 5.
<code>p.test</code>	partition percent of train and test samples when test samples are not available; the default is 1/3 for test set.
<code>n.split</code>	number of splits; the default is 20.
<code>n.split.eval</code>	numbr of splits for evaluation; the default is 100.

**Value**

<code>model</code>	candidate genes (for each split if no indep set is available)
<code>model.eval</code>	Optimal sets of genes for each split when no indep set is available

**Author(s)**

Soukup M, Cho H, and Lee JK

**References**

Soukup M, Cho H, and Lee JK (2005). Robust classification modeling on microarray data using misclassification penalized posterior, *Bioinformatics*, 21 (Suppl): i423-i430.

Soukup M and Lee JK (2004). Developing optimal prediction models for cancer classification using gene expression data, *Journal of Bioinformatics and Computational Biology*, 1(4) 681-694

**Examples**

```
#####
#Example 1: When an independent test set is available

data(leukemia)

#Normalize combined data
leukemia <- cbind(leuk1, leuk2)
leukemia <- mipp.preproc(leukemia, data.type="MAS4")

#Train set
```

```

x.train <- leukemia[,1:38]
y.train <- factor(c(rep("ALL",27),rep("AML",11)))

#Test set
x.test <- leukemia[,39:72]
y.test <- factor(c(rep("ALL",20),rep("AML",14)))

#Compute MiPP
out <- mipp(x=x.train, y=y.train, x.test=x.test, y.test=y.test, probe.ID = 1:nrow(x.train), n.fold=5, percent.

#Print candidate models
out$model

#####
#Example 2: When an independent test set is not available

data(colon)

#Normalize data
x <- mipp.preproc(colon)
y <- factor(c("T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "T", "T", "T", "T", "T",
             "T", "T", "T", "T", "T", "T", "T", "T", "N", "T",
             "T", "N", "N", "T", "T", "T", "T", "N", "T", "N",
             "N", "T", "T", "N", "N", "T", "T", "T", "T", "N",
             "T", "N"))

#Deleting contaminated chips
x <- x[,-c(51,55,45,49,56)]
y <- y[ -c(51,55,45,49,56)]

#Compute MiPP
out <- mipp(x=x, y=y, probe.ID = 1:nrow(x), n.fold=5, p.test=1/3, n.split=5, n.split.eval=100,
percent.cut= 0.1, rule="lda")

#Print candidate models for each split
out$model

#Print optimal models and independent evaluation for each split
out$model.eval

```

---

mipp.preproc

*Preprocessing*


---

## Description

Performs IQR normalization, thesholding, and log2-transformation

**Usage**

```
mipp.preproc(x, data.type = "MAS5")
```

**Arguments**

```
x          data
data.type  data type is MAS5, MAS4, or dChip
```

**See Also**

[mipp](#)

**Examples**

```
library(MiPP)

data(colon)
colon.nor <- mipp.preproc(colon)
```

---

mipp.rule	<i>Computing MiPP</i>
-----------	-----------------------

---

**Description**

Computes MiPP

---

mipp.seq	<i>MiPP-based Classification</i>
----------	----------------------------------

---

**Description**

sequentially finds optimal sets of genes for classification

**Usage**

```
mipp.seq(x, y, x.test = NULL, y.test = NULL, probe.ID = NULL,
rule = "lda", method.cut = "t.test", percent.cut = 0.01,
model.sMiPP.margin = 0.01, min.sMiPP = 0.85, n.drops = 2,
n.fold = 5, p.test = 1/3, n.split = 20, n.split.eval = 100,
n.seq=3, cutoff.sMiPP=0.7, remove.gene.each.model="all")
```

**Arguments**

x	data matrix
y	class vector
x.test	test data matrix if available
y.test	test class vector if available
probe.ID	probe set IDs; if NULL, row numbers are assigned.
rule	classification rule: "lda","qda","logistic","svmlin","svmln","svmrbf"; the default is "lda".
method.cut	method for pre-selection; t-test is available.
percent.cut	proportion of pre-selected genes; the default is 0.01.
model.sMiPP.margin	smallest set of genes s.t. sMiPP <= (max sMiPP-model.sMiPP.margin); the default is 0.01.
min.sMiPP	Adding genes stops if max sMiPP is at least min.sMiPP; the default is 0.85.
n.drops	Adding genes stops if sMiPP decreases (n.drops) times, in addition to min.sMiPP criterion.; the default is 2.
n.fold	number of folds; default is 5.
p.test	partition percent of train and test samples when test samples are not available; the default is 1/3 for test set.
n.split	number of splits; the default is 20.
n.split.eval	numbr of splits for evaluation; the default is 100.
n.seq	Number of sequential gene model selection; the default is 3.
cutoff.sMiPP	Cutoff point of 5 percent sMiPP to select gene models
remove.gene.each.model	Re-run after removing all genes in the selected models if "all" and the first gene for each of the selected models if "first"

**Value**

model	candiadate genes (for each split if no indep set is available)
model.eval	Optimal sets of genes for each split when no indep set is available
genes.selected	a list of genes selected by sequential selection

**Author(s)**

Soukup M, Cho H, and Lee JK

**References**

- Soukup M, Cho H, and Lee JK (2005). Robust classification modeling on microarray data using misclassification penalized posterior, *Bioinformatics*, 21 (Suppl): i423-i430.
- Soukup M and Lee JK (2004). Developing optimal prediction models for cancer classification using gene expression data, *Journal of Bioinformatics and Computational Biology*, 1(4) 681-694

**Examples**

```
#####
#Example 1: When an independent test set is available

data(leukemia)

#Normalize combined data
leukemia <- cbind(leuk1, leuk2)
leukemia <- mipp.preproc(leukemia, data.type="MAS4")

#Train set
x.train <- leukemia[,1:38]
y.train <- factor(c(rep("ALL",27),rep("AML",11)))

#Test set
x.test <- leukemia[,39:72]
y.test <- factor(c(rep("ALL",20),rep("AML",14)))

#Compute MiPP
out <- mipp.seq(x=x.train, y=y.train, x.test=x.test, y.test=y.test, n.fold=5, percent.cut=0.01, rule="lda", n

#Print candidate models
out$model

#Print the genes selected
out$genes.selected

#####
#Example 2: When an independent test set is not available

data(colon)

#Normalize data
x <- mipp.preproc(colon)
y <- factor(c("T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N", "T", "N", "T", "N", "T", "N", "T", "N",
             "T", "N"))

#Deleting contaminated chips
x <- x[,-c(51,55,45,49,56)]
y <- y[ -c(51,55,45,49,56)]

#Compute MiPP
out <- mipp.seq(x=x, y=y, n.fold=5, p.test=1/3, n.split=5, n.split.eval=100,
percent.cut= 0.05, rule="lda", n.seq=2)

#Print candidate models for each split
out$model
```

```
#Print optimal models and independent evaluation for each split
out$model.eval
```

```
#Print the genes selected
out$genes.selected
```

---

```
pre.select          Pre-selection
```

---

### Description

Pre-select genes

---

```
quant.normal       Quantile normalization
```

---

### Description

Performs quantile normalization

---

```
quant.normal2     Quantile normalization
```

---

### Description

Performs quantile normalization

---

```
rbfkernel.decision.function
                   SVM (RBF) kernel to compute MiPP
```

---

### Description

SVM (RBF) kernel to compute MiPP

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