

# Package ‘pickgene’

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**Title** Adaptive Gene Picking for Microarray Expression Data Analysis

**Description** Functions to Analyze Microarray (Gene Expression) Data.

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**License** GPL (>= 2)

**Imports** graphics, grDevices, MASS, stats, utils

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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

*Create Model Matrix for Orthogonal Contrasts***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, modelexpr = 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) |
| modelexpr      | 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 Kendzierski, 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

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

## 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, pl, 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]

```

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