## Package ‘nnNorm’

March 29, 2017

**Version** 2.38.0  
**Date** 2010-04-13  
**Title** Spatial and intensity based normalization of cDNA microarray data based on robust neural nets  
**Author** Adi Laurentiu Tarca <atarca@med.wayne.edu>  
**Depends** R(>= 2.2.0), marray  
**Imports** graphics, grDevices, marray, methods, nnet, stats  
**Maintainer** Adi Laurentiu Tarca <atarca@med.wayne.edu>  
**Description** This package allows to detect and correct for spatial and intensity biases with two-channel microarray data. The normalization method implemented in this package is based on robust neural networks fitting.  
**biocViews** Microarray, TwoChannel, Preprocessing  
**License** LGPL  
**URL** [http://bioinformaticsprb.med.wayne.edu/tarca/](http://bioinformaticsprb.med.wayne.edu/tarca/)  
**NeedsCompilation** no

### R topics documented:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>compNorm</td>
<td>1</td>
</tr>
<tr>
<td>detectSpatialBias</td>
<td>3</td>
</tr>
<tr>
<td>maNormNN</td>
<td>4</td>
</tr>
</tbody>
</table>

**Description**

This function was conceived to easily compare several normalization methods in terms of variability of log-ratios, M. Basically it produces two plots: The first is the density plot of the several matrices passed as arguments, while the second is a box plot. Median of absolute deviations for each method is printed on screen.
Usage

```r
compNorm(x,...,bw="AUTO",xlim=c(-3,3),titles="AUTO",type="d")
```

Arguments

- `x` A vector of numerical values, e.g. the $M$ values of a data set: `as.vector(maM(swirl))`.
- `...` An undefined number of objects similar with `x`.
- `bw` Band width required to compute the density distribution. "AUTO" will adjust `bw` to a suitable value.
- `xlim` The range for abscissa of the density plots.
- `titles` Names to be displayed the charts legend. "AUTO" will use the matrices names passed as arguments.
- `type` If set to "d", density plot will be shown; if set to "d" box plot will be shown.

Details

This function is used to compare the normalized log ratios $M$ obtained with several normalization methods.

Value

NULL, this function only displays charts and prints on the screen some statistics.

Author(s)

Tarca, A.L.

References


See Also

`maNormNN`

Examples

```r
# Normalize swirl data with two methods
data(swirl)
swirlINN<-maNormNN(swirl[,1])
swirlLoess<-maNormMain(swirl[,1])
nms<-c("None","Loess","NNets")
# compare distributions: density plot
compNorm(as.vector(maM(swirl[,1])),as.vector(maM(swirlLoess)),as.vector(maM(swirlINN)),xlim=c(-2,2),bw="AUTO")
# compare distributions: box plot
compNorm(as.vector(maM(swirl[,1])),as.vector(maM(swirlLoess)),as.vector(maM(swirlINN)),xlim=c(-2,2),bw="AUTO")
```
**detectSpatialBias**

*Detecting spatial bias within the print-tips of a two channel array*

**Description**

This function allows to identify in two channel batch of arrays, which are the print-tips where spatial bias is present.

**Usage**

detectSpatialBias(mbatch, corThreshold=0.6)

**Arguments**

- `mbatch` A `marrayRaw` or `marrayNorm` batch of two channel arrays.
- `corThreshold` The correlation threshold to be used.

**Details**

This function computes two matrices: `biasRow` and `biasCol`. The elements of these matrices represent the fraction of rows (columns) for which the correlation coefficient between log-ratios, M, and column index (row index) is higher than a user specified threshold (default `corThreshold=0.6`). The idea here is to see in which print-tip an important fraction of the rows (columns) are highly correlated with the column (row) index. Since some rows (columns) will show positive correlation while the other negative correlation, we are only interested in a single direction of the correlation, i.e. either positive or negative.

**Value**

This function returns a list with two matrices, `biasRow` and `biasCol`. The rows of these matrices correspond to the print-tips counted metaRow wise, and the columns correspond to arrays. Values in these matrices superior to 33 point to print-tips that have more than a third of the rows (columns) with important spatial bias.

**Author(s)**

Tarca, A.L.

**References**


**See Also**

`maNormNN`
Examples

# detecting spatial bias in swirl data
data(swirl)
# print-tip, intensity and spatial normalization of the first slide in swirl data set
myres<-detectSpatialBias(swirl)

maNormNN

Intensity and spatial normalization using robust neural networks fitting

Description

This function normalizes a batch of cDNA arrays by removing the intensity and spatial dependent bias.

Usage

maNormNN(mbatch,w=NULL,binWidth=3,binHeight=3,model.nonlins=3,iterations=100,nFolds=10,maplots=FALSE,verbose=FALSE)

Arguments

mbatch
A marrayRaw or marrayNorm batch of arrays.

w
Weights to be assigned to each spot. If provided, it should be a vector with the same length as maNspots(mbatch).

binWidth
Width of the bins in the X direction (spot column) in which the print tip will be divided in order to account for spatial variation. Max value is maNsc(mbatch), Min value is 1. However if it is set to a number larger than maNsc(mbatch)/2 (so less than two bins in X direction) the variable X will not be used as predictor to estimate the bias.

binHeight
Height of the bins in the Y direction (spot row) in which the print tip will be divided in order to account for spatial variation. Max value is maNsr(mbatch), Min value is 1. However if it is set to a number larger than maNsr(mbatch)/2 (so less than two bins in Y direction) the variable Y will not be used as predictor to estimate the bias.

model.nonlins
Number of nodes in the hidden layer of the neural network model.

iterations
The number of iterations at which (if not converged) the training of the neural net will be stopped.

nFolds
Number of cross-validation folds. It represents the number of equal parts in which the data from a print tip is divided into: the model is trained on nFolds-1 parts and the bias is estimated for one part at the time. Higher values improve the results but increase the computation time. Ideal values are between 5 and 10.

maplots
If set to "TRUE" will produce a M - A plot for each slide before and after normalization.

verbose
If set to "TRUE" will show the output of the nnet function which is training the neural network models.

Details

This function uses neural networks to model the bias in cDNA data sets.
Value
A \texttt{marrayNorm} object containing the normalized log ratios. See \texttt{marrayNorm} class for details.

Author(s)
Tarca, A.L.

References

See Also
\texttt{compNorm}, \texttt{nnet}

Examples
\begin{verbatim}
# Normalization of swirl data
data(swirl)
# print-tip, intensity and spatial normalization of the first slide in swirl data set
swirlNN<-maNormNN(swirl[,1])

# do not consider spatial variations, and display M-A plots before and after normalization
swirlNN<-maNormNN(swirl[,1],binWidth=maNsc(swirl),binHeight=maNsr(swirl),maplots=TRUE)
\end{verbatim}
Index

*Topic **robust**
  maNormNN, 4

*Topic **smooth**
  maNormNN, 4

*Topic **spatial**
  detectSpatialBias, 3

*Topic **univar**
  compNorm, 1

  compNorm, 1, 5

  detectSpatialBias, 3

  maNormNN, 2, 3, 4