

Package ‘pickgene’

February 6, 2025

Version 1.79.0

Author Brian S. Yandell <yandell@stat.wisc.edu>

Title Adaptive Gene Picking for Microarray Expression Data Analysis

Description Functions to Analyze Microarray (Gene Expression) Data.

Maintainer Brian S. Yandell <yandell@stat.wisc.edu>

License GPL (>= 2)

Imports graphics, grDevices, MASS, stats, utils

URL <http://www.stat.wisc.edu/~yandell/statgen>

biocViews Microarray, DifferentialExpression

git_url <https://git.bioconductor.org/packages/pickgene>

git_branch devel

git_last_commit 681c91a

git_last_commit_date 2024-10-29

Repository Bioconductor 3.21

Date/Publication 2025-02-05

Contents

| | |
|-------------------------------|----|
| em.ggb | 2 |
| model.pickgene | 3 |
| oddsplot | 4 |
| pickgene | 5 |
| pickgene-internal | 8 |
| robustscale | 9 |
| Simulation.pickgene | 10 |

| | |
|--------------|-----------|
| Index | 13 |
|--------------|-----------|

em.ggb

*EM calculation for Gamma-Gamma-Bernoulli Model***Description**

The function plots contours for the odds that points on microarray show differential expression between two conditions (e.g. Cy3 and Cy5 dye channels on the same microarray).

Usage

```
em.ggb(x, y, theta, start = c(2,1.2,2.7), pprior = 2,
       printit = FALSE, tol = 1e-9, offset = 0 )
```

Arguments

| | |
|---------|--|
| x | first condition expression levels |
| y | second condition expression levels |
| theta | four parameters a, a0, nu, p |
| start | starting estimates for theta |
| pprior | Beta hyperparameter for prob p of differential expression |
| printit | print iterations if TRUE |
| tol | parameter tolerance for convergence |
| offset | offset added to xx and yy before taking log (can help with negative adjusted values) |

Details

Fit Gamma/Gamma/Bernoulli model (equal marginal distributions) The model has spot intensities $x \sim \text{Gamma}(a,b)$; $y \sim \text{Gamma}(a,c)$. The shape parameters b and c are $\sim \text{Gamma}(a0,nu)$. With probability p, $b = c$; otherwise $b \neq c$. All spots are assumed to be independent.

Value

Four parameter vector theta after convergence.

Author(s)

Michael Newton

References

MA Newton, CM Kendziorski, CS Richmond, FR Blattner and KW Tsui (2000) "On differential variability of expression ratios: improving statistical inference about gene expression changes from microarray data," *J Computational Biology* 00: 000-000.

See Also[oddsplot](#)**Examples**

```
## Not run:  
em.ggb( x, y )  
  
## End(Not run)
```

| | |
|----------------|---|
| model.pickgene | <i>Create Model Matrix for Orthogonal Contrasts</i> |
|----------------|---|

Description

The function created a model matrix of orthogonal contrasts to be used by pickgene.

Usage

```
model.pickgene(faclevel, facnames = letters[seq(length(faclevel))],  
               contrasts.fac = "contr.poly", collapse = "+", show =  
               NULL, renorm = 1, modeexpr = formula(paste("~",  
               paste(facnames, collapse = collapse))),  
               contrasts.list = contr.list)
```

Arguments

| | |
|----------------|--|
| faclevel | vector with number of levels for each factor |
| facnames | vector of factor names (default = "a", "b", ...) |
| contrasts.fac | vector of contrast types |
| collapse | "+" for additive model, "*" for full model with interactions |
| show | vector of contrast numbers to show (default is all) |
| renorm | vector to renormalize contrasts (e.g., use $\sqrt{2}$ to turn two-condition contrast into fold change) |
| modeexpr | model formula |
| contrasts.list | list of contrasts indexed by facnames |

Details

Creates a model matrix data frame with first column having all 1's and other columns having contrasts.

Value

Result of call to model.matrix

Author(s)

Brian Yandell

See Also[model.matrix](#)**Examples**

```
model.pickgene(c(2,3), c("sex","genotype"))
```

oddsplot

*Odds Plot for Differential Microarray Expression***Description**

The function plots contours for the odds that points on microarray show differential expression between two conditions (e.g. Cy3 and Cy5 dye channels on the same microarray).

Usage

```
oddsplot(x, y, theta, by.level = 10, rotate = FALSE, offset =
         0, main = "", xlab = xlabs, ylab = ylabs, col = NULL,
         cex = c(0.25, 0.75), shrink = FALSE, lims =
         range(c(x, y)))
```

Arguments

| | |
|----------|--|
| x | first condition expression levels |
| y | second condition expression levels |
| theta | four parameters from em.ggb |
| by.level | odds plot contours increase by this level |
| rotate | rotate to average versus ratio if TRUE, otherwise plot conditions against each other |
| offset | offset for log transform |
| main | main title for plot |
| xlab | horizontal axis label (default if Cy3 if rotate is FALSE, Average Intensity otherwise) |
| ylab | vertical axis label (default if Cy5 if rotate is FALSE, Cy3 / Cy5 otherwise) |
| col | color of points (if NULL, use black for non-changing points, blue for changing points) |
| cex | character expansion (use rep(.25, 2) to have all points the same size) |
| shrink | use shrinkage on expression levels if TRUE (default is FALSE) |
| lims | limits for plot area |

Details

Fit Gamma/Gamma/Bernoulli model (equal marginal distributions) The model has spot intensities $x \sim \text{Gamma}(a,b)$; $y \sim \text{Gamma}(a,c)$. The shape parameters b and c are $\sim \text{Gamma}(a_0, \nu)$. With probability p , $b = c$; otherwise $b \neq c$. All spots are assumed to be independent.

Value

Log odds for all points in original order.

Author(s)

Michael Newton

References

MA Newton, CM Kendzioriski, CS Richmond, FR Blattner and KW Tsui (2000) "On differential variability of expression ratios: improving statistical inference about gene expression changes from microarray data," *J Computational Biology* 00: 000-000.

See Also

[em.ggb](#)

Examples

```
## Not run:
oddsplot( x, y )

## End(Not run)
```

pickgene

Plot and Pick Genes based on Differential Expression

Description

The function picks plots the average intensity versus linear contrasts (currently linear, quadratic up to cubic) across experimental conditions. Critical line is determine according to Bonferroni-like multiple comparisons, allowing SD to vary with intensity.

Usage

```
pickgene(data, geneID = 1:nrow(data), overalllevel = 0.05,
          npickgene = -1, marginal = FALSE, rankbased = TRUE,
          allrank = FALSE, meanrank = FALSE, offset = 0,
          modelmatrix = model.pickgene(faclevel, facnames,
          contrasts.fac, collapse, show, renorm), faclevel =
          ncol(data), facnames =
          letters[seq(length(faclevel))], contrasts.fac =
```

```
"contr.poly", show = NULL, main = "", renorm = 1,
drop.negative = FALSE, plotit = npickgene < 1, mfrow
= c(nr, nc), mfcol = NULL, ylab = paste(shownames,
"Trend"), ...)
```

Arguments

| | |
|---------------|--|
| data | data matrix |
| geneID | gene identifier (default 1:nrow(x)) |
| overalllevel | overall significance level (default 0.05) |
| npickgene | number of genes to pick (default -1 allows automatic selection) |
| marginal | additive model if TRUE, include interactions if FALSE |
| rankbased | use ranks if TRUE, log transform if FALSE |
| allrank | rank all chips together if true, otherwise rank separately |
| meanrank | show mean abundance as rank if TRUE |
| offset | offset for log transform |
| modelmatrix | model matrix with first row all 1's and other rows corresponding to design contrasts; automatically created by call to model.pickgene if omitted |
| faclevel | number of factor levels for each factor |
| facnames | factor names |
| contrasts.fac | type of contrasts |
| show | vector of contrast numbers to show (default is all) |
| main | vector of main titles for plots (default is none) |
| renorm | vector to renormalize contrasts (e.g. use sqrt(2) to turn two-condition contrast into fold change) |
| drop.negative | drop negative values in log transform |
| plotit | plot if TRUE |
| mfrow | par() plot arrangement by rows (default up to 6 per page; set to NULL to not change) |
| mfcol | par() plot arrangement by columns (default is NULL) |
| ylab | vertical axis labels |
| ... | parameters for robustscale |

Details

Infer genes that differentially express across conditions using a robust data-driven method. Adjusted gene expression levels A are replaced by $qnorm(rank(A))$, followed by `robustscale` estimation of center and spread. Then Bonferroni-style gene by gene tests are performed and displayed graphically.

Value

Data frame containing significant genes with the following information:

`pick` data frame with picked genes
`score` data frame with center and spread for plotting

Each of these is a list with elements for each contrast. The `pick` data frame elements have the following information:

`probe` gene identifier
`average` average gene intensity
`fold1` positive fold change
`fold2` negative fold change
`pvalue` Bonferroni-corrected p-value

The `score` data frame elements have the following:

`x` mean expression level (antilog scale)
`y` contrast (antilog scale)
`center` center for contrast
`scale` scale (spread) for contrast
`lower` lower test limit
`upper` upper test limit

Author(s)

Yi Lin and Brian Yandell

References

Y Lin, BS Yandell and ST Nadler (2000) “Robust Data-Driven Inference for Gene Expression Microarray Experiments,” Technical Report, Department of Statistics, UW-Madison.

See Also

[pickgene](#)

Examples

```
## Not run:  
pickgene( data )  
  
## End(Not run)
```

pickgene-internal *Internal pickgene functions.*

Description

These are generally not to be called by the user.

Usage

```

adjustlevel(ntest, alpha)
chen.poly(cv, err)
chipnorm(xx, chip)
dencont(x, y, align, crit, xlim, ylim, dolog, byranks, dif,
        ave, numlines, levels.z)
dencum(x, y, align, crit, xlim, ylim, dolog, byranks,
        standardize, dif, ave, splineit, numlines, show,
        levels.z)
denlines(x, y, align, crit, xlim, ylim, dolog, dif, ave,
        numlines, offset)
do.oddsplot(data, main, theta, col, redo, conditions, identifier,
            ...)
fitgg(xx, yy, start)
gammaden(x, a, b)
holms(x, alpha, cut)
lod.ggb(x, y, theta)
lod.plot(data, x, y, theta, filename, probe, xlab, ylab, ps,
        col, lowlod, ...)
lodprobes(xx, yy, theta, lod, probes, col, lowlod, offset)
loglik(theta, xx, yy)
makecont(x, y, size, cex, levels)
multipickgene(...)
nlminb(start, objective, lower, xx, yy, zz, use.optim)
nloglik(theta, xx, yy)
normal.richmond(foo, channel)
npdiag(xx, yy, aa, a0, nu, pp)
nploglik(theta, xx, yy, zz)
orangene(n, center, spread, contamination, alpha, noise,
        omega)
pickedchisq(pick, show, title, plotit, alpha)
pickedhist(pick, show, title, p1, plotit, rotate, mfrow, bw)
pickedpair(x, columns, description, probe, renorm, pick, main,
            ...)
pickedscore(pick, description, show, alpha, xlab, ylab, main,
            mfrow)
pickgene2(...)
pickgene.poly(x, condi, geneID, overalllevel, npickgene, d, ylabs,
            contrastnames, ...)

```



```

pickgene.two(y, intensity, geneid, singlelevel, npickgene,
             meanrank, xlab, ylab, main, plotit, col, negative,
             ...)
pmarg(xx, yy, theta, nsupp)
predrecur(xx, theta, gridlim)
rangene(n, center, spread, contamination, alpha, noise,
        omega)
rankgene(xx, yy, fits)
robustbox(y, x, nslice, xlab, ylab, shrink, crit, overalllevel,
         cex, lwd, plotit)
s.check0(xx, yy, theta1, theta2, chip)
s.check1(xx, yy, theta, chip)
s.check2(foo, xa, ya, thetaa, xb, yb, thetab, spots)
shrinkplot(xx, yy, fits, chip)
sixden(x, y, align, crit, xlim, dolog, dif, ave)
s.marg(xx, yy, aa, a0, nuA, nu0, p)
toprankgene(yy, n)
twoarray.norm(foo, ..., conditions, reduce, identifier)
twoarray.plot(mydata, main, theta, conditions, identifier)
twowayanovapickgene(x, fac1level, fac2level, ...)

```

Author(s)

Brian S. Yandell, yandell@stat.wisc.edu

robustscale

Robust Estimation of Median (center) and MAD (scale)

Description

Smoothing spline estimate of median and mean absolute deviation (MAD).

Usage

```
robustscale(y, x, nslice=400, corcenter=TRUE, decrease=TRUE)
```

Arguments

| | |
|-----------|--------------------------------------|
| y | response |
| x | predictor |
| nslice | number of slices (should be "large") |
| corcenter | correct for center |
| decrease | force MAD to decrease with x |

Details

This divides data into roughly many nslice slices and computes median and mean absolute deviation (mad) for each slice. These are then smoothed using smooth.spline.

Value

Data frame containing significant genes with the following information:

| | |
|--------|-------------------------------|
| center | estimate of center median |
| scale | MAD estimate of scale |
| x | ordered x values for plotting |
| y | y sorted by x |

Author(s)

Yi Lin

See Also

[mad](#), [smooth.spline](#)

Examples

```
## Not run:  
robustscale(y,x)  
  
## End(Not run)
```

Simulation.pickgene *Yi Lin's simulations for microarray analysis*

Description

Example simulations

See Also

multipickgene

Examples

```
### Note: This uses old pickgene  
#detail of the model (7-8). (first run does not include meas error \eta_i)  
#par(mfrow=c(3,3))  
t<-rnorm(10000,4,2)  
changes1<-rep(0,10000)  
changes1[1:500]<-rnorm(500)  
t1<-t+changes1  
changes2<-rep(0,10000)  
changes2[1:500]<-rnorm(500)  
t2<-t+changes2  
s<-rnorm(10000,0,0.1)  
cx<-3
```

```

cy<-2
t1<-t1+rnorm(10000,0,0.1)
t2<-t2+rnorm(10000,0,0.1)
x<-cx*exp(t1)
y<-cy*exp(t2)
#x<-cx*exp(t1)+rnorm(10000,0,50)
#y<-cy*exp(t2)+rnorm(10000,0,40)
xx<-qnorm(rank(x)/(10000+1))
yy<-qnorm(rank(y)/(10000+1))
#hist(x,breaks=100)
#hist(y,breaks=100)
#plot(x,y)
#hist(y[x<=0],breaks=20)
#hist(x[y<=0],breaks=20)
#plot(xx,yy)
topgenepick<-multipickgene( cbind(xx,yy),condi=0:1,geneID=1:10000, d=1,
                           npickgene=500)$pick[[1]]$probe

abchangesrank<-rank((-1)*abs(t1-t2))
count <- rep(NA,500)
for( i in 1:500 ) {
  topipick <- topgenepick[1:i]
  count[i] <- sum( abchangesrank[topipick] <= i )
}

## Figure 2
plot( 1:500, 1:500, type="n",
      xlab="Rank of 500 most changed genes by our procedure",
      ylab="Number similarly ranked by the 'optimal' procedure",
      xaxs="i", yaxs="i" )
lines( 1:500, count, type="s", lty=1, lwd=2 )
abline(0,1)
## Not run: dev.print( hor=F, height=6.5, width=6.5, file="rank1.ps" )

#again, but with the additive noise. (includes \eta_i)
par(mfrow=c(2,2))
t<-rnorm(10000,4,2)
changes1<-rep(0,10000)
changes1[1:500]<-rnorm(500)
t1<-t+changes1
changes2<-rep(0,10000)
changes2[1:500]<-rnorm(500)
t2<-t+changes2
s<-rnorm(10000,0,0.1)
cx<-3
cy<-2
t1<-t1+rnorm(10000,0,0.1)
t2<-t2+rnorm(10000,0,0.1)
### note that noise is very large here (50,40)
x<-cx*exp(t1)+rnorm(10000,0,50)
y<-cy*exp(t2)+rnorm(10000,0,40)
xx<-qnorm(rank(x)/(10000+1))
yy<-qnorm(rank(y)/(10000+1))
hist(x,breaks=100)

```

```

hist(y,breaks=100)
plot(x,y,cex=0.4)
#hist(y[x<=0],breaks=20)
#hist(x[y<=0],breaks=20)
plot(xx,yy,cex=0.4)
## Not run: dev.print( hor=F, height=6.5, width=6.5, file="simudata.ps" )

topgenepick<-multipickgene(cbind(xx,yy),condi=0:1, geneID=1:10000, d=1,
                           npickgene=500)$pick[[1]]$probe
abchangesrank<-rank((-1)*abs(t1-t2))
count <- rep(NA,500)
for( i in 1:500 ) {
  topipick <- topgenepick[1:i]
  count[i] <- sum( abchangesrank[topipick] <= i )
}
par(mfrow=c(1,1)) # figure 4
plot( 1:500, 1:500, type="n",
      xlab="Rank of 500 most changed genes by our procedure",
      ylab="Number similarly ranked by the 'optimal' procedure",
      xaxs="i", yaxs="i" )
lines( 1:500, count, type="s", lty=1, lwd=2 )
abline(0,1)
## Not run: dev.print( hor=F, height=6.5, width=6.5, file="rank2.ps" )

### Figure 5
genepick <- multipickgene( cbind(xx,yy), condi=0:1, geneID=1:10000, d=1)
## Not run: dev.print( hor=F, height=6.5, width=6.5, file="simutest.ps" )$pick[[1]]$probe
npick<-length(genepick$pickedgene)
genepick$pickedgene
npick
count[npick]

```

Index

- * **hplot**
 - oddsplot, 4
 - pickgene, 5
- * **internal**
 - pickgene-internal, 8
- * **models**
 - em.ggb, 2
 - oddsplot, 4
 - pickgene, 5
- * **robust**
 - robustscale, 9
- * **smooth**
 - robustscale, 9
- * **utilities**
 - model.pickgene, 3
- adjustlevel (pickgene-internal), 8
- chen.poly (pickgene-internal), 8
- chipnorm (pickgene-internal), 8
- dencont (pickgene-internal), 8
- dencum (pickgene-internal), 8
- denlines (pickgene-internal), 8
- do.oddsplot (pickgene-internal), 8
- em.ggb, 2, 5
- fitgg (pickgene-internal), 8
- gammaden (pickgene-internal), 8
- holms (pickgene-internal), 8
- lod.ggb (pickgene-internal), 8
- lod.plot (pickgene-internal), 8
- lodprobes (pickgene-internal), 8
- loglik (pickgene-internal), 8
- mad, 10
- makecont (pickgene-internal), 8
- model.matrix, 4
- model.pickgene, 3
- multipickgene (pickgene-internal), 8
- nlminb (pickgene-internal), 8
- nloglik (pickgene-internal), 8
- normal.richmond (pickgene-internal), 8
- npdiag (pickgene-internal), 8
- nploglik (pickgene-internal), 8
- oddsplot, 3, 4
- orangene (pickgene-internal), 8
- pickedchisq (pickgene-internal), 8
- pickedhist (pickgene-internal), 8
- pickedpair (pickgene-internal), 8
- pickedscore (pickgene-internal), 8
- pickgene, 5, 7
- pickgene-internal, 8
- pickgene.poly (pickgene-internal), 8
- pickgene.two (pickgene-internal), 8
- pickgene2 (pickgene-internal), 8
- pmarg (pickgene-internal), 8
- predrecur (pickgene-internal), 8
- rangene (pickgene-internal), 8
- rankgene (pickgene-internal), 8
- robustbox (pickgene-internal), 8
- robustscale, 9
- s.check0 (pickgene-internal), 8
- s.check1 (pickgene-internal), 8
- s.check2 (pickgene-internal), 8
- s.marg (pickgene-internal), 8
- shrinkplot (pickgene-internal), 8
- Simulation.pickgene, 10
- sixden (pickgene-internal), 8
- smooth.spline, 10
- toprankgene (pickgene-internal), 8
- twoarray.norm (pickgene-internal), 8

`twoarray.plot (pickgene-internal), 8`
`twowayanovapickgene`
 `(pickgene-internal), 8`