rnaSeq.R

phanthihonghuong

2019-04-27

```
library(edgeR)
```

```
## Loading required package: limma
```

```
library(ggplot2)
#declare your files so you can import them at once.
files = dir(pattern="*dbxref.count")

#import the reads into a DGE (differential gene expression) object for use in edgeR
table=readDGE(files)
```

```
## Meta tags detected: __no_feature, __ambiguous, __too_low_aQual, __not_aligned, __alignment_not_unique
```

```
dim(table)
```

```
## [1] 18754    32
```

```
str(table)
```

```
## Formal class 'DGEList' [package "edgeR"] with 1 slot
##   ..@ .Data:List of 2
##   .. ..$ :'data.frame':  32 obs. of  4 variables:
##   .. .. ..$ files       : chr [1:32] "SRR1103950_dbxref.count" "SRR1103952_dbxref.count" "SRR1103953_
##   .. .. ..$ group       : Factor w/ 1 level "1": 1 1 1 1 1 1 1 1 1 1 ...
##   .. .. ..$ lib.size    : num [1:32] 20869121 69330557 28450156 64471339 14340640 ...
##   .. .. ..$ norm.factors: num [1:32] 1 1 1 1 1 1 1 1 1 1 ...
##   .. ..$ : num [1:18754, 1:32] 1 368 193 5 36 108 186 355 4 5 ...
##   .. .. ..- attr(*, "dimnames")=List of 2
##   .. .. .. ..$ Tags   : chr [1:18754] "VectorBase:AAEL000002-RA,GeneID:5563549,Genbank:XM_001647810.1
##   .. .. .. ..$ Samples: chr [1:32] "SRR1103950_dbxref" "SRR1103952_dbxref" "SRR1103953_dbxref" "SRR11
```

```
#get rid of the meta tags (unfiltered reads, etc.) that are at the end of the table
MetaTags = grep("^__", rownames(table))
table=table[-MetaTags,]
dim(table)
```

```
## [1] 18749    32
```

```
#import the metadata downloaded from the SRA
#this can be obtained in the same place you originally downloaded the accession numbers
#in the NCBI SRA.  Instead of downloading the accession list you ask for the run table,
#for all 32 libraries.
#note that as written, the command below will look for the file in your current #directory.
runtable = read.table(file="SraRunTable.txt", sep="\t", header=TRUE)
colnames(runtable[,c(12:14, 18:19, 20:22)])
```

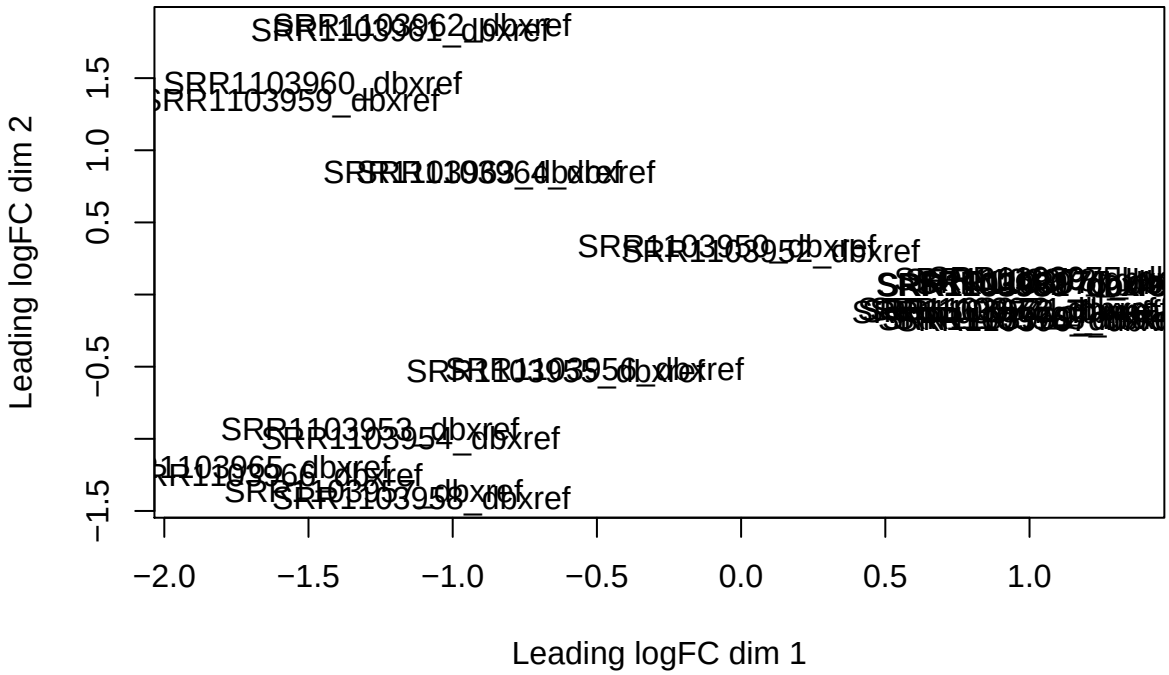
```
## [1] "Run"                "SRA_Sample"         "Sample_Name"
## [4] "geographic_location" "isolate"            "label"
## [7] "phenotype"          "strain"
```

```
Groups = runtable[,c(12:14, 18:19, 20:22)]
```

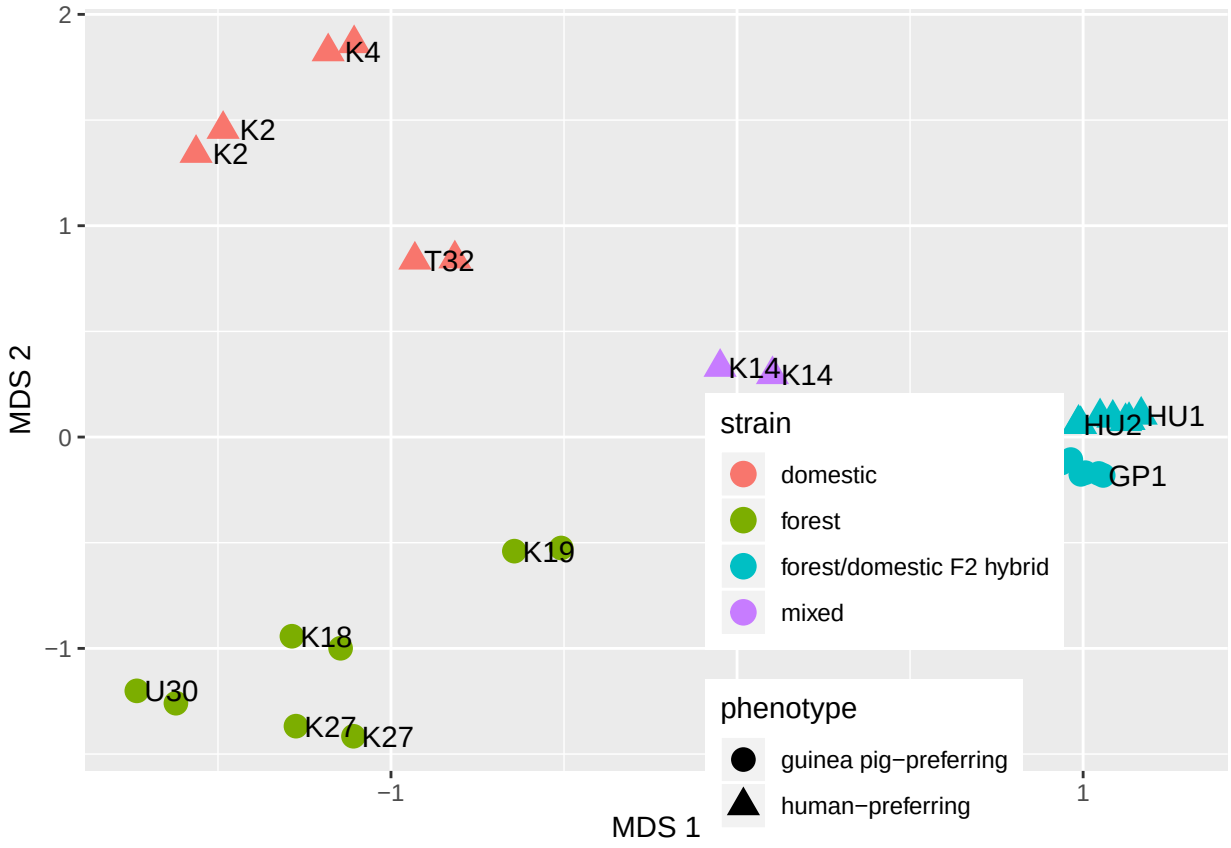
```
#filter out low read samples.  Since the smallest grouping (i.e., level of replication
#is 6, we are getting rid of genes that don't have at least 1 CPM in at least 6 #samples.
keep = rowSums(cpm(table)>1) >=6
table = table[keep,]
dim(table)
```

```
## [1] 10561    32
```

```
#apply TMM normalization
table = calcNormFactors(table)

#make a principal coordinates graph
x <- plotMDS(table)
```




```
#to make this better and label things, it is best to bring out the data for use in #ggplot
#the data for the mds was saved within the DGE list and can be renamed as its own #object.
xy = x$cmdscale.out

#now change this xy object into a data.frame...it was a matrix by default
xy = as.data.frame(xy)

#this new table of coordinates can be modified so that the column names mean something
#and the labels are all part of the same table.
names(xy) = c("MDS_1", "MDS_2")
#before merging you need to make sure your df's are in the same order
#they are not, so sort Groups by Run
Groups2 = Groups[order(Groups$Run),]
xy = cbind(xy, Groups2)
mdsplot = ggplot(data=xy, aes(x=MDS_1, y=MDS_2, color=strain, label=label, pch=phenotype))+geom_point(si
mdsplot
```




```
#estimate dispersions, this is for statistical purposes (think of it as the variance #for all and the v
table=estimateCommonDisp(table)
table=estimateTagwiseDisp(table)

table$samples$group <- Groups2$phenotype
#do a pairwise test
de = exactTest(table, pair=c("guinea pig-preferring", "human-preferring"))
#summarize the results...this just shows how many genes are up or down regulated
#by default this corrects for false discovery (FDR)
summary(decideTestsDGE(de))
```

```
##        human-preferring-guinea pig-preferring
## Down                                     618
## NotSig                                  8999
## Up                                       944
```

```
#what the above shows is that there are 618 genes up-regulated in human-preferring and
#944 in guinea pig preferring.
#But we are using the whole dataset.  Let's subset it and then repeat.

#here we are subsetting to only include the first 16 libraries, i.e., no F2s
#note that the normalizations and calculated dispersions stay with this object and #don't need to be re
table2=table[,1:16]

de2 = exactTest(table2, pair=c("guinea pig-preferring", "human-preferring"))
summary(decideTestsDGE(de2))
```

```
##        human-preferring-guinea pig-preferring
```

```
## Down                                    771
## NotSig                                 8718
## Up                                     1072
```

```
table3=table[,17:32]

de3 = exactTest(table3, pair=c("guinea pig-preferring", "human-preferring"))
summary(decideTestsDGE(de3))
```

```
##        human-preferring-guinea pig-preferring
## Down                                       0
## NotSig                                 10561
## Up                                         0
```

```
#for simplicity we will ask for a report of the top 100
topTags(de2, n=100)
```

```
## Comparison of groups:  human-preferring-guinea pig-preferring
##                                                                                                 logFC
## VectorBase:AAEL006425-RA,GeneID:5567964,Genbank:XM_001657736.1,VectorBase:AAEL006425  -7.2984658
## VectorBase:AAEL007320-RA,GeneID:5569019,Genbank:XM_001658225.1,VectorBase:AAEL007320  -7.4582095
## VectorBase:AAEL015450-RA,GeneID:5579425,Genbank:XM_001647675.1,VectorBase:AAEL015450  -7.2345252
## VectorBase:AAEL005480-RA,GeneID:5566574,Genbank:XM_001650898.1,VectorBase:AAEL005480  -5.3291735
## VectorBase:AAEL001291-RA,GeneID:5569809,Genbank:XM_001652976.1,VectorBase:AAEL001291   3.3332324
## VectorBase:AAEL013566-RB,GeneID:5578228,Genbank:XM_001656819.2,VectorBase:AAEL013566  -3.5120309
## VectorBase:AAEL007489-RA,GeneID:5569242,Genbank:XM_001652755.1,VectorBase:AAEL007489   3.3228660
## VectorBase:AAEL008628-RA,GeneID:5570850,Genbank:XM_001653308.1,VectorBase:AAEL008628   1.3995590
## VectorBase:AAEL013841-RA,GeneID:5578731,Genbank:XM_001663983.1,VectorBase:AAEL013841  -2.5884262
## VectorBase:AAEL005753-RA,GeneID:5567003,Genbank:XM_001651367.1,VectorBase:AAEL005753   3.5825014
## VectorBase:AAEL006207-RA,GeneID:5567606,Genbank:XM_001657533.1,VectorBase:AAEL006207   2.2956864
## VectorBase:AAEL000028-RA,GeneID:5563616,Genbank:XM_001647815.2,VectorBase:AAEL000028   1.0700929
## VectorBase:AAEL017246-RA,GeneID:23687666,Genbank:XM_011495454.1,VectorBase:AAEL017246 -3.0295265
## VectorBase:AAEL012311-RA,GeneID:5576085,Genbank:XM_001662363.1,VectorBase:AAEL012311   1.5826902
## VectorBase:AAEL014311-RA,GeneID:5564094,Genbank:XM_001648370.1,VectorBase:AAEL014311  -2.2842580
## VectorBase:AAEL013839-RA,GeneID:5578730,Genbank:XM_001663980.1,VectorBase:AAEL013839  -3.9201184
## VectorBase:AAEL017347-RA,GeneID:23687767,Genbank:XM_011494816.1,VectorBase:AAEL017347  2.2823892
## VectorBase:AAEL003431-RA,GeneID:5578121,Genbank:XM_001656769.1,VectorBase:AAEL003431   1.0648375
## VectorBase:AAEL010219-RA,GeneID:5573047,Genbank:XM_001654316.1,VectorBase:AAEL010219   1.3080217
## VectorBase:AAEL002668-RA,GeneID:5575578,Genbank:XM_001662012.1,VectorBase:AAEL002668   1.7026579
## VectorBase:AAEL007984-RA,GeneID:5569909,Genbank:XM_001658756.1,VectorBase:AAEL007984   5.5154061
## VectorBase:AAEL007947-RA,GeneID:5569859,Genbank:XM_001658705.2,VectorBase:AAEL007947   1.7638987
## VectorBase:AAEL000508-RA,GeneID:5578475,Genbank:XM_001656948.1,VectorBase:AAEL000508   2.6040078
## VectorBase:AAEL001312-RA,GeneID:5569822,Genbank:XM_001652992.2,VectorBase:AAEL001312   3.6255777
## VectorBase:AAEL015434-RA,GeneID:5579442,Genbank:XM_001647691.1,VectorBase:AAEL015434  -3.5417241
## VectorBase:AAEL012939-RA,GeneID:5577023,Genbank:XM_001656260.1,VectorBase:AAEL012939   1.3538418
## VectorBase:AAEL005687-RA,GeneID:5566931,Genbank:XM_001651295.1,VectorBase:AAEL005687   1.8757475
## VectorBase:AAEL014449-RA,GeneID:5564439,Genbank:XM_001648732.1,VectorBase:AAEL014449  -2.5928771
## VectorBase:AAEL009569-RA,GeneID:5572148,Genbank:XM_001660175.1,VectorBase:AAEL009569   1.4060889
## VectorBase:AAEL001066-RA,GeneID:5568337,Genbank:XM_001657939.1,VectorBase:AAEL001066   1.9595491
## VectorBase:AAEL001279-RB,GeneID:5569623,Genbank:XM_001652856.1,VectorBase:AAEL001279  -5.0950226
## VectorBase:AAEL000047-RA,GeneID:5563597,Genbank:XM_001647865.1,VectorBase:AAEL000047   1.6466086
## VectorBase:AAEL013801-RA,GeneID:5578653,Genbank:XM_001663944.1,VectorBase:AAEL013801   2.1996098
## VectorBase:AAEL005521-RA,GeneID:5579822,Genbank:XM_001651003.1,VectorBase:AAEL005521   0.9058658
## VectorBase:AAEL017513-RA,GeneID:23687933,Genbank:XM_011495175.1,VectorBase:AAEL017513  1.5193651
## VectorBase:AAEL013895-RA,GeneID:5578892,Genbank:XM_001664050.1,VectorBase:AAEL013895  -5.2185463
```

```
## VectorBase:AAEL010524-RA,GeneID:5573480,Genbank:XM_001654580.1,VectorBase:AAEL010524   1.4033084
## VectorBase:AAEL017123-RA,GeneID:23687543,Genbank:XM_011494887.1,VectorBase:AAEL017123  1.0463703
## VectorBase:AAEL011452-RA,GeneID:5574847,Genbank:XM_001661617.1,VectorBase:AAEL011452   1.6457352
## VectorBase:AAEL007557-RA,GeneID:5569296,Genbank:XM_001658375.1,VectorBase:AAEL007557   2.2894367
## VectorBase:AAEL007992-RA,GeneID:5569892,Genbank:XM_001658735.1,VectorBase:AAEL007992   1.5410273
## VectorBase:AAEL007828-RA,GeneID:5569689,Genbank:XM_001658631.1,VectorBase:AAEL007828  -2.4802819
## VectorBase:AAEL015148-RA,GeneID:5566401,Genbank:XM_001650743.1,VectorBase:AAEL015148  -2.3870003
## VectorBase:AAEL003284-RA,GeneID:5577767,Genbank:XM_001663490.1,VectorBase:AAEL003284   3.9698900
## VectorBase:AAEL001964-RA,GeneID:5573170,Genbank:XM_001660736.1,VectorBase:AAEL001964   1.3994364
## VectorBase:AAEL002680-RA,GeneID:5575580,Genbank:XM_001662010.1,VectorBase:AAEL002680   2.4329539
## VectorBase:AAEL011777-RA,GeneID:5575375,Genbank:XM_001661855.2,VectorBase:AAEL011777   0.9809385
## VectorBase:AAEL007630-RA,GeneID:5569425,Genbank:XM_001658464.1,VectorBase:AAEL007630   1.3084322
## VectorBase:AAEL008710-RA,GeneID:5570984,Genbank:XM_001659395.1,VectorBase:AAEL008710   1.1642268
## VectorBase:AAEL003597-RB,GeneID:5578624,Genbank:XM_001656998.1,VectorBase:AAEL003597  -2.9352770
## VectorBase:AAEL014411-RA,GeneID:5564382,Genbank:XM_001648677.2,VectorBase:AAEL014411   1.2997383
## VectorBase:AAEL014613-RA,GeneID:5564763,Genbank:XM_001649048.1,VectorBase:AAEL014613   3.9711987
## VectorBase:AAEL001965-RA,GeneID:5573204,Genbank:XM_001660695.1,VectorBase:AAEL001965   1.3857593
## VectorBase:AAEL000080-RA,GeneID:5563575,Genbank:XM_001647887.1,VectorBase:AAEL000080   1.3702189
## VectorBase:AAEL014198-RA,GeneID:5563880,Genbank:XM_001648141.1,VectorBase:AAEL014198  -1.4266613
## VectorBase:AAEL007830-RA,GeneID:5569684,Genbank:XM_001658623.2,VectorBase:AAEL007830   1.3286883
## VectorBase:AAEL012765-RA,GeneID:5576781,Genbank:XM_001662818.2,VectorBase:AAEL012765  -4.3138145
## VectorBase:AAEL013153-RA,GeneID:5577305,Genbank:XM_001663282.1,VectorBase:AAEL013153  -1.3298371
## VectorBase:AAEL010702-RA,GeneID:5573720,Genbank:XM_001660979.2,VectorBase:AAEL010702   2.8155453
## VectorBase:AAEL002784-RA,GeneID:5576111,Genbank:XM_001662406.1,VectorBase:AAEL002784   1.3805279
## VectorBase:AAEL010293-RA,GeneID:5573093,Genbank:XM_001654354.1,VectorBase:AAEL010293   2.1976368
## VectorBase:AAEL015147-RA,GeneID:5566400,Genbank:XM_001650742.1,VectorBase:AAEL015147   2.6680856
## VectorBase:AAEL012780-RA,GeneID:5576795,Genbank:XM_001662829.1,VectorBase:AAEL012780   2.1370394
## VectorBase:AAEL004660-RA,GeneID:5565209,Genbank:XM_001649503.1,VectorBase:AAEL004660   2.7864388
## VectorBase:AAEL007951-RA,GeneID:5569855,Genbank:XM_001658701.2,VectorBase:AAEL007951   2.2190754
## VectorBase:AAEL010415-RA,GeneID:5573330,Genbank:XM_001654500.2,VectorBase:AAEL010415   2.8647471
## VectorBase:AAEL004654-RA,GeneID:5565228,Genbank:XM_001649502.1,VectorBase:AAEL004654   1.2282338
## VectorBase:AAEL005772-RA,GeneID:5567053,Genbank:XM_001651395.1,VectorBase:AAEL005772   1.5080146
## VectorBase:AAEL011793-RA,GeneID:5575387,Genbank:XM_001655687.1,VectorBase:AAEL011793   2.8158832
## VectorBase:AAEL014246-RA,GeneID:5563937,Genbank:XM_001648205.1,VectorBase:AAEL014246   1.4666114
## VectorBase:AAEL006102-RA,GeneID:5567446,Genbank:XM_001657383.1,VectorBase:AAEL006102  -1.4653073
## VectorBase:AAEL000038-RA,GeneID:5563662,Genbank:XM_001647823.2,VectorBase:AAEL000038   1.0724475
## VectorBase:AAEL015038-RA,GeneID:5565992,Genbank:XM_001650310.1,VectorBase:AAEL015038   1.7596111
## VectorBase:AAEL014625-RA,GeneID:5564801,Genbank:XM_001649100.1,VectorBase:AAEL014625   2.8016464
## VectorBase:AAEL010684-RA,GeneID:5573696,Genbank:XM_001660971.1,VectorBase:AAEL010684   1.2170337
## VectorBase:AAEL004120-RA,GeneID:5564141,Genbank:XM_001648386.1,VectorBase:AAEL004120   1.8574171
## VectorBase:AAEL000655-RA,GeneID:5565444,Genbank:XM_001649746.1,VectorBase:AAEL000655   1.2805601
## VectorBase:AAEL014228-RA,GeneID:5563925,Genbank:XM_001648198.1,VectorBase:AAEL014228   4.5247474
## VectorBase:AAEL012492-RA,GeneID:5576386,Genbank:XM_001662554.2,VectorBase:AAEL012492   2.2570126
## VectorBase:AAEL006284-RA,GeneID:5567704,Genbank:XM_001651820.1,VectorBase:AAEL006284   2.4133201
## VectorBase:AAEL001267-RA,GeneID:5569588,Genbank:XM_001652810.1,VectorBase:AAEL001267   1.5228814
## VectorBase:AAEL004284-RA,GeneID:5564516,Genbank:XM_001648804.1,VectorBase:AAEL004284   1.0478206
## VectorBase:AAEL005303-RA,GeneID:5566305,Genbank:XM_001650649.1,VectorBase:AAEL005303   1.0200491
## VectorBase:AAEL006190-RA,GeneID:5567605,Genbank:XM_001657534.1,VectorBase:AAEL006190   1.2189111
## VectorBase:AAEL005384-RA,GeneID:5566442,Genbank:XM_001650782.1,VectorBase:AAEL005384   1.0564329
## VectorBase:AAEL012836-RA,GeneID:5576850,Genbank:XM_001656232.1,VectorBase:AAEL012836   1.1201655
## VectorBase:AAEL002675-RA,GeneID:5575552,Genbank:XM_001662007.1,VectorBase:AAEL002675   2.0652068
## VectorBase:AAEL012577-RA,GeneID:5576523,Genbank:XM_001662666.1,VectorBase:AAEL012577   2.3676043
## VectorBase:AAEL013563-RA,GeneID:5578227,Genbank:XM_001663704.2,VectorBase:AAEL013563  -1.9786564
## VectorBase:AAEL014592-RA,GeneID:5564738,Genbank:XM_001649034.1,VectorBase:AAEL014592   1.4142407
```

```
## VectorBase:AAEL004279-RA,GeneID:5564499,Genbank:XM_001648808.1,VectorBase:AAEL004279  -1.4556996
## VectorBase:AAEL001259-RA,GeneID:5569583,Genbank:XM_001652811.1,VectorBase:AAEL001259   1.3292416
## VectorBase:AAEL005129-RA,GeneID:5566032,Genbank:XM_001650336.1,VectorBase:AAEL005129  -1.1603399
## VectorBase:AAEL004643-RA,GeneID:5565138,Genbank:XM_001649463.1,VectorBase:AAEL004643   1.1468646
## VectorBase:AAEL005876-RA,GeneID:5567132,Genbank:XM_001651509.1,VectorBase:AAEL005876   2.4074758
## VectorBase:AAEL002236-RA,GeneID:5573925,Genbank:XM_001654911.1,VectorBase:AAEL002236   2.1856180
## VectorBase:AAEL003864-RA,GeneID:5579115,Genbank:XM_001657264.1,VectorBase:AAEL003864   1.0325163
## VectorBase:AAEL011394-RA,GeneID:5580153,Genbank:XM_001661588.2,VectorBase:AAEL011394  -1.2795256
## VectorBase:AAEL005763-RA,GeneID:5567014,Genbank:XM_001651362.1,VectorBase:AAEL005763   0.9394475
## VectorBase:AAEL007260-RA,GeneID:5568952,Genbank:XM_001652572.1,VectorBase:AAEL007260  -1.2704847
##                                                                                             logCPM
## VectorBase:AAEL006425-RA,GeneID:5567964,Genbank:XM_001657736.1,VectorBase:AAEL006425   0.006268603
## VectorBase:AAEL007320-RA,GeneID:5569019,Genbank:XM_001658225.1,VectorBase:AAEL007320   2.668840041
## VectorBase:AAEL015450-RA,GeneID:5579425,Genbank:XM_001647675.1,VectorBase:AAEL015450  -0.092589482
## VectorBase:AAEL005480-RA,GeneID:5566574,Genbank:XM_001650898.1,VectorBase:AAEL005480   0.454133734
## VectorBase:AAEL001291-RA,GeneID:5569809,Genbank:XM_001652976.1,VectorBase:AAEL001291   2.339206982
## VectorBase:AAEL013566-RB,GeneID:5578228,Genbank:XM_001656819.2,VectorBase:AAEL013566   2.230461098
## VectorBase:AAEL007489-RA,GeneID:5569242,Genbank:XM_001652755.1,VectorBase:AAEL007489   1.275570796
## VectorBase:AAEL008628-RA,GeneID:5570850,Genbank:XM_001653308.1,VectorBase:AAEL008628   4.094458813
## VectorBase:AAEL013841-RA,GeneID:5578731,Genbank:XM_001663983.1,VectorBase:AAEL013841   2.841185615
## VectorBase:AAEL005753-RA,GeneID:5567003,Genbank:XM_001651367.1,VectorBase:AAEL005753   5.273401586
## VectorBase:AAEL006207-RA,GeneID:5567606,Genbank:XM_001657533.1,VectorBase:AAEL006207   5.223436849
## VectorBase:AAEL000028-RA,GeneID:5563616,Genbank:XM_001647815.2,VectorBase:AAEL000028   6.585824380
## VectorBase:AAEL017246-RA,GeneID:23687666,Genbank:XM_011495454.1,VectorBase:AAEL017246  1.292750967
## VectorBase:AAEL012311-RA,GeneID:5576085,Genbank:XM_001662363.1,VectorBase:AAEL012311   8.285778588
## VectorBase:AAEL014311-RA,GeneID:5564094,Genbank:XM_001648370.1,VectorBase:AAEL014311   2.398833038
## VectorBase:AAEL013839-RA,GeneID:5578730,Genbank:XM_001663980.1,VectorBase:AAEL013839   0.676614079
## VectorBase:AAEL017347-RA,GeneID:23687767,Genbank:XM_011494816.1,VectorBase:AAEL017347  4.920514937
## VectorBase:AAEL003431-RA,GeneID:5578121,Genbank:XM_001656769.1,VectorBase:AAEL003431   5.372648288
## VectorBase:AAEL010219-RA,GeneID:5573047,Genbank:XM_001654316.1,VectorBase:AAEL010219   7.106185064
## VectorBase:AAEL002668-RA,GeneID:5575578,Genbank:XM_001662012.1,VectorBase:AAEL002668   3.838364614
## VectorBase:AAEL007984-RA,GeneID:5569909,Genbank:XM_001658756.1,VectorBase:AAEL007984  -0.500389345
## VectorBase:AAEL007947-RA,GeneID:5569859,Genbank:XM_001658705.2,VectorBase:AAEL007947   5.632680453
## VectorBase:AAEL000508-RA,GeneID:5578475,Genbank:XM_001656948.1,VectorBase:AAEL000508   1.371362889
## VectorBase:AAEL001312-RA,GeneID:5569822,Genbank:XM_001652992.2,VectorBase:AAEL001312   5.136347733
## VectorBase:AAEL015434-RA,GeneID:5579442,Genbank:XM_001647691.1,VectorBase:AAEL015434   0.513872175
## VectorBase:AAEL012939-RA,GeneID:5577023,Genbank:XM_001656260.1,VectorBase:AAEL012939   5.681641402
## VectorBase:AAEL005687-RA,GeneID:5566931,Genbank:XM_001651295.1,VectorBase:AAEL005687  10.043905214
## VectorBase:AAEL014449-RA,GeneID:5564439,Genbank:XM_001648732.1,VectorBase:AAEL014449   0.123686876
## VectorBase:AAEL009569-RA,GeneID:5572148,Genbank:XM_001660175.1,VectorBase:AAEL009569   2.519874289
## VectorBase:AAEL001066-RA,GeneID:5568337,Genbank:XM_001657939.1,VectorBase:AAEL001066   2.382524773
## VectorBase:AAEL001279-RB,GeneID:5569623,Genbank:XM_001652856.1,VectorBase:AAEL001279   5.280360919
## VectorBase:AAEL000047-RA,GeneID:5563597,Genbank:XM_001647865.1,VectorBase:AAEL000047   2.688494510
## VectorBase:AAEL013801-RA,GeneID:5578653,Genbank:XM_001663944.1,VectorBase:AAEL013801   2.666096203
## VectorBase:AAEL005521-RA,GeneID:5579822,Genbank:XM_001651003.1,VectorBase:AAEL005521   4.789226664
## VectorBase:AAEL017513-RA,GeneID:23687933,Genbank:XM_011495175.1,VectorBase:AAEL017513  6.625893137
## VectorBase:AAEL013895-RA,GeneID:5578892,Genbank:XM_001664050.1,VectorBase:AAEL013895   1.062928401
## VectorBase:AAEL010524-RA,GeneID:5573480,Genbank:XM_001654580.1,VectorBase:AAEL010524   5.195132859
## VectorBase:AAEL017123-RA,GeneID:23687543,Genbank:XM_011494887.1,VectorBase:AAEL017123  5.094009178
## VectorBase:AAEL011452-RA,GeneID:5574847,Genbank:XM_001661617.1,VectorBase:AAEL011452   2.685799233
## VectorBase:AAEL007557-RA,GeneID:5569296,Genbank:XM_001658375.1,VectorBase:AAEL007557   2.518005812
## VectorBase:AAEL007992-RA,GeneID:5569892,Genbank:XM_001658735.1,VectorBase:AAEL007992   1.934660064
## VectorBase:AAEL007828-RA,GeneID:5569689,Genbank:XM_001658631.1,VectorBase:AAEL007828   1.632385486
## VectorBase:AAEL015148-RA,GeneID:5566401,Genbank:XM_001650743.1,VectorBase:AAEL015148  -0.376405371
```

```
## VectorBase:AAEL003284-RA,GeneID:5577767,Genbank:XM_001663490.1,VectorBase:AAEL003284   3.078306185
## VectorBase:AAEL001964-RA,GeneID:5573170,Genbank:XM_001660736.1,VectorBase:AAEL001964   7.037771988
## VectorBase:AAEL002680-RA,GeneID:5575580,Genbank:XM_001662010.1,VectorBase:AAEL002680   4.250515792
## VectorBase:AAEL011777-RA,GeneID:5575375,Genbank:XM_001661855.2,VectorBase:AAEL011777   4.193379375
## VectorBase:AAEL007630-RA,GeneID:5569425,Genbank:XM_001658464.1,VectorBase:AAEL007630   3.227447943
## VectorBase:AAEL008710-RA,GeneID:5570984,Genbank:XM_001659395.1,VectorBase:AAEL008710   3.637227783
## VectorBase:AAEL003597-RB,GeneID:5578624,Genbank:XM_001656998.1,VectorBase:AAEL003597  -0.482269052
## VectorBase:AAEL014411-RA,GeneID:5564382,Genbank:XM_001648677.2,VectorBase:AAEL014411   8.969722935
## VectorBase:AAEL014613-RA,GeneID:5564763,Genbank:XM_001649048.1,VectorBase:AAEL014613   3.913147832
## VectorBase:AAEL001965-RA,GeneID:5573204,Genbank:XM_001660695.1,VectorBase:AAEL001965   6.114344412
## VectorBase:AAEL000080-RA,GeneID:5563575,Genbank:XM_001647887.1,VectorBase:AAEL000080   4.181321661
## VectorBase:AAEL014198-RA,GeneID:5563880,Genbank:XM_001648141.1,VectorBase:AAEL014198   2.200242007
## VectorBase:AAEL007830-RA,GeneID:5569684,Genbank:XM_001658623.2,VectorBase:AAEL007830   3.946961534
## VectorBase:AAEL012765-RA,GeneID:5576781,Genbank:XM_001662818.2,VectorBase:AAEL012765   0.907000439
## VectorBase:AAEL013153-RA,GeneID:5577305,Genbank:XM_001663282.1,VectorBase:AAEL013153   3.435780408
## VectorBase:AAEL010702-RA,GeneID:5573720,Genbank:XM_001660979.2,VectorBase:AAEL010702   0.924098839
## VectorBase:AAEL002784-RA,GeneID:5576111,Genbank:XM_001662406.1,VectorBase:AAEL002784   3.094426060
## VectorBase:AAEL010293-RA,GeneID:5573093,Genbank:XM_001654354.1,VectorBase:AAEL010293  -0.352773445
## VectorBase:AAEL015147-RA,GeneID:5566400,Genbank:XM_001650742.1,VectorBase:AAEL015147   4.575192025
## VectorBase:AAEL012780-RA,GeneID:5576795,Genbank:XM_001662829.1,VectorBase:AAEL012780   3.858740827
## VectorBase:AAEL004660-RA,GeneID:5565209,Genbank:XM_001649503.1,VectorBase:AAEL004660   0.142952890
## VectorBase:AAEL007951-RA,GeneID:5569855,Genbank:XM_001658701.2,VectorBase:AAEL007951   4.076541192
## VectorBase:AAEL010415-RA,GeneID:5573330,Genbank:XM_001654500.2,VectorBase:AAEL010415   2.045300892
## VectorBase:AAEL004654-RA,GeneID:5565228,Genbank:XM_001649502.1,VectorBase:AAEL004654   3.117656765
## VectorBase:AAEL005772-RA,GeneID:5567053,Genbank:XM_001651395.1,VectorBase:AAEL005772   2.451010543
## VectorBase:AAEL011793-RA,GeneID:5575387,Genbank:XM_001655687.1,VectorBase:AAEL011793   1.257589549
## VectorBase:AAEL014246-RA,GeneID:5563937,Genbank:XM_001648205.1,VectorBase:AAEL014246   8.441181098
## VectorBase:AAEL006102-RA,GeneID:5567446,Genbank:XM_001657383.1,VectorBase:AAEL006102   4.519892460
## VectorBase:AAEL000038-RA,GeneID:5563662,Genbank:XM_001647823.2,VectorBase:AAEL000038   5.087897924
## VectorBase:AAEL015038-RA,GeneID:5565992,Genbank:XM_001650310.1,VectorBase:AAEL015038   1.953377514
## VectorBase:AAEL014625-RA,GeneID:5564801,Genbank:XM_001649100.1,VectorBase:AAEL014625   3.580611870
## VectorBase:AAEL010684-RA,GeneID:5573696,Genbank:XM_001660971.1,VectorBase:AAEL010684   3.533198522
## VectorBase:AAEL004120-RA,GeneID:5564141,Genbank:XM_001648386.1,VectorBase:AAEL004120   3.428251368
## VectorBase:AAEL000655-RA,GeneID:5565444,Genbank:XM_001649746.1,VectorBase:AAEL000655   3.351808171
## VectorBase:AAEL014228-RA,GeneID:5563925,Genbank:XM_001648198.1,VectorBase:AAEL014228   0.303310041
## VectorBase:AAEL012492-RA,GeneID:5576386,Genbank:XM_001662554.2,VectorBase:AAEL012492   2.900744164
## VectorBase:AAEL006284-RA,GeneID:5567704,Genbank:XM_001651820.1,VectorBase:AAEL006284   0.193484762
## VectorBase:AAEL001267-RA,GeneID:5569588,Genbank:XM_001652810.1,VectorBase:AAEL001267   3.639609757
## VectorBase:AAEL004284-RA,GeneID:5564516,Genbank:XM_001648804.1,VectorBase:AAEL004284   4.972653106
## VectorBase:AAEL005303-RA,GeneID:5566305,Genbank:XM_001650649.1,VectorBase:AAEL005303   3.502196159
## VectorBase:AAEL006190-RA,GeneID:5567605,Genbank:XM_001657534.1,VectorBase:AAEL006190   5.743589878
## VectorBase:AAEL005384-RA,GeneID:5566442,Genbank:XM_001650782.1,VectorBase:AAEL005384   3.554388526
## VectorBase:AAEL012836-RA,GeneID:5576850,Genbank:XM_001656232.1,VectorBase:AAEL012836   3.103236256
## VectorBase:AAEL002675-RA,GeneID:5575552,Genbank:XM_001662007.1,VectorBase:AAEL002675   1.934841349
## VectorBase:AAEL012577-RA,GeneID:5576523,Genbank:XM_001662666.1,VectorBase:AAEL012577   0.377751060
## VectorBase:AAEL013563-RA,GeneID:5578227,Genbank:XM_001663704.2,VectorBase:AAEL013563   1.753599956
## VectorBase:AAEL014592-RA,GeneID:5564738,Genbank:XM_001649034.1,VectorBase:AAEL014592   3.418041045
## VectorBase:AAEL004279-RA,GeneID:5564499,Genbank:XM_001648808.1,VectorBase:AAEL004279   1.335023124
## VectorBase:AAEL001259-RA,GeneID:5569583,Genbank:XM_001652811.1,VectorBase:AAEL001259   3.642774738
## VectorBase:AAEL005129-RA,GeneID:5566032,Genbank:XM_001650336.1,VectorBase:AAEL005129   5.737464364
## VectorBase:AAEL004643-RA,GeneID:5565138,Genbank:XM_001649463.1,VectorBase:AAEL004643   2.788103603
## VectorBase:AAEL005876-RA,GeneID:5567132,Genbank:XM_001651509.1,VectorBase:AAEL005876   0.014544721
## VectorBase:AAEL002236-RA,GeneID:5573925,Genbank:XM_001654911.1,VectorBase:AAEL002236   0.046093218
## VectorBase:AAEL003864-RA,GeneID:5579115,Genbank:XM_001657264.1,VectorBase:AAEL003864   2.469300605
```

```
## VectorBase:AAEL011394-RA,GeneID:5580153,Genbank:XM_001661588.2,VectorBase:AAEL011394   3.059527719
## VectorBase:AAEL005763-RA,GeneID:5567014,Genbank:XM_001651362.1,VectorBase:AAEL005763   5.229610059
## VectorBase:AAEL007260-RA,GeneID:5568952,Genbank:XM_001652572.1,VectorBase:AAEL007260   2.124302059
##                                                                                              PValue
## VectorBase:AAEL006425-RA,GeneID:5567964,Genbank:XM_001657736.1,VectorBase:AAEL006425  4.572886e-10
## VectorBase:AAEL007320-RA,GeneID:5569019,Genbank:XM_001658225.1,VectorBase:AAEL007320  8.651659e-10
## VectorBase:AAEL015450-RA,GeneID:5579425,Genbank:XM_001647675.1,VectorBase:AAEL015450  1.095072e-09
## VectorBase:AAEL005480-RA,GeneID:5566574,Genbank:XM_001650898.1,VectorBase:AAEL005480  1.836361e-09
## VectorBase:AAEL001291-RA,GeneID:5569809,Genbank:XM_001652976.1,VectorBase:AAEL001291  4.288599e-09
## VectorBase:AAEL013566-RB,GeneID:5578228,Genbank:XM_001656819.2,VectorBase:AAEL013566  5.253881e-09
## VectorBase:AAEL007489-RA,GeneID:5569242,Genbank:XM_001652755.1,VectorBase:AAEL007489  1.089563e-08
## VectorBase:AAEL008628-RA,GeneID:5570850,Genbank:XM_001653308.1,VectorBase:AAEL008628  1.341419e-08
## VectorBase:AAEL013841-RA,GeneID:5578731,Genbank:XM_001663983.1,VectorBase:AAEL013841  1.647191e-08
## VectorBase:AAEL005753-RA,GeneID:5567003,Genbank:XM_001651367.1,VectorBase:AAEL005753  2.618750e-08
## VectorBase:AAEL006207-RA,GeneID:5567606,Genbank:XM_001657533.1,VectorBase:AAEL006207  2.619336e-08
## VectorBase:AAEL000028-RA,GeneID:5563616,Genbank:XM_001647815.2,VectorBase:AAEL000028  2.661689e-08
## VectorBase:AAEL017246-RA,GeneID:23687666,Genbank:XM_011495454.1,VectorBase:AAEL017246 3.606792e-08
## VectorBase:AAEL012311-RA,GeneID:5576085,Genbank:XM_001662363.1,VectorBase:AAEL012311  4.115793e-08
## VectorBase:AAEL014311-RA,GeneID:5564094,Genbank:XM_001648370.1,VectorBase:AAEL014311  4.692365e-08
## VectorBase:AAEL013839-RA,GeneID:5578730,Genbank:XM_001663980.1,VectorBase:AAEL013839  4.755495e-08
## VectorBase:AAEL017347-RA,GeneID:23687767,Genbank:XM_011494816.1,VectorBase:AAEL017347 4.902695e-08
## VectorBase:AAEL003431-RA,GeneID:5578121,Genbank:XM_001656769.1,VectorBase:AAEL003431  5.651991e-08
## VectorBase:AAEL010219-RA,GeneID:5573047,Genbank:XM_001654316.1,VectorBase:AAEL010219  6.658022e-08
## VectorBase:AAEL002668-RA,GeneID:5575578,Genbank:XM_001662012.1,VectorBase:AAEL002668  6.806044e-08
## VectorBase:AAEL007984-RA,GeneID:5569909,Genbank:XM_001658756.1,VectorBase:AAEL007984  8.815350e-08
## VectorBase:AAEL007947-RA,GeneID:5569859,Genbank:XM_001658705.2,VectorBase:AAEL007947  9.198157e-08
## VectorBase:AAEL000508-RA,GeneID:5578475,Genbank:XM_001656948.1,VectorBase:AAEL000508  1.094262e-07
## VectorBase:AAEL001312-RA,GeneID:5569822,Genbank:XM_001652992.2,VectorBase:AAEL001312  1.207946e-07
## VectorBase:AAEL015434-RA,GeneID:5579442,Genbank:XM_001647691.1,VectorBase:AAEL015434  1.313984e-07
## VectorBase:AAEL012939-RA,GeneID:5577023,Genbank:XM_001656260.1,VectorBase:AAEL012939  1.414008e-07
## VectorBase:AAEL005687-RA,GeneID:5566931,Genbank:XM_001651295.1,VectorBase:AAEL005687  1.521487e-07
## VectorBase:AAEL014449-RA,GeneID:5564439,Genbank:XM_001648732.1,VectorBase:AAEL014449  1.652777e-07
## VectorBase:AAEL009569-RA,GeneID:5572148,Genbank:XM_001660175.1,VectorBase:AAEL009569  1.668618e-07
## VectorBase:AAEL001066-RA,GeneID:5568337,Genbank:XM_001657939.1,VectorBase:AAEL001066  1.699543e-07
## VectorBase:AAEL001279-RB,GeneID:5569623,Genbank:XM_001652856.1,VectorBase:AAEL001279  1.725884e-07
## VectorBase:AAEL000047-RA,GeneID:5563597,Genbank:XM_001647865.1,VectorBase:AAEL000047  1.777343e-07
## VectorBase:AAEL013801-RA,GeneID:5578653,Genbank:XM_001663944.1,VectorBase:AAEL013801  1.798615e-07
## VectorBase:AAEL005521-RA,GeneID:5579822,Genbank:XM_001651003.1,VectorBase:AAEL005521  1.799820e-07
## VectorBase:AAEL017513-RA,GeneID:23687933,Genbank:XM_011495175.1,VectorBase:AAEL017513 1.886640e-07
## VectorBase:AAEL013895-RA,GeneID:5578892,Genbank:XM_001664050.1,VectorBase:AAEL013895  2.420290e-07
## VectorBase:AAEL010524-RA,GeneID:5573480,Genbank:XM_001654580.1,VectorBase:AAEL010524  2.583553e-07
## VectorBase:AAEL017123-RA,GeneID:23687543,Genbank:XM_011494887.1,VectorBase:AAEL017123 2.965464e-07
## VectorBase:AAEL011452-RA,GeneID:5574847,Genbank:XM_001661617.1,VectorBase:AAEL011452  2.973368e-07
## VectorBase:AAEL007557-RA,GeneID:5569296,Genbank:XM_001658375.1,VectorBase:AAEL007557  3.207072e-07
## VectorBase:AAEL007992-RA,GeneID:5569892,Genbank:XM_001658735.1,VectorBase:AAEL007992  3.382110e-07
## VectorBase:AAEL007828-RA,GeneID:5569689,Genbank:XM_001658631.1,VectorBase:AAEL007828  3.478429e-07
## VectorBase:AAEL015148-RA,GeneID:5566401,Genbank:XM_001650743.1,VectorBase:AAEL015148  3.507509e-07
## VectorBase:AAEL003284-RA,GeneID:5577767,Genbank:XM_001663490.1,VectorBase:AAEL003284  3.594491e-07
## VectorBase:AAEL001964-RA,GeneID:5573170,Genbank:XM_001660736.1,VectorBase:AAEL001964  3.756123e-07
## VectorBase:AAEL002680-RA,GeneID:5575580,Genbank:XM_001662010.1,VectorBase:AAEL002680  3.785473e-07
## VectorBase:AAEL011777-RA,GeneID:5575375,Genbank:XM_001661855.2,VectorBase:AAEL011777  3.799701e-07
## VectorBase:AAEL007630-RA,GeneID:5569425,Genbank:XM_001658464.1,VectorBase:AAEL007630  3.849159e-07
## VectorBase:AAEL008710-RA,GeneID:5570984,Genbank:XM_001659395.1,VectorBase:AAEL008710  4.216378e-07
## VectorBase:AAEL003597-RB,GeneID:5578624,Genbank:XM_001656998.1,VectorBase:AAEL003597  4.237720e-07
```

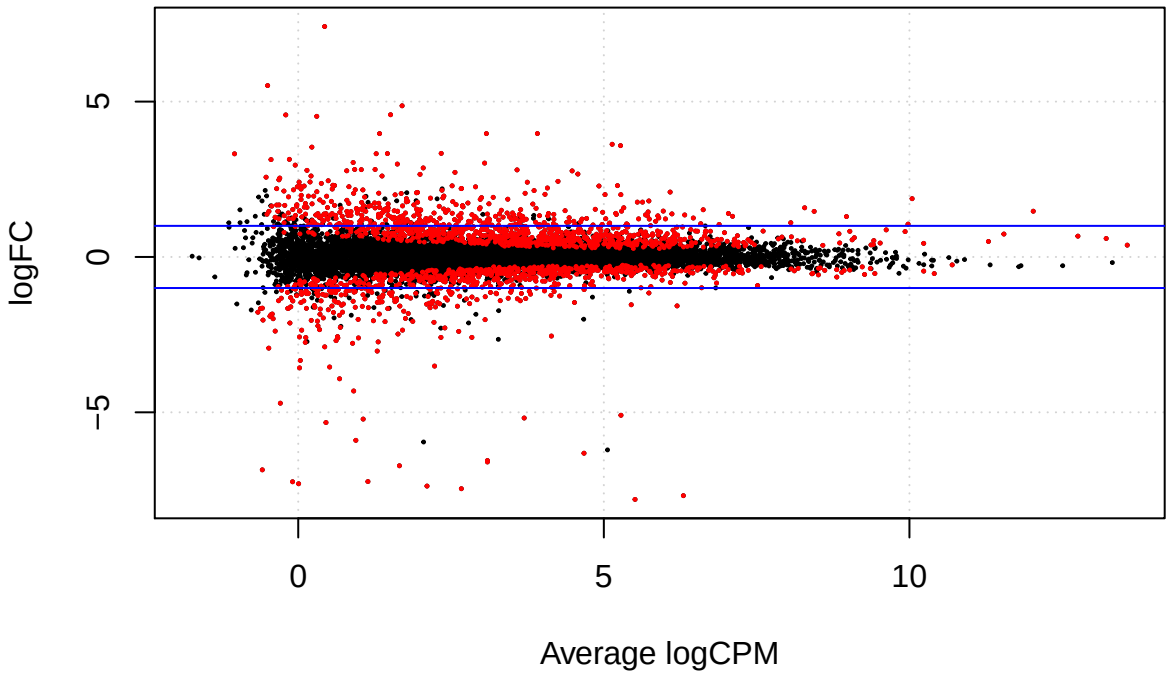
```
## VectorBase:AAEL014411-RA,GeneID:5564382,Genbank:XM_001648677.2,VectorBase:AAEL014411  4.263355e-07
## VectorBase:AAEL014613-RA,GeneID:5564763,Genbank:XM_001649048.1,VectorBase:AAEL014613  4.386528e-07
## VectorBase:AAEL001965-RA,GeneID:5573204,Genbank:XM_001660695.1,VectorBase:AAEL001965  4.403022e-07
## VectorBase:AAEL000080-RA,GeneID:5563575,Genbank:XM_001647887.1,VectorBase:AAEL000080  4.524943e-07
## VectorBase:AAEL014198-RA,GeneID:5563880,Genbank:XM_001648141.1,VectorBase:AAEL014198  4.741368e-07
## VectorBase:AAEL007830-RA,GeneID:5569684,Genbank:XM_001658623.2,VectorBase:AAEL007830  5.361855e-07
## VectorBase:AAEL012765-RA,GeneID:5576781,Genbank:XM_001662818.2,VectorBase:AAEL012765  5.489470e-07
## VectorBase:AAEL013153-RA,GeneID:5577305,Genbank:XM_001663282.1,VectorBase:AAEL013153  5.559766e-07
## VectorBase:AAEL010702-RA,GeneID:5573720,Genbank:XM_001660979.2,VectorBase:AAEL010702  5.748079e-07
## VectorBase:AAEL002784-RA,GeneID:5576111,Genbank:XM_001662406.1,VectorBase:AAEL002784  6.010642e-07
## VectorBase:AAEL010293-RA,GeneID:5573093,Genbank:XM_001654354.1,VectorBase:AAEL010293  6.186319e-07
## VectorBase:AAEL015147-RA,GeneID:5566400,Genbank:XM_001650742.1,VectorBase:AAEL015147  6.410514e-07
## VectorBase:AAEL012780-RA,GeneID:5576795,Genbank:XM_001662829.1,VectorBase:AAEL012780  6.790624e-07
## VectorBase:AAEL004660-RA,GeneID:5565209,Genbank:XM_001649503.1,VectorBase:AAEL004660  7.061458e-07
## VectorBase:AAEL007951-RA,GeneID:5569855,Genbank:XM_001658701.2,VectorBase:AAEL007951  7.081679e-07
## VectorBase:AAEL010415-RA,GeneID:5573330,Genbank:XM_001654500.2,VectorBase:AAEL010415  7.252768e-07
## VectorBase:AAEL004654-RA,GeneID:5565228,Genbank:XM_001649502.1,VectorBase:AAEL004654  7.263675e-07
## VectorBase:AAEL005772-RA,GeneID:5567053,Genbank:XM_001651395.1,VectorBase:AAEL005772  7.907437e-07
## VectorBase:AAEL011793-RA,GeneID:5575387,Genbank:XM_001655687.1,VectorBase:AAEL011793  7.949337e-07
## VectorBase:AAEL014246-RA,GeneID:5563937,Genbank:XM_001648205.1,VectorBase:AAEL014246  8.003392e-07
## VectorBase:AAEL006102-RA,GeneID:5567446,Genbank:XM_001657383.1,VectorBase:AAEL006102  8.602617e-07
## VectorBase:AAEL000038-RA,GeneID:5563662,Genbank:XM_001647823.2,VectorBase:AAEL000038  9.879858e-07
## VectorBase:AAEL015038-RA,GeneID:5565992,Genbank:XM_001650310.1,VectorBase:AAEL015038  1.006504e-06
## VectorBase:AAEL014625-RA,GeneID:5564801,Genbank:XM_001649100.1,VectorBase:AAEL014625  1.088991e-06
## VectorBase:AAEL010684-RA,GeneID:5573696,Genbank:XM_001660971.1,VectorBase:AAEL010684  1.242593e-06
## VectorBase:AAEL004120-RA,GeneID:5564141,Genbank:XM_001648386.1,VectorBase:AAEL004120  1.293251e-06
## VectorBase:AAEL000655-RA,GeneID:5565444,Genbank:XM_001649746.1,VectorBase:AAEL000655  1.337012e-06
## VectorBase:AAEL014228-RA,GeneID:5563925,Genbank:XM_001648198.1,VectorBase:AAEL014228  1.439180e-06
## VectorBase:AAEL012492-RA,GeneID:5576386,Genbank:XM_001662554.2,VectorBase:AAEL012492  1.463590e-06
## VectorBase:AAEL006284-RA,GeneID:5567704,Genbank:XM_001651820.1,VectorBase:AAEL006284  1.466183e-06
## VectorBase:AAEL001267-RA,GeneID:5569588,Genbank:XM_001652810.1,VectorBase:AAEL001267  1.525772e-06
## VectorBase:AAEL004284-RA,GeneID:5564516,Genbank:XM_001648804.1,VectorBase:AAEL004284  1.597840e-06
## VectorBase:AAEL005303-RA,GeneID:5566305,Genbank:XM_001650649.1,VectorBase:AAEL005303  1.619720e-06
## VectorBase:AAEL006190-RA,GeneID:5567605,Genbank:XM_001657534.1,VectorBase:AAEL006190  1.656514e-06
## VectorBase:AAEL005384-RA,GeneID:5566442,Genbank:XM_001650782.1,VectorBase:AAEL005384  1.680451e-06
## VectorBase:AAEL012836-RA,GeneID:5576850,Genbank:XM_001656232.1,VectorBase:AAEL012836  1.857789e-06
## VectorBase:AAEL002675-RA,GeneID:5575552,Genbank:XM_001662007.1,VectorBase:AAEL002675  1.869043e-06
## VectorBase:AAEL012577-RA,GeneID:5576523,Genbank:XM_001662666.1,VectorBase:AAEL012577  1.921028e-06
## VectorBase:AAEL013563-RA,GeneID:5578227,Genbank:XM_001663704.2,VectorBase:AAEL013563  1.944996e-06
## VectorBase:AAEL014592-RA,GeneID:5564738,Genbank:XM_001649034.1,VectorBase:AAEL014592  2.005576e-06
## VectorBase:AAEL004279-RA,GeneID:5564499,Genbank:XM_001648808.1,VectorBase:AAEL004279  2.023097e-06
## VectorBase:AAEL001259-RA,GeneID:5569583,Genbank:XM_001652811.1,VectorBase:AAEL001259  2.271802e-06
## VectorBase:AAEL005129-RA,GeneID:5566032,Genbank:XM_001650336.1,VectorBase:AAEL005129  2.303630e-06
## VectorBase:AAEL004643-RA,GeneID:5565138,Genbank:XM_001649463.1,VectorBase:AAEL004643  2.419553e-06
## VectorBase:AAEL005876-RA,GeneID:5567132,Genbank:XM_001651509.1,VectorBase:AAEL005876  2.553656e-06
## VectorBase:AAEL002236-RA,GeneID:5573925,Genbank:XM_001654911.1,VectorBase:AAEL002236  2.578787e-06
## VectorBase:AAEL003864-RA,GeneID:5579115,Genbank:XM_001657264.1,VectorBase:AAEL003864  2.595053e-06
## VectorBase:AAEL011394-RA,GeneID:5580153,Genbank:XM_001661588.2,VectorBase:AAEL011394  2.715160e-06
## VectorBase:AAEL005763-RA,GeneID:5567014,Genbank:XM_001651362.1,VectorBase:AAEL005763  2.742868e-06
## VectorBase:AAEL007260-RA,GeneID:5568952,Genbank:XM_001652572.1,VectorBase:AAEL007260  2.805132e-06
##                                                                                                  FDR
## VectorBase:AAEL006425-RA,GeneID:5567964,Genbank:XM_001657736.1,VectorBase:AAEL006425  3.855020e-06
## VectorBase:AAEL007320-RA,GeneID:5569019,Genbank:XM_001658225.1,VectorBase:AAEL007320  3.855020e-06
## VectorBase:AAEL015450-RA,GeneID:5579425,Genbank:XM_001647675.1,VectorBase:AAEL015450  3.855020e-06
```

```
## VectorBase:AAEL005480-RA,GeneID:5566574,Genbank:XM_001650898.1,VectorBase:AAEL005480  4.848453e-06
## VectorBase:AAEL001291-RA,GeneID:5569809,Genbank:XM_001652976.1,VectorBase:AAEL001291  9.058378e-06
## VectorBase:AAEL013566-RB,GeneID:5578228,Genbank:XM_001656819.2,VectorBase:AAEL013566  9.247707e-06
## VectorBase:AAEL007489-RA,GeneID:5569242,Genbank:XM_001652755.1,VectorBase:AAEL007489  1.643839e-05
## VectorBase:AAEL008628-RA,GeneID:5570850,Genbank:XM_001653308.1,VectorBase:AAEL008628  1.770840e-05
## VectorBase:AAEL013841-RA,GeneID:5578731,Genbank:XM_001663983.1,VectorBase:AAEL013841  1.932887e-05
## VectorBase:AAEL005753-RA,GeneID:5567003,Genbank:XM_001651367.1,VectorBase:AAEL005753  2.342508e-05
## VectorBase:AAEL006207-RA,GeneID:5567606,Genbank:XM_001657533.1,VectorBase:AAEL006207  2.342508e-05
## VectorBase:AAEL000028-RA,GeneID:5563616,Genbank:XM_001647815.2,VectorBase:AAEL000028  2.342508e-05
## VectorBase:AAEL017246-RA,GeneID:23687666,Genbank:XM_011495454.1,VectorBase:AAEL017246 2.930102e-05
## VectorBase:AAEL012311-RA,GeneID:5576085,Genbank:XM_001662363.1,VectorBase:AAEL012311  3.045727e-05
## VectorBase:AAEL014311-RA,GeneID:5564094,Genbank:XM_001648370.1,VectorBase:AAEL014311  3.045727e-05
## VectorBase:AAEL013839-RA,GeneID:5578730,Genbank:XM_001663980.1,VectorBase:AAEL013839  3.045727e-05
## VectorBase:AAEL017347-RA,GeneID:23687767,Genbank:XM_011494816.1,VectorBase:AAEL017347 3.045727e-05
## VectorBase:AAEL003431-RA,GeneID:5578121,Genbank:XM_001656769.1,VectorBase:AAEL003431  3.316148e-05
## VectorBase:AAEL010219-RA,GeneID:5573047,Genbank:XM_001654316.1,VectorBase:AAEL010219  3.593931e-05
## VectorBase:AAEL002668-RA,GeneID:5575578,Genbank:XM_001662012.1,VectorBase:AAEL002668  3.593931e-05
## VectorBase:AAEL007984-RA,GeneID:5569909,Genbank:XM_001658756.1,VectorBase:AAEL007984  4.415533e-05
## VectorBase:AAEL007947-RA,GeneID:5569859,Genbank:XM_001658705.2,VectorBase:AAEL007947  4.415533e-05
## VectorBase:AAEL000508-RA,GeneID:5578475,Genbank:XM_001656948.1,VectorBase:AAEL000508  5.024565e-05
## VectorBase:AAEL001312-RA,GeneID:5569822,Genbank:XM_001652992.2,VectorBase:AAEL001312  5.315465e-05
## VectorBase:AAEL015434-RA,GeneID:5579442,Genbank:XM_001647691.1,VectorBase:AAEL015434  5.550792e-05
## VectorBase:AAEL012939-RA,GeneID:5577023,Genbank:XM_001656260.1,VectorBase:AAEL012939  5.590558e-05
## VectorBase:AAEL005687-RA,GeneID:5566931,Genbank:XM_001651295.1,VectorBase:AAEL005687  5.590558e-05
## VectorBase:AAEL014449-RA,GeneID:5564439,Genbank:XM_001648732.1,VectorBase:AAEL014449  5.590558e-05
## VectorBase:AAEL009569-RA,GeneID:5572148,Genbank:XM_001660175.1,VectorBase:AAEL009569  5.590558e-05
## VectorBase:AAEL001066-RA,GeneID:5568337,Genbank:XM_001657939.1,VectorBase:AAEL001066  5.590558e-05
## VectorBase:AAEL001279-RB,GeneID:5569623,Genbank:XM_001652856.1,VectorBase:AAEL001279  5.590558e-05
## VectorBase:AAEL000047-RA,GeneID:5563597,Genbank:XM_001647865.1,VectorBase:AAEL000047  5.590558e-05
## VectorBase:AAEL013801-RA,GeneID:5578653,Genbank:XM_001663944.1,VectorBase:AAEL013801  5.590558e-05
## VectorBase:AAEL005521-RA,GeneID:5579822,Genbank:XM_001651003.1,VectorBase:AAEL005521  5.590558e-05
## VectorBase:AAEL017513-RA,GeneID:23687933,Genbank:XM_011495175.1,VectorBase:AAEL017513 5.692801e-05
## VectorBase:AAEL013895-RA,GeneID:5578892,Genbank:XM_001664050.1,VectorBase:AAEL013895  7.100189e-05
## VectorBase:AAEL010524-RA,GeneID:5573480,Genbank:XM_001654580.1,VectorBase:AAEL010524  7.374299e-05
## VectorBase:AAEL017123-RA,GeneID:23687543,Genbank:XM_011494887.1,VectorBase:AAEL017123 8.051729e-05
## VectorBase:AAEL011452-RA,GeneID:5574847,Genbank:XM_001661617.1,VectorBase:AAEL011452  8.051729e-05
## VectorBase:AAEL007557-RA,GeneID:5569296,Genbank:XM_001658375.1,VectorBase:AAEL007557  8.467473e-05
## VectorBase:AAEL007992-RA,GeneID:5569892,Genbank:XM_001658735.1,VectorBase:AAEL007992  8.468952e-05
## VectorBase:AAEL007828-RA,GeneID:5569689,Genbank:XM_001658631.1,VectorBase:AAEL007828  8.468952e-05
## VectorBase:AAEL015148-RA,GeneID:5566401,Genbank:XM_001650743.1,VectorBase:AAEL015148  8.468952e-05
## VectorBase:AAEL003284-RA,GeneID:5577767,Genbank:XM_001663490.1,VectorBase:AAEL003284  8.468952e-05
## VectorBase:AAEL001964-RA,GeneID:5573170,Genbank:XM_001660736.1,VectorBase:AAEL001964  8.468952e-05
## VectorBase:AAEL002680-RA,GeneID:5575580,Genbank:XM_001662010.1,VectorBase:AAEL002680  8.468952e-05
## VectorBase:AAEL011777-RA,GeneID:5575375,Genbank:XM_001661855.2,VectorBase:AAEL011777  8.468952e-05
## VectorBase:AAEL007630-RA,GeneID:5569425,Genbank:XM_001658464.1,VectorBase:AAEL007630  8.468952e-05
## VectorBase:AAEL008710-RA,GeneID:5570984,Genbank:XM_001659395.1,VectorBase:AAEL008710  8.773645e-05
## VectorBase:AAEL003597-RB,GeneID:5578624,Genbank:XM_001656998.1,VectorBase:AAEL003597  8.773645e-05
## VectorBase:AAEL014411-RA,GeneID:5564382,Genbank:XM_001648677.2,VectorBase:AAEL014411  8.773645e-05
## VectorBase:AAEL014613-RA,GeneID:5564763,Genbank:XM_001649048.1,VectorBase:AAEL014613  8.773645e-05
## VectorBase:AAEL001965-RA,GeneID:5573204,Genbank:XM_001660695.1,VectorBase:AAEL001965  8.773645e-05
## VectorBase:AAEL000080-RA,GeneID:5563575,Genbank:XM_001647887.1,VectorBase:AAEL000080  8.849615e-05
## VectorBase:AAEL014198-RA,GeneID:5563880,Genbank:XM_001648141.1,VectorBase:AAEL014198  9.104288e-05
## VectorBase:AAEL007830-RA,GeneID:5569684,Genbank:XM_001658623.2,VectorBase:AAEL007830  1.011188e-04
## VectorBase:AAEL012765-RA,GeneID:5576781,Genbank:XM_001662818.2,VectorBase:AAEL012765  1.012357e-04
```

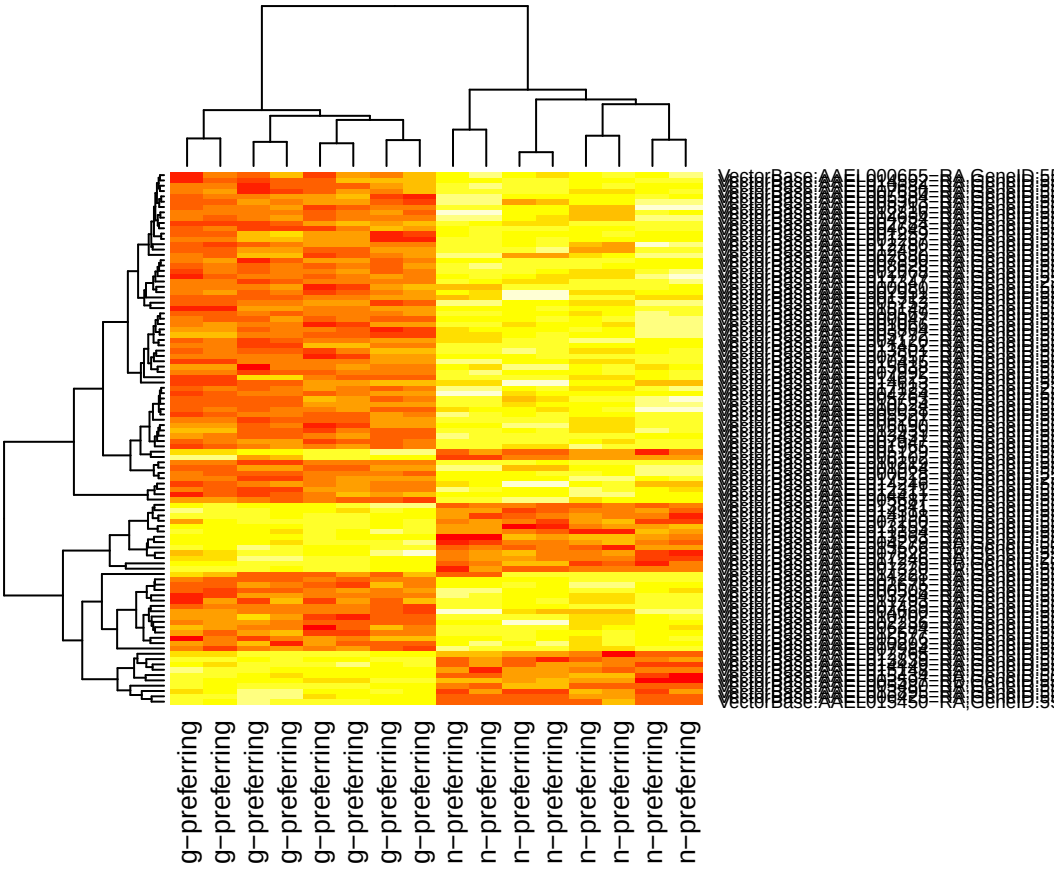
```
## VectorBase:AAEL013153-RA,GeneID:5577305,Genbank:XM_001663282.1,VectorBase:AAEL013153  1.012357e-04
## VectorBase:AAEL010702-RA,GeneID:5573720,Genbank:XM_001660979.2,VectorBase:AAEL010702  1.028906e-04
## VectorBase:AAEL002784-RA,GeneID:5576111,Genbank:XM_001662406.1,VectorBase:AAEL002784  1.057973e-04
## VectorBase:AAEL010293-RA,GeneID:5573093,Genbank:XM_001654354.1,VectorBase:AAEL010293  1.071045e-04
## VectorBase:AAEL015147-RA,GeneID:5566400,Genbank:XM_001650742.1,VectorBase:AAEL015147  1.091959e-04
## VectorBase:AAEL012780-RA,GeneID:5576795,Genbank:XM_001662829.1,VectorBase:AAEL012780  1.138346e-04
## VectorBase:AAEL004660-RA,GeneID:5565209,Genbank:XM_001649503.1,VectorBase:AAEL004660  1.144950e-04
## VectorBase:AAEL007951-RA,GeneID:5569855,Genbank:XM_001658701.2,VectorBase:AAEL007951  1.144950e-04
## VectorBase:AAEL010415-RA,GeneID:5573330,Genbank:XM_001654500.2,VectorBase:AAEL010415  1.144950e-04
## VectorBase:AAEL004654-RA,GeneID:5565228,Genbank:XM_001649502.1,VectorBase:AAEL004654  1.144950e-04
## VectorBase:AAEL005772-RA,GeneID:5567053,Genbank:XM_001651395.1,VectorBase:AAEL005772  1.207483e-04
## VectorBase:AAEL011793-RA,GeneID:5575387,Genbank:XM_001655687.1,VectorBase:AAEL011793  1.207483e-04
## VectorBase:AAEL014246-RA,GeneID:5563937,Genbank:XM_001648205.1,VectorBase:AAEL014246  1.207483e-04
## VectorBase:AAEL006102-RA,GeneID:5567446,Genbank:XM_001657383.1,VectorBase:AAEL006102  1.279609e-04
## VectorBase:AAEL000038-RA,GeneID:5563662,Genbank:XM_001647823.2,VectorBase:AAEL000038  1.449183e-04
## VectorBase:AAEL015038-RA,GeneID:5565992,Genbank:XM_001650310.1,VectorBase:AAEL015038  1.456121e-04
## VectorBase:AAEL014625-RA,GeneID:5564801,Genbank:XM_001649100.1,VectorBase:AAEL014625  1.554166e-04
## VectorBase:AAEL010684-RA,GeneID:5573696,Genbank:XM_001660971.1,VectorBase:AAEL010684  1.749737e-04
## VectorBase:AAEL004120-RA,GeneID:5564141,Genbank:XM_001648386.1,VectorBase:AAEL004120  1.797108e-04
## VectorBase:AAEL000655-RA,GeneID:5565444,Genbank:XM_001649746.1,VectorBase:AAEL000655  1.833790e-04
## VectorBase:AAEL014228-RA,GeneID:5563925,Genbank:XM_001648198.1,VectorBase:AAEL014228  1.935545e-04
## VectorBase:AAEL012492-RA,GeneID:5576386,Genbank:XM_001662554.2,VectorBase:AAEL012492  1.935545e-04
## VectorBase:AAEL006284-RA,GeneID:5567704,Genbank:XM_001651820.1,VectorBase:AAEL006284  1.935545e-04
## VectorBase:AAEL001267-RA,GeneID:5569588,Genbank:XM_001652810.1,VectorBase:AAEL001267  1.989344e-04
## VectorBase:AAEL004284-RA,GeneID:5564516,Genbank:XM_001648804.1,VectorBase:AAEL004284  2.057901e-04
## VectorBase:AAEL005303-RA,GeneID:5566305,Genbank:XM_001650649.1,VectorBase:AAEL005303  2.060948e-04
## VectorBase:AAEL006190-RA,GeneID:5567605,Genbank:XM_001657534.1,VectorBase:AAEL006190  2.082672e-04
## VectorBase:AAEL005384-RA,GeneID:5566442,Genbank:XM_001650782.1,VectorBase:AAEL005384  2.087911e-04
## VectorBase:AAEL012836-RA,GeneID:5576850,Genbank:XM_001656232.1,VectorBase:AAEL012836  2.268847e-04
## VectorBase:AAEL002675-RA,GeneID:5575552,Genbank:XM_001662007.1,VectorBase:AAEL002675  2.268847e-04
## VectorBase:AAEL012577-RA,GeneID:5576523,Genbank:XM_001662666.1,VectorBase:AAEL012577  2.305452e-04
## VectorBase:AAEL013563-RA,GeneID:5578227,Genbank:XM_001663704.2,VectorBase:AAEL013563  2.307989e-04
## VectorBase:AAEL014592-RA,GeneID:5564738,Genbank:XM_001649034.1,VectorBase:AAEL014592  2.347904e-04
## VectorBase:AAEL004279-RA,GeneID:5564499,Genbank:XM_001648808.1,VectorBase:AAEL004279  2.347904e-04
## VectorBase:AAEL001259-RA,GeneID:5569583,Genbank:XM_001652811.1,VectorBase:AAEL001259  2.607881e-04
## VectorBase:AAEL005129-RA,GeneID:5566032,Genbank:XM_001650336.1,VectorBase:AAEL005129  2.615982e-04
## VectorBase:AAEL004643-RA,GeneID:5565138,Genbank:XM_001649463.1,VectorBase:AAEL004643  2.718394e-04
## VectorBase:AAEL005876-RA,GeneID:5567132,Genbank:XM_001651509.1,VectorBase:AAEL005876  2.825397e-04
## VectorBase:AAEL002236-RA,GeneID:5573925,Genbank:XM_001654911.1,VectorBase:AAEL002236  2.825397e-04
## VectorBase:AAEL003864-RA,GeneID:5579115,Genbank:XM_001657264.1,VectorBase:AAEL003864  2.825397e-04
## VectorBase:AAEL011394-RA,GeneID:5580153,Genbank:XM_001661588.2,VectorBase:AAEL011394  2.926000e-04
## VectorBase:AAEL005763-RA,GeneID:5567014,Genbank:XM_001651362.1,VectorBase:AAEL005763  2.926003e-04
## VectorBase:AAEL007260-RA,GeneID:5568952,Genbank:XM_001652572.1,VectorBase:AAEL007260  2.961362e-04
```

```
topTags = topTags(de2, n=10561)
write.table(topTags, file="topTags.txt")
#another useful visualization for these data is a smear plot.  This plots the
#level of expression against the fold change difference of your treatments.
#typically, highly expressed genes tend not to be too different between treatments
#so the differentially expressed, very different, gene expression patterns
#are of lesser expressed genes.  This then creates a pattern of decreasing
#variance in fold change with increasing expression level.
de2_decide = decideTestsDGE(de2)
#differentiates the differentially expressed genes
```

```
detags = rownames(table)[as.logical(de2_decide)]
#converts those diff expressed genes with 1 or 0
plotSmear(de2, de.tags=detags)
#the plotting function, the de.tags are those that are diff expressed, by default red
abline(h=c(-1, 1), col="blue")
```




```
#adds lines at +/-1 (i.e., 2 fold difference in expression since it is log2)


#lastly, if you want to do a heatmap, which can look pretty cool, here are some basics
topde2 = topTags(de2, n=100)
detags2 = rownames(topde2)
cpm_de2 = cpm(table2, log=TRUE)[detags2,]
heatmap(cpm_de2, labRow=table2$group, labCol=Groups2$phenotype)
```




```
#this can be further modified as wanted
```