Arkas: Transcript Abundance Quantification In Much Less Time

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Contents

1 Arkas Analysis Introduction

Arkas analysis is the second phase for basespace cloud compting algorithm. It uses a single node and will parse the single node JSON and prepare for the workflow. the appresults are downloaded into the /data/input/appresults directory, in which there will be 1 directory for each appResults selected by the user (fasta files, comparison, and control results).

2 Uploaded Fasta Transcript References

Currently TxDbLite supports any uploaded fasta from ENSEMBL or RepBase (Giri), where the counted reads can be annotated against these databases. Currently the default supports are for mouse and ENSEMBL Rel 84, and RepBase April 2016 (2103) issue. Here we print out detected user uploaded fastas, but use only the default transcriptomes.

```
## [1] "Homo_sapiens.GRCh38.81.cdna.all.fa"
## [2] "Homo_sapiens.GRCh38.81.ncrna.fa"
## [3] "Homo_sapiens.RepBase.20_12.merged.fa"
```

```
## [1] "Homo_sapiens.GRCh38.81.cdna.all.fa"
## [2] "Homo_sapiens.GRCh38.81.ncrna.fa"
## [3] "Homo_sapiens.RepBase.20_12.merged.fa"
```

3 Annotating Kallisto Experiment against ENSEMBL/RepBase

Here we list the default annotation libraries for Mouse and Human samples. Currently, we use only the default transcriptomes.

```
## Setting transcriptome automatically from Kallisto call string.

## the kallisto data found transcriptome libraries given as:

## [1] "ErccDbLite.ERCC.97, EnsDbLite.Mmusculus.84, RepDbLite.Mmusculus.2103"

## Normalizing ENSEMBL transcript names (by removing .XYZ suffix)...

## Loading required package: ErccDbLite.ERCC.97

## Annotating transcripts from ErccDbLite.ERCC.97...

## Loading required package: EnsDbLite.Mmusculus.84

## Annotating transcripts from EnsDbLite.Mmusculus.84...

## Loading required package: RepDbLite.Mmusculus.2103

## Annotating transcripts from RepDbLite.Mmusculus.2103...

## 46 features lack any annotations.

## Leaving the metadata columns for the unannotated rows as-is.

## saving annotated Kexp to output directory

## creating two group comparison design matrix.

## creating single covariate, two group comparison design matrix ...

## the design uses limma to contrast Comparison (MUT) vs. Control (WT) where MUT positive values is wit

##            Intercept CompVsControl
## SRR3174494         1             1
## SRR3174490         1             1
## SRR3174502         1             0
## SRR3174501         1             0
```

4 ERCC Analysis

If ERCC spike-ins are present in the samples, and if their counts are non-zero, Arkas-Analysis performs an analysis outputting FDR, ROC plots and more. If ERCC counts are non-detected, then Arkas-Analysis removes unwanted variance using in silico negative controls, and outputs a heatmap of normalized counts. Here we create a design matrix model that includes the weights of removal of unwanted variance. For plotting we show sample type abbreviations, but also include a key for rigorous tracking.

```
## detecting erccs..

## successfully detected erccs, checking if any erccs were counted greater than 0..

## removing unwanted variance using in silico controls, not using ercc spike in counts...

## For the time being, only summing of bundles is supported

## I'm afraid I did not detect a vector of in silico negative controls, ... checking for design matrix

## I found a design matrix, determining in silinco negative control...

## performing gene-wise-analysis...
```

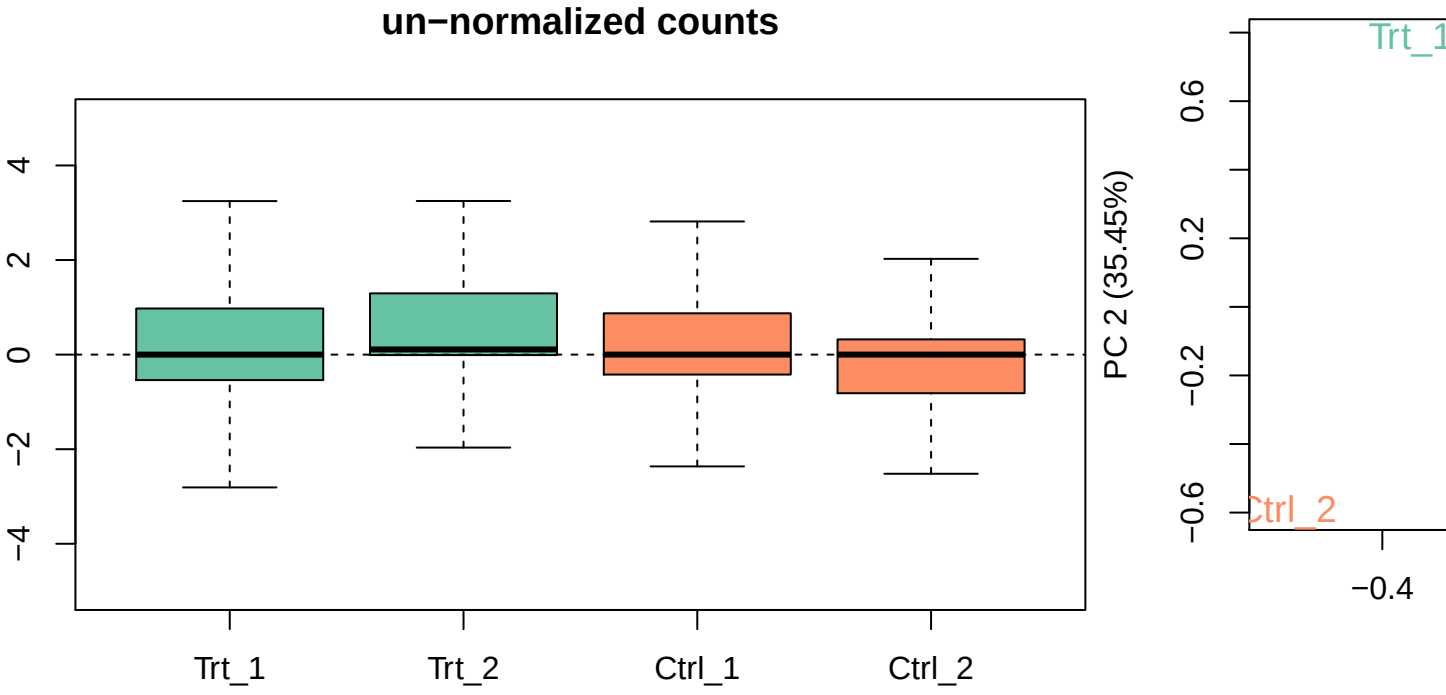
```
## Fitting bundles...
```

```
## For the time being, only summing of bundles is supported
```

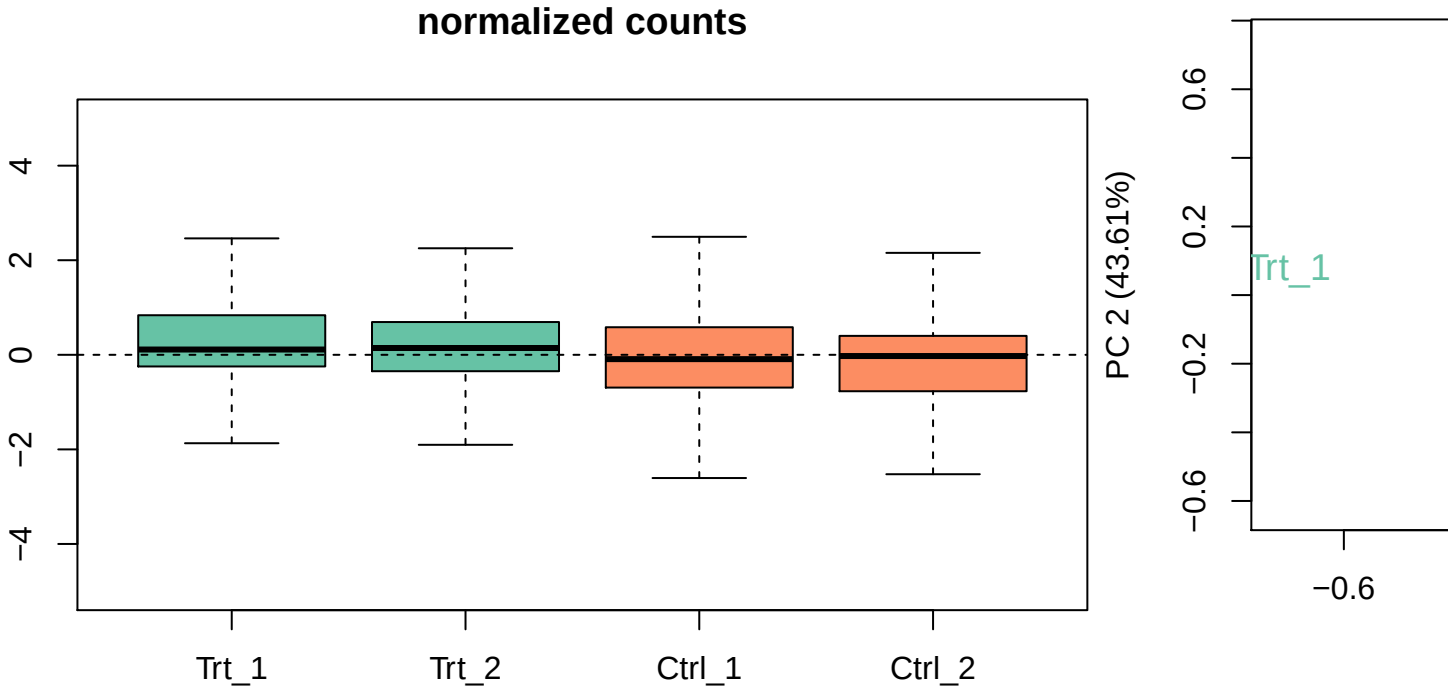
```
##             W_1
## [1,] -0.5318271
## [2,]  0.5720596
## [3,]  0.4209611
## [4,] -0.4611936
```

```
## done with inSilico normalization
## For the time being, only summing of bundles is supported
```

```
##                   term suffix type        W_1
## SRR3174494 SRR3174494  Trt_1  Trt -0.5318271
## SRR3174490 SRR3174490  Trt_2  Trt  0.5720596
## SRR3174502 SRR3174502 Ctrl_1 Ctrl  0.4209611
## SRR3174501 SRR3174501 Ctrl_2 Ctrl -0.4611936
```




```
##                   term suffix type        W_1
## SRR3174494 SRR3174494  Trt_1  Trt -0.5318271
## SRR3174490 SRR3174490  Trt_2  Trt  0.5720596
## SRR3174502 SRR3174502 Ctrl_1 Ctrl  0.4209611
## SRR3174501 SRR3174501 Ctrl_2 Ctrl -0.4611936
```




```
##            (Intercept) phenoDat$typeTrt phenoDat$W_1
## SRR3174494           1                1   -0.5318271
## SRR3174490           1                1    0.5720596
## SRR3174502           1                0    0.4209611
## SRR3174501           1                0   -0.4611936
## attr(,"assign")
## [1] 0 1 2
## attr(,"contrasts")
## attr(,"contrasts")$`phenoDat$type`
## [1] "contr.treatment"
```

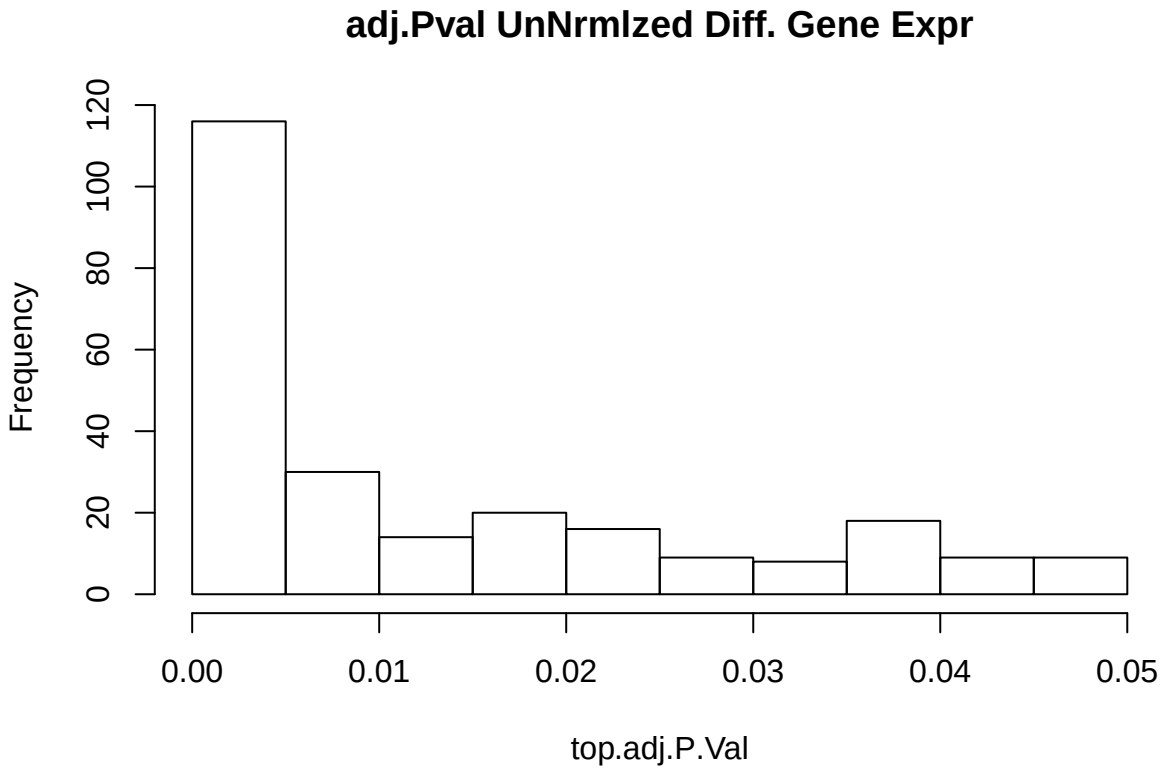
5 Gene Level Analysis UnNormalized

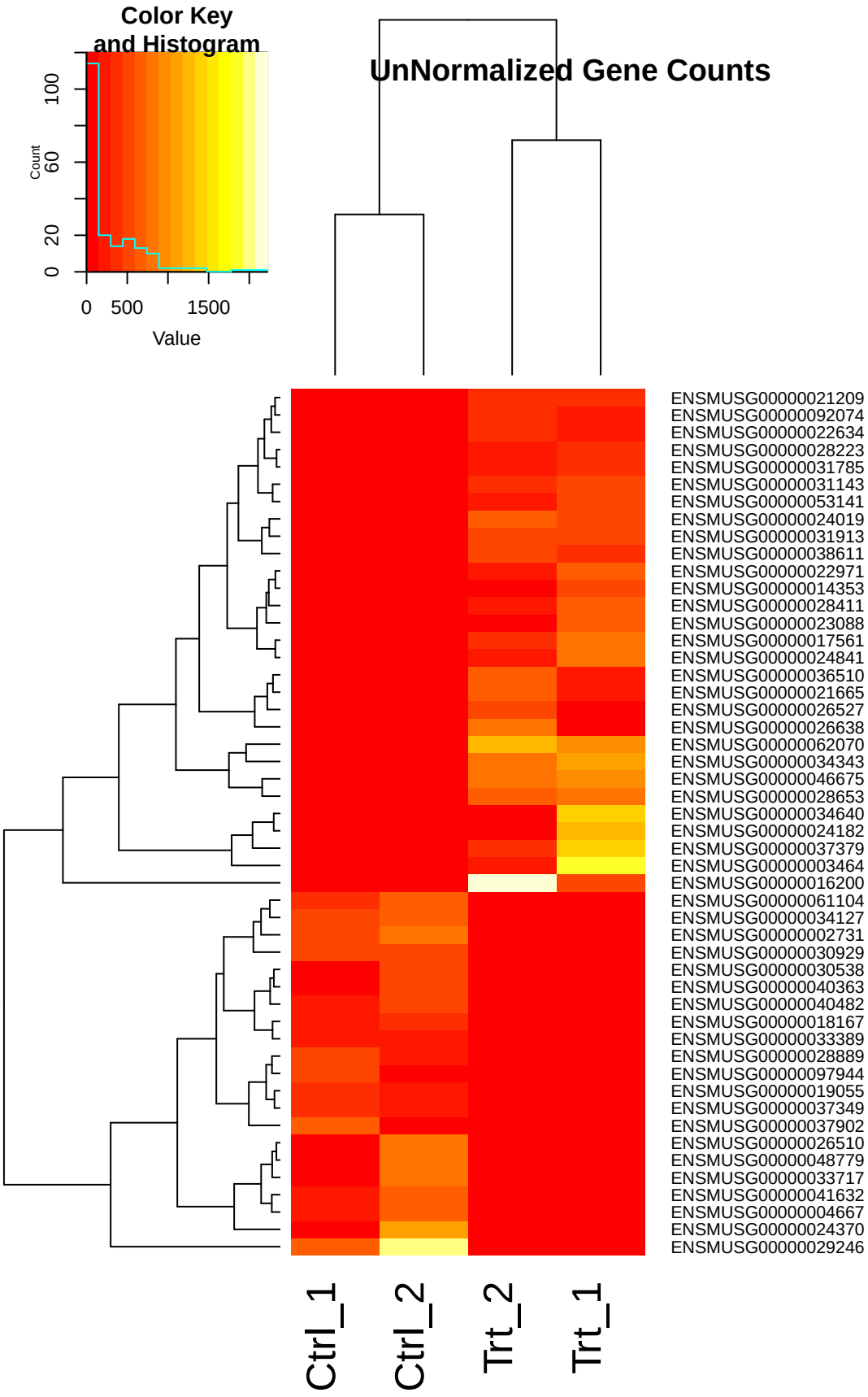
Gene Wise analysis is ran on two designs, one without model the removal of unwanted variance factors, and the other with the weights correcting unwanted variance by RUVSeq. We plot here the Gene Level UnNormalized two group design model, and the raw counts; note that the unNormalized raw counts may have high numbers, and the default heatmaps show the unscaled data sets, which could be saturated if a few genes have very large counts. the raw data can be downloaded and input into Advaita's iPathway Guide for complete pathway analysis.

```
## Fitting bundles...

## For the time being, only summing of bundles is supported

## finding entrez IDs of top ensembl genes...

##                         logFC  AveExpr          t      P.Value
## ENSMUSG00000029246 -11.633320 2.865683 -12.254448 6.706928e-11
## ENSMUSG00000062070  10.672830 2.796673  11.635013 1.710556e-10
## ENSMUSG00000034343  10.515375 2.732827  11.186793 3.448474e-10
```

```
## ENSMUSG00000016200  10.662041 2.750137  10.698120 7.584791e-10
## ENSMUSG00000046675  10.304820 2.623826  10.692599 7.653753e-10
## ENSMUSG00000002731 -10.803917 2.449835 -10.640086 8.343274e-10
## ENSMUSG00000028653  10.052680 2.496580  10.074823 2.152973e-09
## ENSMUSG00000030929 -10.527406 2.310838  -9.991964 2.481505e-09
## ENSMUSG00000034127 -10.498283 2.296820  -9.898492 2.915470e-09
## ENSMUSG00000061104 -10.489281 2.292727  -9.820706 3.336529e-09
## ENSMUSG00000037379   9.997651 2.503795   9.437701 6.551379e-09
## ENSMUSG00000024019   9.744927 2.329442   9.311895 8.208642e-09
## ENSMUSG00000031913   9.682294 2.305527   9.186196 1.030320e-08
## ENSMUSG00000017561   9.502385 2.238264   8.656833 2.742184e-08
## ENSMUSG00000041632 -10.052781 2.074984  -8.695016 2.552192e-08
## ENSMUSG00000003464   9.696661 2.374544   8.309092 5.319523e-08
## ENSMUSG00000038611   9.347423 2.132530   8.393826 4.519789e-08
## ENSMUSG00000024841   9.370514 2.176003   8.327928 5.129897e-08
## ENSMUSG00000024370 -10.054148 2.077208  -8.232508 6.168419e-08
## ENSMUSG00000031143   9.245004 2.095353   8.172128 6.935961e-08
## ENSMUSG00000028411   9.180321 2.078710   7.940929 1.091630e-07
## ENSMUSG00000040482  -9.747929 1.922524  -8.027309 9.207104e-08
## ENSMUSG00000026510  -9.828639 1.963936  -7.949109 1.074122e-07
## ENSMUSG00000028889  -9.681055 1.886774  -7.934170 1.106317e-07
## ENSMUSG00000037902  -9.740559 1.915484  -7.864728 1.269615e-07
## ENSMUSG00000004667  -9.702735 1.900507  -7.815264 1.400981e-07
## ENSMUSG00000034640   9.264675 2.153850   7.625255 2.051246e-07
## ENSMUSG00000036510   9.129900 1.999615   7.707073 1.739636e-07
## ENSMUSG00000053141   9.025853 1.990922   7.678410 1.842820e-07
## ENSMUSG00000019055  -9.570177 1.831771  -7.736266 1.640668e-07
## ENSMUSG00000021665   9.060567 1.969048   7.609895 2.115903e-07
## ENSMUSG00000048779  -9.655587 1.877581  -7.552730 2.375615e-07
## ENSMUSG00000026638   9.100862 1.973051   7.473957 2.788526e-07
## ENSMUSG00000021209   8.929683 1.929208   7.490716 2.694867e-07
## ENSMUSG00000033717  -9.622271 1.860795  -7.521621 2.530572e-07
## ENSMUSG00000022634   8.855701 1.881661   7.300684 3.978730e-07
## ENSMUSG00000033389  -9.377279 1.736235  -7.339785 3.670756e-07
## ENSMUSG00000022971   8.828599 1.912106   7.135306 5.606796e-07
## ENSMUSG00000028223   8.772362 1.858942   7.162436 5.298678e-07
## ENSMUSG00000037349  -9.353198 1.722914  -7.252081 4.399059e-07
## ENSMUSG00000092074   8.753007 1.839865   7.121132 5.775073e-07
## ENSMUSG00000018167  -9.291791 1.694097  -7.122994 5.752667e-07
## ENSMUSG00000097944  -9.322563 1.706865  -7.093706 6.115591e-07
## ENSMUSG00000031785   8.641737 1.793450   6.898527 9.220868e-07
## ENSMUSG00000014353   8.674299 1.835662   6.829823 1.066768e-06
## ENSMUSG00000030538  -9.266940 1.682829  -6.899011 9.211435e-07
## ENSMUSG00000023088   8.698572 1.856618   6.786886 1.168871e-06
## ENSMUSG00000026527   8.660590 1.760490   6.711818 1.372215e-06
## ENSMUSG00000040363  -9.184204 1.641264  -6.779604 1.187161e-06
## ENSMUSG00000024182   8.800837 1.933032   6.608992 1.711417e-06
##                       adj.P.Val         B
## ENSMUSG00000029246 9.462804e-07 13.172994
## ENSMUSG00000062070 1.206711e-06 12.428863
## ENSMUSG00000034343 1.621817e-06 11.849286
## ENSMUSG00000016200 1.961921e-06 11.286350
## ENSMUSG00000046675 1.961921e-06 11.144380
## ENSMUSG00000002731 1.961921e-06 10.865743
```

```
## ENSMUSG00000028653 4.339471e-06 10.239491
## ENSMUSG00000030929 4.376445e-06  9.905259
## ENSMUSG00000034127 4.570484e-06  9.771467
## ENSMUSG00000061104 4.707509e-06  9.669277
## ENSMUSG00000037379 8.403037e-06  9.413871
## ENSMUSG00000024019 9.651311e-06  9.058869
## ENSMUSG00000031913 1.118214e-05  8.862960
## ENSMUSG00000017561 2.579299e-05  8.056417
## ENSMUSG00000041632 2.572062e-05  7.920861
## ENSMUSG00000003464 4.169619e-05  7.677852
## ENSMUSG00000038611 3.985607e-05  7.567477
## ENSMUSG00000024841 4.169619e-05  7.518098
## ENSMUSG00000024370 4.580538e-05  7.271739
## ENSMUSG00000031143 4.892973e-05  7.206114
## ENSMUSG00000028411 6.503763e-05  6.846377
## ENSMUSG00000040482 6.185858e-05  6.800265
## ENSMUSG00000026510 6.503763e-05  6.733875
## ENSMUSG00000028889 6.503763e-05  6.623928
## ENSMUSG00000037902 7.165199e-05  6.555906
## ENSMUSG00000004667 7.602478e-05  6.466351
## ENSMUSG00000034640 9.630090e-05  6.432263
## ENSMUSG00000036510 8.765903e-05  6.413389
## ENSMUSG00000053141 8.965635e-05  6.361027
## ENSMUSG00000019055 8.573404e-05  6.271738
## ENSMUSG00000021665 9.630090e-05  6.234487
## ENSMUSG00000048779 1.047424e-04  6.049885
## ENSMUSG00000026638 1.124095e-04  6.029227
## ENSMUSG00000021209 1.118291e-04  6.011666
## ENSMUSG00000033717 1.081934e-04  5.984898
## ENSMUSG00000022634 1.517187e-04  5.670182
## ENSMUSG00000033389 1.438630e-04  5.574415
## ENSMUSG00000022971 1.940012e-04  5.438763
## ENSMUSG00000028223 1.916898e-04  5.431502
## ENSMUSG00000037349 1.633324e-04  5.427153
## ENSMUSG00000092074 1.940012e-04  5.347928
## ENSMUSG00000018167 1.940012e-04  5.199090
## ENSMUSG00000097944 2.006625e-04  5.167743
## ENSMUSG00000031785 2.891049e-04  4.949829
## ENSMUSG00000014353 3.271963e-04  4.877464
## ENSMUSG00000030538 2.891049e-04  4.840220
## ENSMUSG00000023088 3.489510e-04  4.825675
## ENSMUSG00000026527 3.872116e-04  4.618093
## ENSMUSG00000040363 3.489510e-04  4.610480
## ENSMUSG00000024182 4.390250e-04  4.591148

## completed gene wise analysis, saved the advaita compatible output of differentially expressed genes
```


adj.Pval UnNrmlzed Diff. Gene Expr
Frequency
0
20
40
60
80
100
120
0.00
0.01
0.02
0.03
0.04
0.05
top.adj.P.Val


Color Key
and Histogram
Count
0
20
60
100
0
500
1500
Value
UnNormalized Gene Counts
ENSMUSG00000021209
ENSMUSG00000092074
ENSMUSG00000022634
ENSMUSG00000028223
ENSMUSG00000031785
ENSMUSG00000031143
ENSMUSG00000053141
ENSMUSG00000024019
ENSMUSG00000031913
ENSMUSG00000038611
ENSMUSG00000022971
ENSMUSG00000014353
ENSMUSG00000028411
ENSMUSG00000023088
ENSMUSG00000017561
ENSMUSG00000024841
ENSMUSG00000036510
ENSMUSG00000021665
ENSMUSG00000026527
ENSMUSG00000026638
ENSMUSG00000062070
ENSMUSG00000034343
ENSMUSG00000046675
ENSMUSG00000028653
ENSMUSG00000034640
ENSMUSG00000024182
ENSMUSG00000037379
ENSMUSG00000003464
ENSMUSG00000016200
ENSMUSG00000061104
ENSMUSG00000034127
ENSMUSG00000002731
ENSMUSG00000030929
ENSMUSG00000030538
ENSMUSG00000040363
ENSMUSG00000040482
ENSMUSG00000018167
ENSMUSG00000033389
ENSMUSG00000028889
ENSMUSG00000097944
ENSMUSG00000019055
ENSMUSG00000037349
ENSMUSG00000037902
ENSMUSG00000026510
ENSMUSG00000048779
ENSMUSG00000033717
ENSMUSG00000041632
ENSMUSG00000004667
ENSMUSG00000024370
ENSMUSG00000029246
Ctrl_1
Ctrl_2
Trt_2
Trt_1

6 Gene Level Analysis Including Removal of UnWanted Variance

Here Arkas-Analysis models the gene expression count correction the unwanted factors of noise. Arkas-Analysis saves the normalized differential gene expression as a text file that is compatible with Advaita iPathway Guide for an exhaustive pathway analysis.

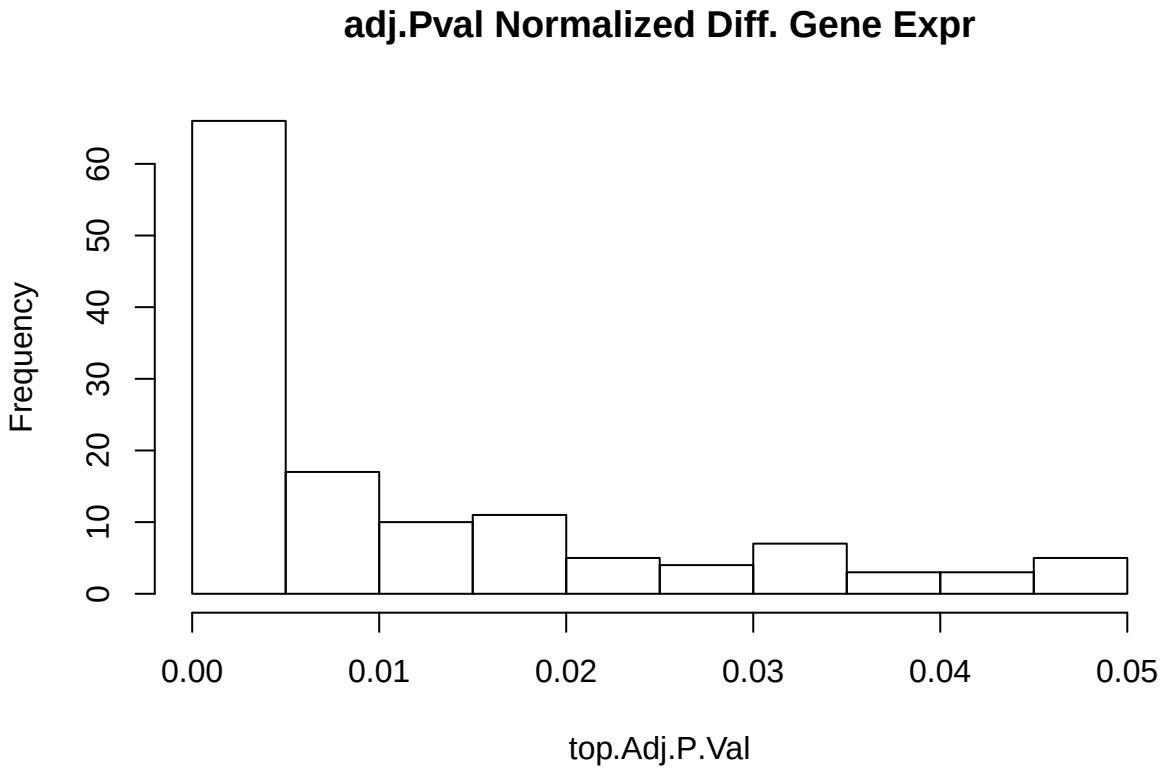
```
## Fitting bundles...

## For the time being, only summing of bundles is supported

## finding entrez IDs of top ensembl genes...
```

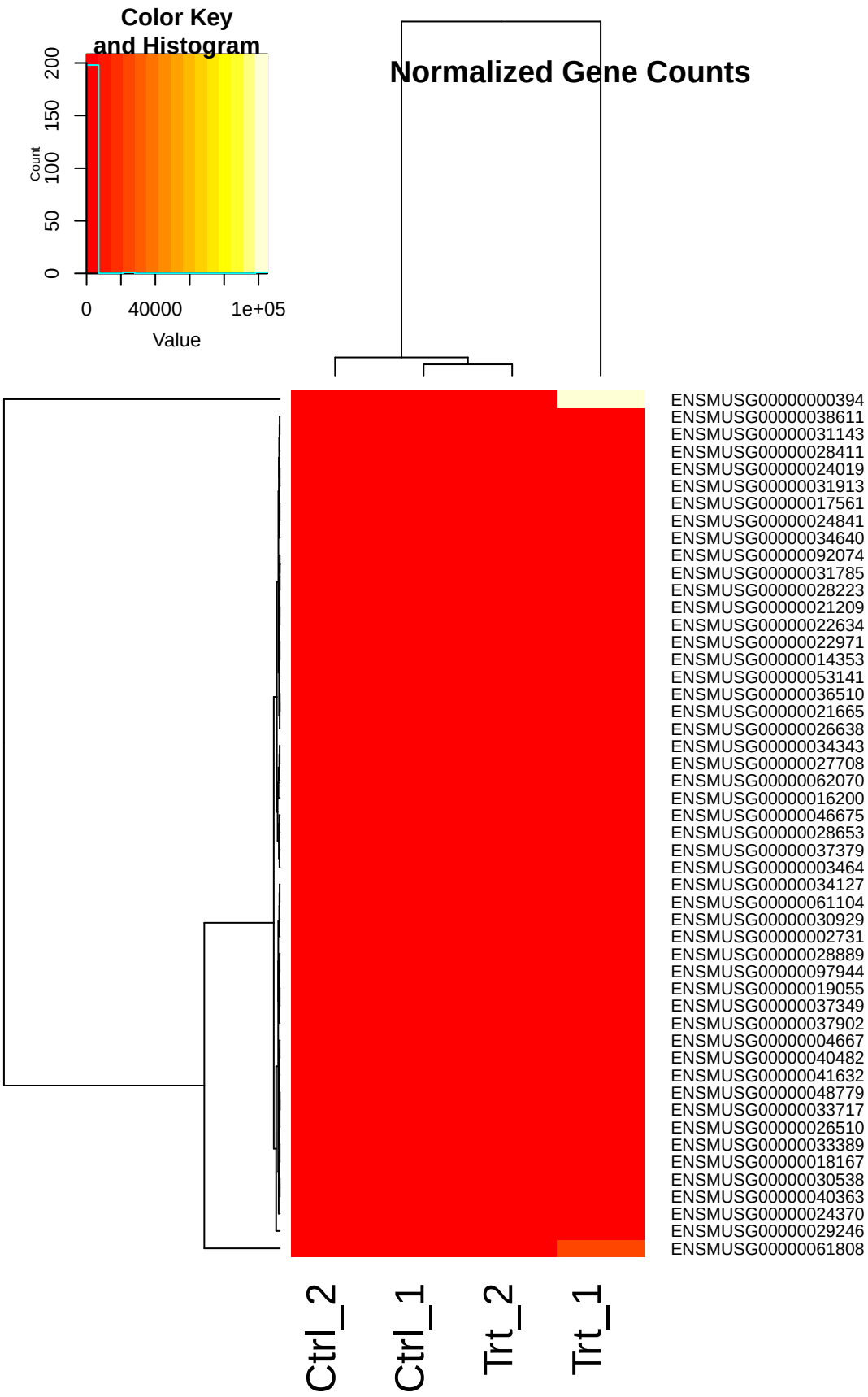
	logFC	AveExpr	t	P.Value
ENSMUSG00000000394	10.445271	9.328003	12.663683	1.485688e-36
ENSMUSG00000029246	-11.647432	2.865683	-7.741497	1.049112e-14
ENSMUSG00000061808	4.121015	10.402734	7.243984	4.582670e-13
ENSMUSG00000062070	10.670340	2.796673	7.016933	2.371313e-12
ENSMUSG00000034343	10.565779	2.732827	6.881592	6.168362e-12
ENSMUSG00000002731	-10.797397	2.449835	-6.623260	3.640823e-11
ENSMUSG00000046675	10.340316	2.623826	6.589516	4.569175e-11
ENSMUSG00000016200	10.569595	2.750137	6.602423	4.189529e-11
ENSMUSG00000028653	10.083800	2.496580	6.258620	3.996302e-10
ENSMUSG00000030929	-10.522466	2.310838	-6.266447	3.801127e-10
ENSMUSG00000034127	-10.490425	2.296820	-6.222621	5.027386e-10
ENSMUSG00000061104	-10.490193	2.292727	-6.213945	5.312301e-10
ENSMUSG00000037379	10.161616	2.503795	6.087929	1.173456e-09
ENSMUSG00000024019	9.734999	2.329442	5.811424	6.328114e-09
ENSMUSG00000031913	9.692144	2.305527	5.763008	8.435390e-09
ENSMUSG00000017561	9.628180	2.238264	5.659903	1.544065e-08
ENSMUSG00000041632	-10.087853	2.074984	-5.677475	1.393905e-08
ENSMUSG00000024841	9.524472	2.176003	5.515596	3.537154e-08
ENSMUSG00000038611	9.342025	2.132530	5.329567	9.996164e-08
ENSMUSG00000028411	9.323680	2.078710	5.280414	1.308053e-07
ENSMUSG00000040482	-9.787780	1.922524	-5.306513	1.134324e-07
ENSMUSG00000031143	9.288796	2.095353	5.266100	1.413986e-07
ENSMUSG00000003464	9.810541	2.374544	5.288688	1.250360e-07
ENSMUSG00000028889	-9.720294	1.886774	-5.236164	1.663030e-07
ENSMUSG00000024370	-10.058271	2.077208	-5.197870	2.043990e-07
ENSMUSG00000004667	-9.773181	1.900507	-5.174294	2.319118e-07
ENSMUSG00000026510	-9.882566	1.963936	-5.146928	2.683433e-07
ENSMUSG00000037902	-9.815292	1.915484	-5.140119	2.782345e-07
ENSMUSG00000019055	-9.580023	1.831771	-5.082958	3.763576e-07
ENSMUSG00000053141	9.098407	1.990922	5.033060	4.886560e-07
ENSMUSG00000036510	9.134130	1.999615	5.023985	5.122922e-07
ENSMUSG00000021665	9.056614	1.969048	4.947525	7.602911e-07
ENSMUSG00000021209	8.939187	1.929208	4.856244	1.209160e-06
ENSMUSG00000034640	9.412198	2.153850	4.881112	1.066432e-06
ENSMUSG00000033717	-9.682444	1.860795	-4.891512	1.011678e-06
ENSMUSG00000048779	-9.707804	1.877581	-4.882122	1.060991e-06
ENSMUSG00000037349	-9.388403	1.722914	-4.847473	1.263755e-06
ENSMUSG00000033389	-9.370920	1.736235	-4.844469	1.282996e-06
ENSMUSG00000022971	9.007826	1.912106	4.763643	1.920216e-06
ENSMUSG00000022634	8.843868	1.881661	4.738211	2.177151e-06
ENSMUSG00000018167	-9.312429	1.694097	-4.761921	1.936650e-06
ENSMUSG00000028223	8.816810	1.858942	4.712814	2.466520e-06
ENSMUSG00000097944	-9.402505	1.706865	-4.751503	2.039005e-06

```
## ENSMUSG00000026638   9.070455  1.973051  4.727873 2.290780e-06
## ENSMUSG00000027708   9.711208  3.218274  4.729493 2.272602e-06
## ENSMUSG00000092074   8.759329  1.839865  4.650705 3.338049e-06
## ENSMUSG00000014353   8.858255  1.835662  4.579814 4.693708e-06
## ENSMUSG00000031785   8.685613  1.793450  4.565047 5.036020e-06
## ENSMUSG00000030538  -9.347731  1.682829 -4.591687 4.434756e-06
## ENSMUSG00000040363  -9.267460  1.641264 -4.560335 5.150196e-06
##                        adj.P.Val         B
## ENSMUSG00000000394 6.987190e-33 70.484306
## ENSMUSG00000029246 2.960383e-11 20.365621
## ENSMUSG00000061808 9.236698e-10 19.158466
## ENSMUSG00000062070 4.182108e-09 15.680288
## ENSMUSG00000034343 9.669936e-09 14.821960
## ENSMUSG00000002731 5.136837e-08 13.042905
## ENSMUSG00000046675 5.372208e-08 13.030700
## ENSMUSG00000016200 5.372208e-08 13.012176
## ENSMUSG00000028653 4.027416e-07 11.102973
## ENSMUSG00000030929 4.027416e-07 10.966511
## ENSMUSG00000034127 4.684453e-07 10.719391
## ENSMUSG00000061104 4.684453e-07 10.668131
## ENSMUSG00000037379 9.738990e-07 10.066032
## ENSMUSG00000024019 4.699124e-06  8.669683
## ENSMUSG00000031913 5.950746e-06  8.419993
## ENSMUSG00000017561 9.902369e-06  7.885748
## ENSMUSG00000041632 9.365052e-06  7.806600
## ENSMUSG00000024841 2.169813e-05  7.161167
## ENSMUSG00000038611 5.876495e-05  6.274710
## ENSMUSG00000028411 6.835305e-05  6.035811
## ENSMUSG00000040482 6.401670e-05  6.003082
## ENSMUSG00000031143 7.124973e-05  5.976818
## ENSMUSG00000003464 6.785128e-05  5.906649
## ENSMUSG00000028889 8.090928e-05  5.680139
## ENSMUSG00000024370 9.612884e-05  5.374656
## ENSMUSG00000004667 1.055498e-04  5.361153
## ENSMUSG00000026510 1.183142e-04  5.191601
## ENSMUSG00000037902 1.189579e-04  5.182430
## ENSMUSG00000019055 1.561773e-04  4.991175
## ENSMUSG00000053141 1.969842e-04  4.915424
## ENSMUSG00000036510 2.007759e-04  4.861194
## ENSMUSG00000021665 2.899175e-04  4.530407
## ENSMUSG00000021209 4.160986e-04  4.150600
## ENSMUSG00000034640 3.761574e-04  4.113051
## ENSMUSG00000033717 3.756254e-04  4.071914
## ENSMUSG00000048779 3.761574e-04  4.021247
## ENSMUSG00000037349 4.209719e-04  3.969306
## ENSMUSG00000033389 4.209719e-04  3.961437
## ENSMUSG00000022971 6.072042e-04  3.715877
## ENSMUSG00000022634 6.535623e-04  3.653807
## ENSMUSG00000018167 6.072042e-04  3.613741
## ENSMUSG00000028223 6.960027e-04  3.550690
## ENSMUSG00000097944 6.253983e-04  3.539768
## ENSMUSG00000026638 6.596045e-04  3.539604
## ENSMUSG00000027708 6.596045e-04  3.346135
## ENSMUSG00000092074 9.234613e-04  3.298552
```

```
## ENSMUSG00000014353 1.249500e-03  2.967520
## ENSMUSG00000031785 1.315800e-03  2.955426
## ENSMUSG00000030538 1.203269e-03  2.871478
## ENSMUSG00000040363 1.321166e-03  2.764487
```

```
## completed gene wise analysis, saved the advaita compatible output of differentially expressed genes
```





Design Model

Correcting for unwanted factors of Variance.

```
##                     Trt_1 Trt_2 Ctrl_1 Ctrl_2
## ENSMUSG00000000394 105212  2642   2324     33
## ENSMUSG00000002731      0     0    654    676
## ENSMUSG00000003464   1101   345      1      0
## ENSMUSG00000004667      0     1    218    435
## ENSMUSG00000014353    433   193      0      0
## ENSMUSG00000016200    855  1157      0      1
## ENSMUSG00000017561    678   372      0      0
## ENSMUSG00000018167      0     0    201    269
## ENSMUSG00000019055      0     0    357    226
## ENSMUSG00000021209    366   287      0      0
## ENSMUSG00000021665    311   368      0      0
## ENSMUSG00000022634    313   292      0      0
## ENSMUSG00000022971    477   217      0      0
## ENSMUSG00000024019    608   521      0      0
## ENSMUSG00000024370      0     1    226    676
## ENSMUSG00000024841    641   332      0      0
## ENSMUSG00000026510      0     1    214    525
## ENSMUSG00000026638    274   418      0      1
## ENSMUSG00000027708   1165   771      1      1
## ENSMUSG00000028223    356   244      0      0
## ENSMUSG00000028411    552   294      0      0
## ENSMUSG00000028653    852   598      0      0
## ENSMUSG00000028889      0     0    429    221
## ENSMUSG00000029246      0     1    967   1431
## ENSMUSG00000030538      0     1    147    350
## ENSMUSG00000030929      0     0    628    483
## ENSMUSG00000031143    497   338      0      0
## ENSMUSG00000031785    325   223      0      0
## ENSMUSG00000031913    623   479      0      0
## ENSMUSG00000033389      0     0    249    246
## ENSMUSG00000033717      0     1    180    467
## ENSMUSG00000034127      0     0    547    530
## ENSMUSG00000034343   1224   803      0      0
## ENSMUSG00000034640    799   258      1      0
## ENSMUSG00000036510    315   395      0      1
## ENSMUSG00000037349      0     0    338    178
## ENSMUSG00000037379   1111   481      0      0
## ENSMUSG00000037902      0     0    573    181
## ENSMUSG00000038611    466   394      0      0
## ENSMUSG00000040363      0     1    145    317
## ENSMUSG00000040482      0     0    258    392
## ENSMUSG00000041632      0     0    322    481
## ENSMUSG00000046675   1025   707      0      0
## ENSMUSG00000048779      0     1    179    490
## ENSMUSG00000053141    448   282      0      0
## ENSMUSG00000061104      0     0    497    574
## ENSMUSG00000061808  27957  4144   5843    627
## ENSMUSG00000062070   1210   959      0      0
## ENSMUSG00000092074    320   256      0      0
## ENSMUSG00000097944      0     0    398    146
```

7 Transcript Level Analysis UnNormalized Two-Group Comparison

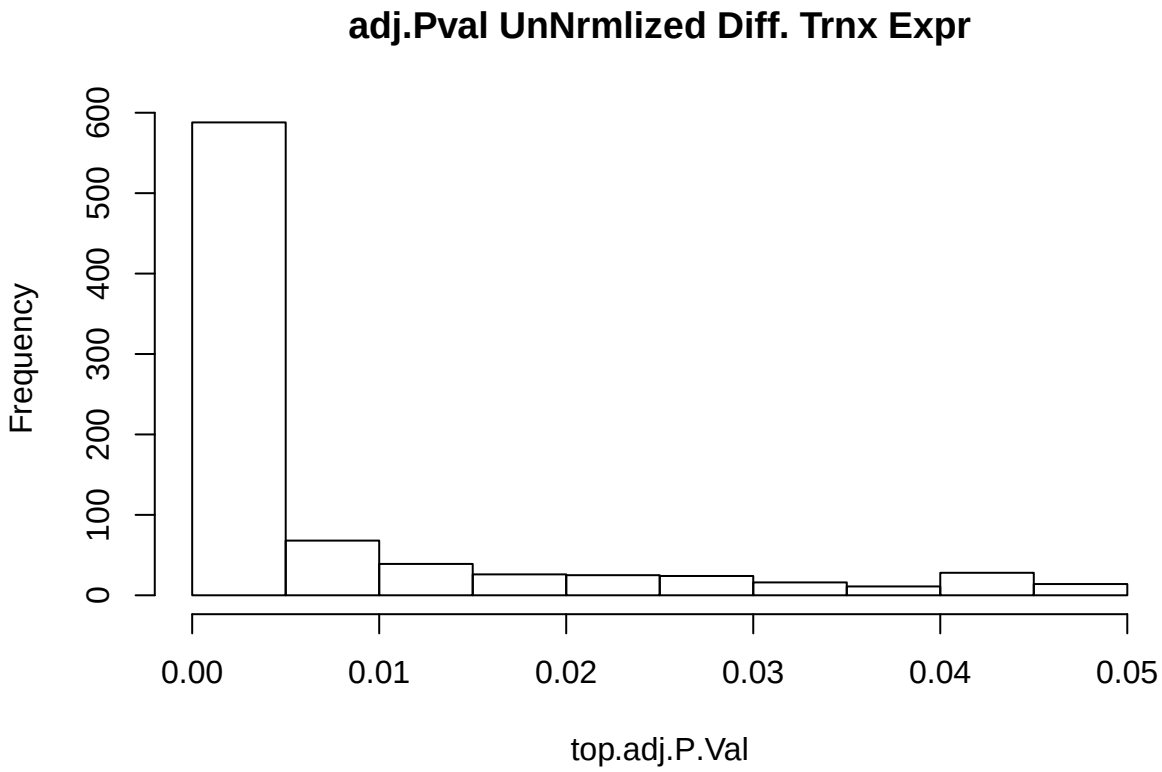
Arkas Analysis output transcript level differential transcript expression of un-normalized data. The unnormalized data is saved as a text file compatible with Advaita's pathway analysis software.

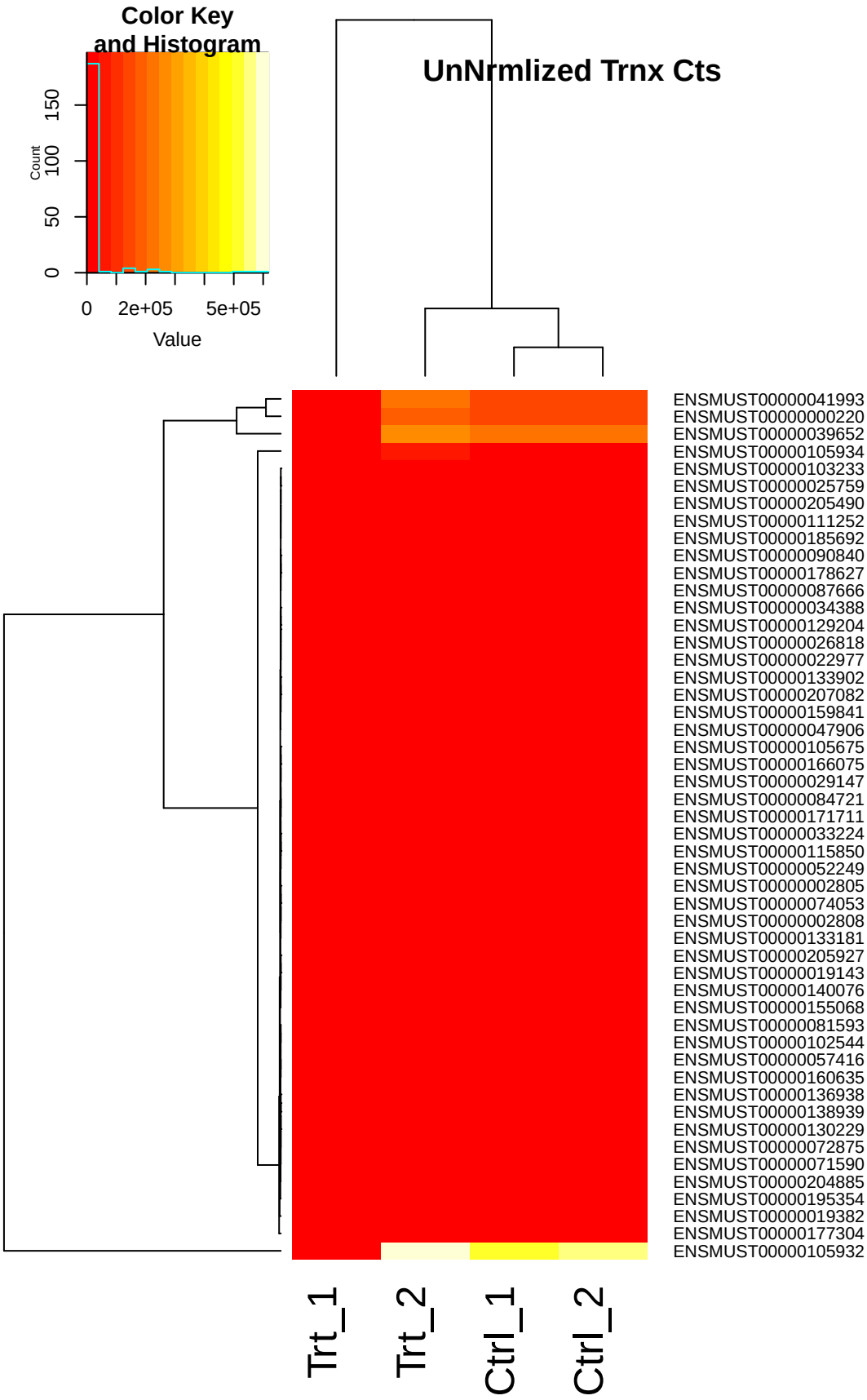
```
## It might be wise to run RUVg using ERCC controls prior to this...
```

	logFC	AveExpr	t	P.Value
ENSMUST00000105932	-3.471141	15.104519	-104.442047	0.000000e+00
ENSMUST00000041993	-2.802001	13.925091	-56.436448	0.000000e+00
ENSMUST00000039652	-4.239387	13.751483	-42.206335	0.000000e+00
ENSMUST00000000220	-4.001740	13.259114	-31.764209	2.726828e-219
ENSMUST00000019382	-12.377505	3.240919	-17.346683	3.251986e-67
ENSMUST00000081593	10.703793	2.788952	13.344512	1.490051e-40
ENSMUST00000102544	10.631804	2.757297	13.130275	2.556066e-39
ENSMUST00000195354	10.512204	2.662173	12.609335	2.124232e-36
ENSMUST00000057416	10.343133	2.616105	12.227463	2.475739e-34
ENSMUST00000105934	-4.131123	11.393031	-11.993569	4.252296e-33
ENSMUST00000160635	10.320689	2.599161	12.135082	7.660530e-34
ENSMUST00000155068	-10.701837	2.407111	-11.804332	4.079774e-32
ENSMUST00000002808	-10.610236	2.358246	-11.509395	1.290097e-30
ENSMUST00000090840	10.078551	2.490761	11.438511	2.921275e-30
ENSMUST00000178627	10.038156	2.470892	11.317552	1.164972e-29
ENSMUST00000087666	10.031010	2.462603	11.278197	1.821466e-29
ENSMUST00000084721	-10.462344	2.285360	-11.065795	1.979675e-28
ENSMUST00000074053	-10.463521	2.285006	-11.065670	1.982414e-28
ENSMUST00000022977	9.893258	2.383448	10.829348	2.675240e-27
ENSMUST00000185692	9.837303	2.377425	10.745936	6.615460e-27
ENSMUST00000177304	9.680920	2.356580	10.499725	9.200659e-26
ENSMUST00000002805	-10.103709	2.495196	-10.399513	2.640685e-25
ENSMUST00000034388	9.715707	2.297806	10.325132	5.738702e-25
ENSMUST00000071590	9.726311	2.283698	10.285636	8.646632e-25
ENSMUST00000129204	9.657079	2.271094	10.167476	2.920676e-24
ENSMUST00000072875	9.652496	2.256180	10.109599	5.275239e-24
ENSMUST00000171711	-10.130992	2.119526	-10.103428	5.617362e-24
ENSMUST00000205490	9.577481	2.245483	9.993352	1.712432e-23
ENSMUST00000140076	-10.098178	2.104499	-10.016425	1.356987e-23
ENSMUST00000204885	9.616047	2.214012	9.922715	3.479559e-23
ENSMUST00000103233	9.533785	2.221838	9.865103	6.181300e-23
ENSMUST00000052249	-10.029018	2.067263	-9.815092	1.015220e-22
ENSMUST00000026818	9.528067	2.200011	9.783257	1.390490e-22
ENSMUST00000025759	9.422199	2.168282	9.565929	1.159244e-21
ENSMUST00000033224	-9.899964	2.003073	-9.465666	3.035773e-21
ENSMUST00000047906	9.337801	2.146129	9.405482	5.384841e-21
ENSMUST00000029147	-9.857120	1.983226	-9.356766	8.541099e-21
ENSMUST00000115850	-9.851587	1.978995	-9.337084	1.028408e-20
ENSMUST00000105675	-9.833677	1.971270	-9.293856	1.544281e-20
ENSMUST00000111252	9.280088	2.105608	9.212395	3.305752e-20
ENSMUST00000019143	-9.805551	1.959031	-9.225905	2.915058e-20
ENSMUST00000133181	-9.811489	1.957163	-9.225188	2.934578e-20
ENSMUST00000133902	9.292919	2.095293	9.190918	4.035926e-20
ENSMUST00000136938	9.321826	2.084595	9.183885	4.308109e-20
ENSMUST00000205927	-9.797840	1.955311	-9.206114	3.504594e-20

```
## ENSMUST00000207082   9.276159  2.087374    9.148178  5.995754e-20
## ENSMUST00000130229   9.241465  2.133925    9.123356  7.539126e-20
## ENSMUST00000159841   9.234890  2.062552    9.026140  1.838163e-19
## ENSMUST00000166075  -9.717122  1.912949   -8.989607  2.563276e-19
## ENSMUST00000138939   9.221007  2.033029    8.916640  4.960464e-19
##                        adj.P.Val          B
## ENSMUST00000105932  0.000000e+00 5444.31413
## ENSMUST00000041993  0.000000e+00 1583.31914
## ENSMUST00000039652  0.000000e+00  881.84242
## ENSMUST00000000220 1.749328e-215  495.92841
## ENSMUST00000019382  1.668984e-63  139.27398
## ENSMUST00000081593  6.372698e-37   79.22967
## ENSMUST00000102544  9.370174e-36   76.45393
## ENSMUST00000195354  6.813740e-33   69.86571
## ENSMUST00000057416  7.058881e-31   65.25245
## ENSMUST00000105934  9.919833e-30   64.34042
## ENSMUST00000160635  1.965769e-30   64.14848
## ENSMUST00000155068  8.724256e-29   60.02115
## ENSMUST00000002808  2.546551e-27   56.66587
## ENSMUST00000090840  5.354489e-27   56.13730
## ENSMUST00000178627  1.992956e-26   54.79474
## ENSMUST00000087666  2.921290e-26   54.35809
## ENSMUST00000084721  2.826152e-25   51.78885
## ENSMUST00000074053  2.826152e-25   51.78688
## ENSMUST00000022977  3.613123e-24   49.51602
## ENSMUST00000185692  8.487966e-24   48.65317
## ENSMUST00000177304  1.073173e-22   46.14171
## ENSMUST00000002805  2.946201e-22   44.90218
## ENSMUST00000034388  6.135868e-22   44.32848
## ENSMUST00000071590  8.875249e-22   43.92131
## ENSMUST00000129204  2.882595e-21   42.76016
## ENSMUST00000072875  5.013626e-21   42.18275
## ENSMUST00000171711  5.148112e-21   41.89151
## ENSMUST00000205490  1.464757e-20   41.06377
## ENSMUST00000140076  1.200746e-20   41.04390
## ENSMUST00000204885  2.880289e-20   40.35157
## ENSMUST00000103233  4.956823e-20   39.82679
## ENSMUST00000052249  7.894413e-20   39.10825
## ENSMUST00000026818  1.049452e-19   39.03590
## ENSMUST00000025759  8.499248e-19   37.00967
## ENSMUST00000033224  2.163916e-18   35.84967
## ENSMUST00000047906  3.734606e-18   35.54661
## ENSMUST00000029147  5.767714e-18   34.86038
## ENSMUST00000115850  6.766662e-18   34.68182
## ENSMUST00000105675  9.906949e-18   34.29368
## ENSMUST00000111252  1.972765e-17   33.80073
## ENSMUST00000019143  1.792957e-17   33.68734
## ENSMUST00000133181  1.792957e-17   33.67808
## ENSMUST00000133902  2.301465e-17   33.60049
## ENSMUST00000136938  2.403269e-17   33.52424
## ENSMUST00000205927  2.043895e-17   33.51139
## ENSMUST00000207082  3.273554e-17   33.22179
## ENSMUST00000130229  4.030448e-17   33.01348
## ENSMUST00000159841  9.626345e-17   32.14772
```

```
## ENSMUST00000166075  1.315525e-16   31.61052
## ENSMUST00000138939  2.495892e-16   31.18686
```

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and Histogram
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50
100
150
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2e+05
5e+05
Value
UnNrmlized Trnx Cts
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ENSMUST00000090840
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ENSMUST00000204885
ENSMUST00000195354
ENSMUST00000019382
ENSMUST00000177304
ENSMUST00000105932
Trt_1
Trt_2
Ctrl_1
Ctrl_2

8 Transcript Level Analysis Including Corrections for UnWanted Variance

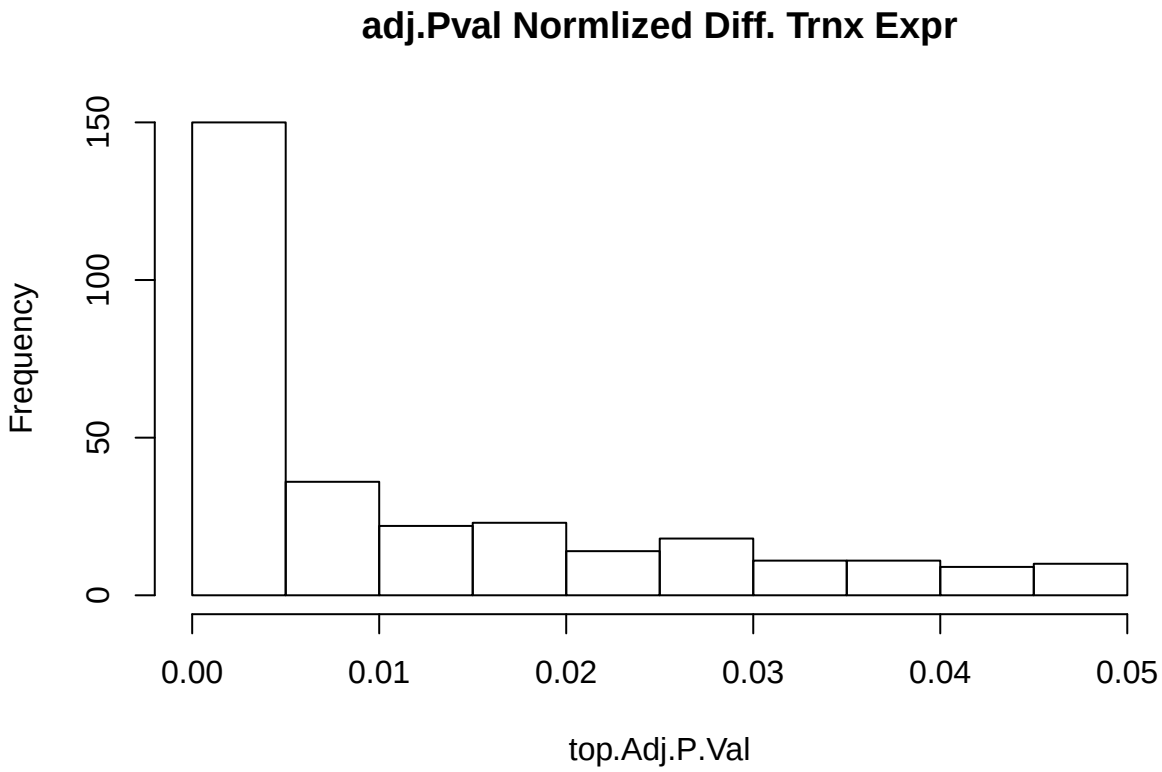
Arkas-Analysis performs transcrpit level analysis correcting for the factors of unwanted variance, the data can be input into Advaita's pathway guide.

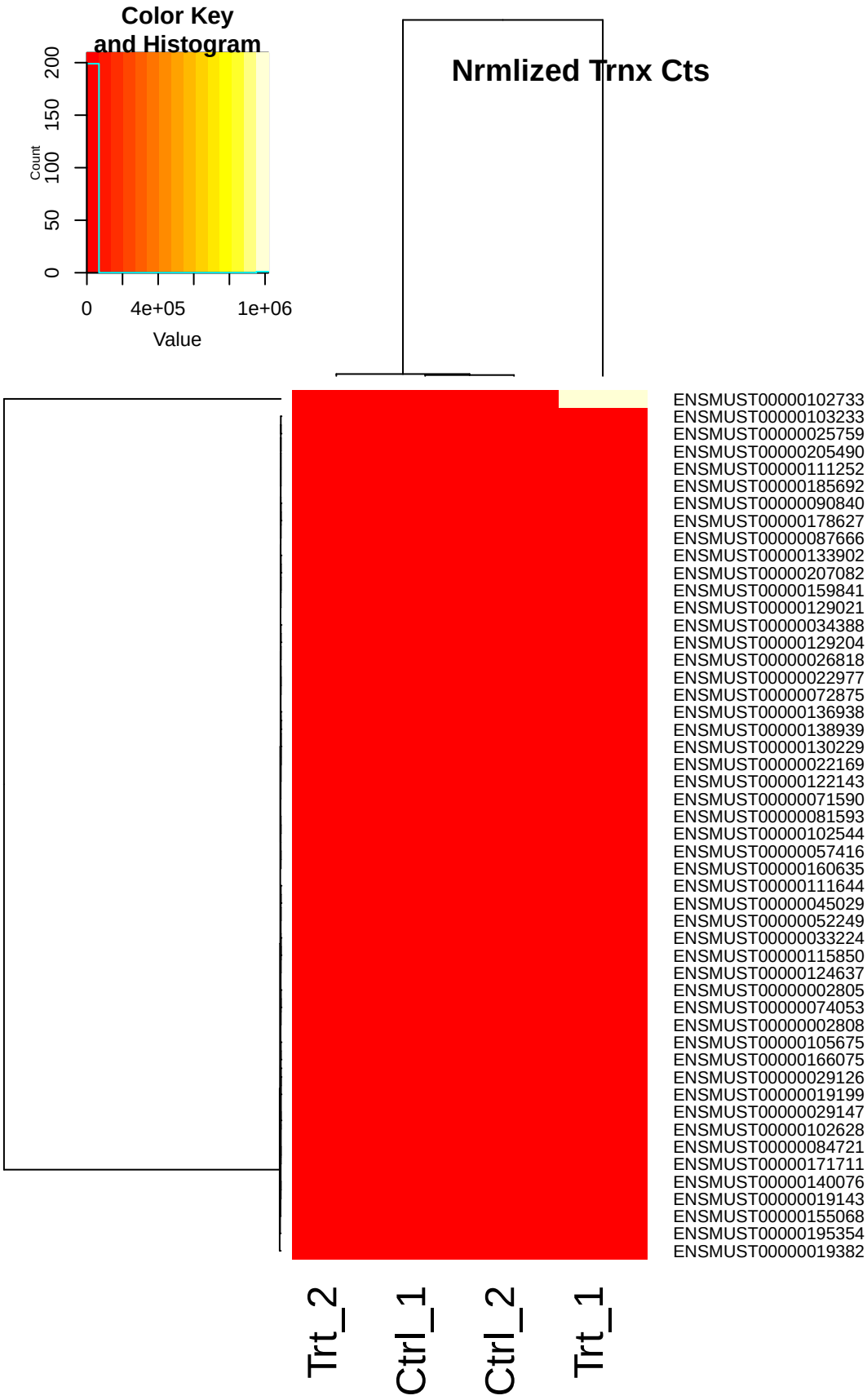
```
## It might be wise to run RUVg using ERCC controls prior to this...
```

	logFC	AveExpr	t	P.Value	adj.P.Val
ENSMUST00000102733	10.151498	9.234976	9.823290	9.802562e-23	2.515435e-18
ENSMUST00000019382	-12.382084	3.240919	-9.510843	2.051378e-21	2.632021e-17
ENSMUST00000081593	10.697911	2.788952	7.548095	4.563422e-14	3.903399e-10
ENSMUST00000102544	10.640433	2.757297	7.466145	8.520423e-14	5.466064e-10
ENSMUST00000057416	10.365463	2.616105	7.068326	1.608244e-12	8.253828e-09
ENSMUST00000160635	10.320135	2.599161	7.003695	2.554461e-12	1.092501e-08
ENSMUST00000002808	-10.614239	2.358246	-6.838777	8.166406e-12	2.993688e-08
ENSMUST00000090840	10.143113	2.490761	6.746202	1.549910e-11	4.971531e-08
ENSMUST00000178627	10.105458	2.470892	6.693169	2.228874e-11	6.312754e-08
ENSMUST00000087666	10.067551	2.462603	6.648561	3.019103e-11	6.509215e-08
ENSMUST00000155068	-10.729018	2.407111	-6.678694	2.460058e-11	6.312754e-08
ENSMUST00000084721	-10.459369	2.285360	-6.636805	3.269428e-11	6.509215e-08
ENSMUST00000074053	-10.465104	2.285006	-6.635537	3.297603e-11	6.509215e-08
ENSMUST00000185692	9.967566	2.377425	6.482418	9.190285e-11	1.684514e-07
ENSMUST00000022977	9.887117	2.383448	6.403713	1.542671e-10	2.474155e-07
ENSMUST00000195354	10.341870	2.662173	6.414537	1.437121e-10	2.458531e-07
ENSMUST00000002805	-10.097930	2.495196	-6.258859	3.939357e-10	5.946344e-07
ENSMUST00000034388	9.718871	2.297806	6.181726	6.435934e-10	8.257625e-07
ENSMUST00000140076	-10.162268	2.104499	-6.207803	5.455316e-10	7.777159e-07
ENSMUST00000171711	-10.125449	2.119526	-6.190816	6.076007e-10	8.206127e-07
ENSMUST00000071590	9.731556	2.283698	6.150664	7.829860e-10	9.567716e-07
ENSMUST00000205490	9.693753	2.245483	6.121732	9.390556e-10	1.069694e-06
ENSMUST00000129204	9.670655	2.271094	6.118416	9.587683e-10	1.069694e-06
ENSMUST00000072875	9.639642	2.256180	6.063749	1.348415e-09	1.384068e-06
ENSMUST00000052249	-10.059155	2.067263	-6.077100	1.240991e-09	1.326878e-06
ENSMUST00000103233	9.633603	2.221838	6.048767	1.479770e-09	1.460476e-06
ENSMUST00000025759	9.546421	2.168282	5.927444	3.116153e-09	2.961615e-06
ENSMUST00000026818	9.520404	2.200011	5.920824	3.244052e-09	2.973058e-06
ENSMUST00000033224	-9.912678	2.003073	-5.901505	3.647233e-09	3.227299e-06
ENSMUST00000029147	-9.870214	1.983226	-5.856427	4.786924e-09	4.094575e-06
ENSMUST00000115850	-9.859719	1.978995	-5.837813	5.352685e-09	4.430815e-06
ENSMUST00000105675	-9.836900	1.971270	-5.818568	6.005881e-09	4.816153e-06
ENSMUST00000133902	9.344232	2.095293	5.693486	1.258293e-08	9.784565e-06
ENSMUST00000207082	9.331020	2.087374	5.676051	1.393256e-08	1.044833e-05
ENSMUST00000166075	-9.718860	1.912949	-5.672179	1.425087e-08	1.044833e-05
ENSMUST00000136938	9.326088	2.084595	5.642099	1.697591e-08	1.210053e-05
ENSMUST00000130229	9.245896	2.133925	5.602971	2.128680e-08	1.437475e-05
ENSMUST00000159841	9.261926	2.062552	5.596238	2.212876e-08	1.456015e-05
ENSMUST00000102628	-9.686542	1.879053	-5.616519	1.968584e-08	1.365293e-05
ENSMUST00000138939	9.232166	2.033029	5.520584	3.411439e-08	2.188523e-05
ENSMUST00000029126	-9.588653	1.845332	-5.510929	3.603749e-08	2.255508e-05
ENSMUST00000111644	-9.698259	1.881607	-5.488410	4.094030e-08	2.501355e-05
ENSMUST00000129021	9.202234	1.996609	5.445402	5.216253e-08	3.042143e-05
ENSMUST00000019199	-9.536562	1.817561	-5.446642	5.180079e-08	3.042143e-05
ENSMUST00000122143	9.100834	1.985979	5.389150	7.141543e-08	3.817899e-05

```
## ENSMUST00000045029  -9.610157 1.834251 -5.421620 5.959389e-08 3.398308e-05
## ENSMUST00000124637  -9.498265 1.793402 -5.389973 7.108942e-08 3.817899e-05
## ENSMUST00000111252   9.361417 2.105608  5.379236 7.545668e-08 3.951620e-05
## ENSMUST00000019143  -9.802773 1.959031 -5.402387 6.634450e-08 3.701014e-05
## ENSMUST00000022169   9.086445 1.961327  5.346632 9.037110e-08 4.547084e-05
##                            B
## ENSMUST00000102733 39.234819
## ENSMUST00000019382 35.107472
## ENSMUST00000081593 19.603541
## ENSMUST00000102544 19.031407
## ENSMUST00000057416 16.346431
## ENSMUST00000160635 15.925266
## ENSMUST00000002808 14.699368
## ENSMUST00000090840 14.286894
## ENSMUST00000178627 13.958096
## ENSMUST00000087666 13.686157
## ENSMUST00000155068 13.609506
## ENSMUST00000084721 13.453004
## ENSMUST00000074053 13.442563
## ENSMUST00000185692 12.674415
## ENSMUST00000022977 12.217457
## ENSMUST00000195354 12.106822
## ENSMUST00000002805 11.256202
## ENSMUST00000034388 10.938810
## ENSMUST00000140076 10.926740
## ENSMUST00000171711 10.840061
## ENSMUST00000071590 10.750461
## ENSMUST00000205490 10.594153
## ENSMUST00000129204 10.583143
## ENSMUST00000072875 10.275372
## ENSMUST00000052249 10.198230
## ENSMUST00000103233 10.190664
## ENSMUST00000025759  9.526778
## ENSMUST00000026818  9.498476
## ENSMUST00000033224  9.248919
## ENSMUST00000029147  9.011855
## ENSMUST00000115850  8.912004
## ENSMUST00000105675  8.813430
## ENSMUST00000133902  8.299430
## ENSMUST00000207082  8.209482
## ENSMUST00000166075  8.055597
## ENSMUST00000136938  8.028215
## ENSMUST00000130229  7.845615
## ENSMUST00000159841  7.804434
## ENSMUST00000102628  7.768674
## ENSMUST00000138939  7.414559
## ENSMUST00000029126  7.245396
## ENSMUST00000111644  7.091091
## ENSMUST00000129021  7.033112
## ENSMUST00000019199  6.929617
## ENSMUST00000122143  6.776779
## ENSMUST00000045029  6.776541
## ENSMUST00000124637  6.652133
## ENSMUST00000111252  6.642357
```

```
## ENSMUST00000019143  6.613543
## ENSMUST00000022169  6.565157
```




Color Key
and Histogram
Count
0
50
100
150
200
0
4e+05
1e+06
Value
Nrmlized Trnx Cts
ENSMUST00000102733
ENSMUST00000103233
ENSMUST00000025759
ENSMUST00000205490
ENSMUST00000111252
ENSMUST00000185692
ENSMUST00000090840
ENSMUST00000178627
ENSMUST00000087666
ENSMUST00000133902
ENSMUST00000207082
ENSMUST00000159841
ENSMUST00000129021
ENSMUST00000034388
ENSMUST00000129204
ENSMUST00000026818
ENSMUST00000022977
ENSMUST00000072875
ENSMUST00000136938
ENSMUST00000138939
ENSMUST00000130229
ENSMUST00000022169
ENSMUST00000122143
ENSMUST00000071590
ENSMUST00000081593
ENSMUST00000102544
ENSMUST00000057416
ENSMUST00000160635
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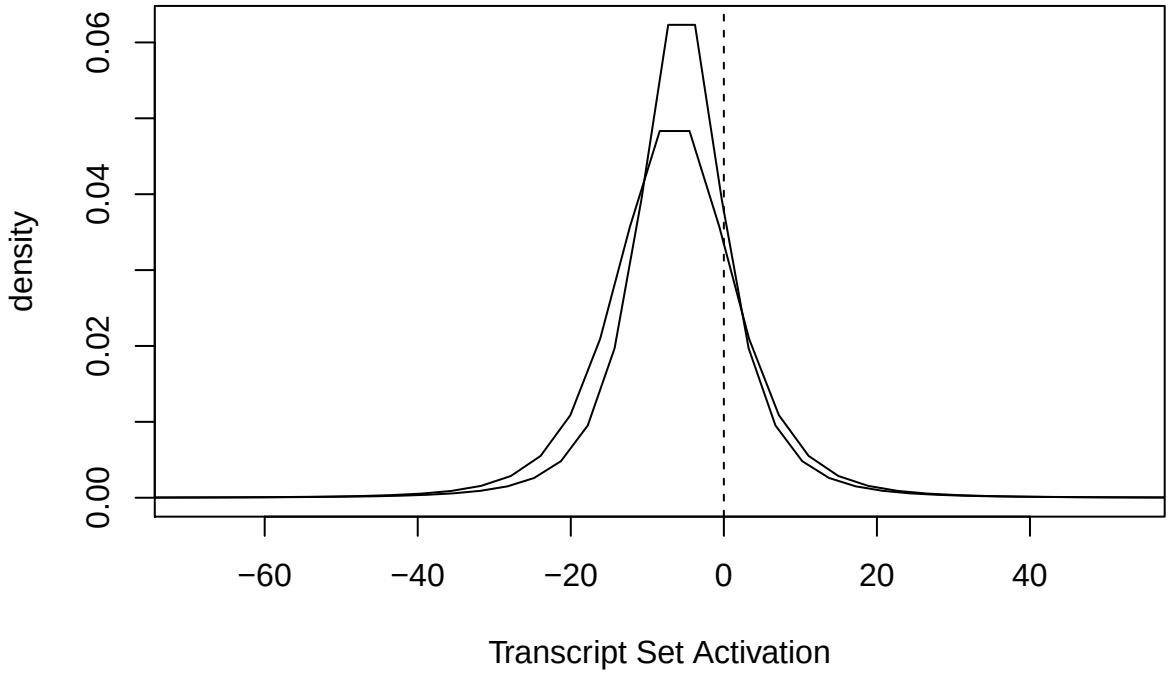
ENSMUST00000002805
ENSMUST00000074053
ENSMUST00000002808
ENSMUST00000105675
ENSMUST00000166075
ENSMUST00000029126
ENSMUST00000019199
ENSMUST00000029147
ENSMUST00000102628
ENSMUST00000084721
ENSMUST00000171711
ENSMUST00000140076
ENSMUST00000019143
ENSMUST00000155068
ENSMUST00000195354
ENSMUST00000019382
Trt_2
Ctrl_1
Ctrl_2
Trt_1

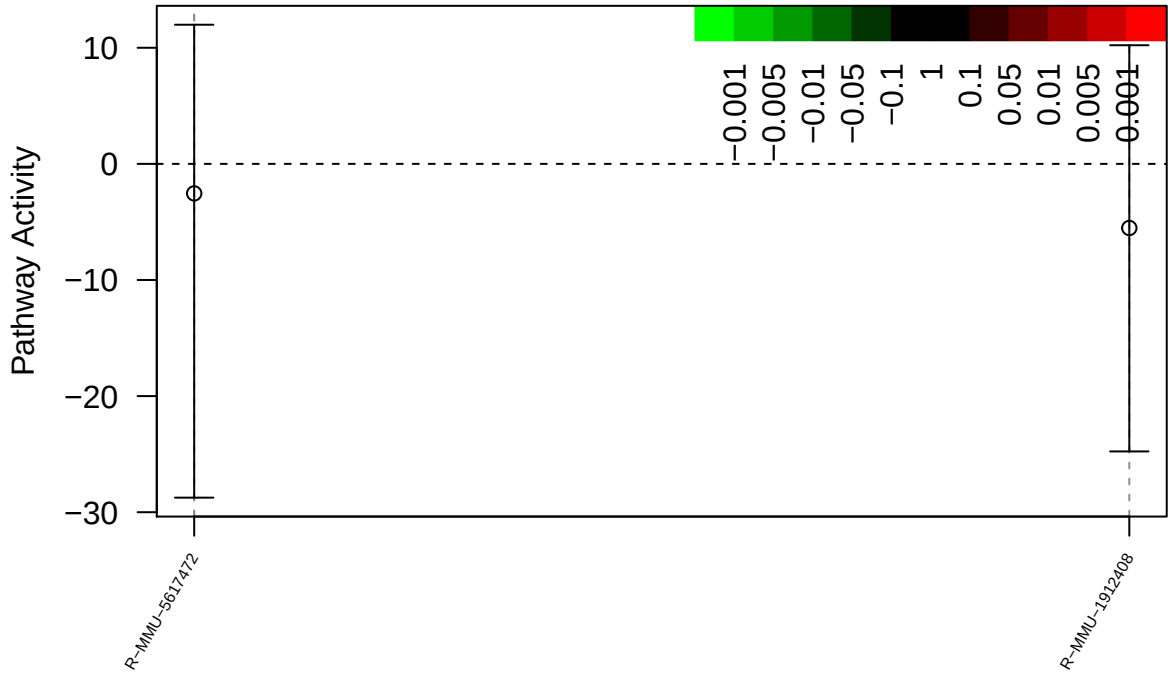
9 Enrichment Analysis

Enrichment is done using speedSage client package which accelerates Gene-Set Enrichment Analysis. Currently Arkas-Analysis uses Reactome Gene Sets which includes transcripts as well.

```
## completed transcript level Diff.Expr Analysis, running enrichment reactome set analysis ...

##  creating reactome set from mapped reactome list...

## done

## found reactome gene set for transcript level, transforming expression to log base 2

## $`R-MMU-1912408`
## [1] "ENSMUST00000028288"
##
## $`R-MMU-5617472`
##  [1] "ENSMUST00000049241" "ENSMUST00000100523" "ENSMUST00000055334"
##  [4] "ENSMUST00000019117" "ENSMUST00000000964" "ENSMUST00000114434"
##  [7] "ENSMUST00000101395" "ENSMUST00000014848" "ENSMUST00000111980"
## [10] "ENSMUST00000111983" "ENSMUST00000047793" "ENSMUST00000100375"

## filtering transcripts which the row sum is 0 across all samples...

## Calculating gene-by-gene comparisons...Done.
## Aggregating gene data for gene sets.
## Low sample size detected. Increasing n.points in aggregateGeneSet.Done.
## Calculating variance inflation factors...Done.

## pathway activity statistics for 2 activated pathways

##    pathway.name log.fold.change   p.Value       FDR
## 1 R-MMU-1912408       -5.521446 0.2777187 0.3207851
## 2 R-MMU-5617472       -2.541424 0.3207851 0.3207851

## [1] 0.2777187 0.3207851
```



```
## the fdr adjusted p.vals of each transcript set is:

##   names.tx.Results.pathways.    q.vals
## 1              R-MMU-1912408 0.3207851
## 2              R-MMU-5617472 0.3207851

##    pathway.name log.fold.change   p.Value       FDR
## 1 R-MMU-1912408       -5.521446 0.2777187 0.3207851
## 2 R-MMU-5617472       -2.541424 0.3207851 0.3207851

## plotting confidence intervals of pathways
```

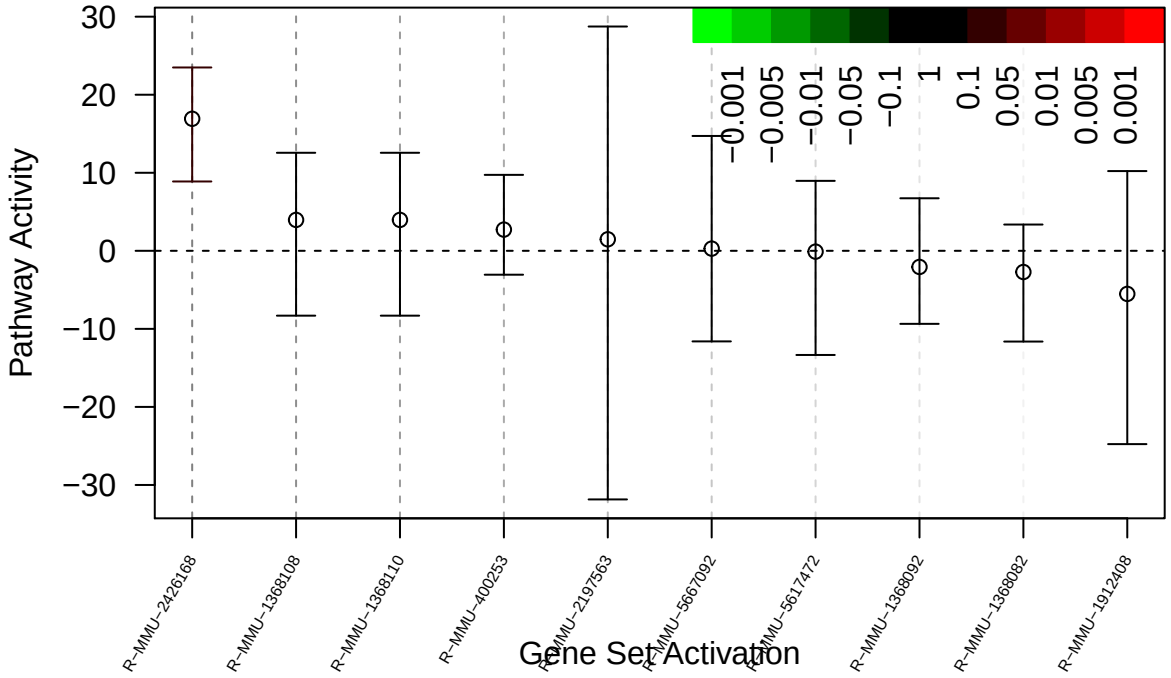



```
## printing Reactome Urls for exploration...

##    pathway.name log.fold.change   p.Value       FDR
## 1 R-MMU-1912408       -5.521446 0.2777187 0.3207851
## 2 R-MMU-5617472       -2.541424 0.3207851 0.3207851
##                                                 tx.Url
## 1 http://www.reactome.org/PathwayBrowser/#/R-MMU-1912408
## 2 http://www.reactome.org/PathwayBrowser/#/R-MMU-5617472

## done with transcript level enrichment.

## starting gene level enrichment.

## For the time being, only summing of bundles is supported

##  creating reactome set from mapped reactome list...

## I detected duplicates...correcting...

## I split the reactomeSet, now correcting the ID lengths for duplicates...

## done

## found reactome gene set for gene level, transforming expression to log base 2

## $`R-MMU-1368082`
## [1] "ENSMUSG00000020538" "ENSMUSG00000020889" "ENSMUSG00000024900"
```

```
## [4] "ENSMUSG00000055116"
##
## $`R-MMU-1368092`
## [1] "ENSMUSG00000020538" "ENSMUSG00000020889" "ENSMUSG00000024900"
## [4] "ENSMUSG00000029238" "ENSMUSG00000055116"
##
## $`R-MMU-1368108`
##  [1] "ENSMUSG00000020038" "ENSMUSG00000020572" "ENSMUSG00000020889"
##  [4] "ENSMUSG00000020893" "ENSMUSG00000030103" "ENSMUSG00000030256"
##  [7] "ENSMUSG00000032238" "ENSMUSG00000055866" "ENSMUSG00000059824"
## [10] "ENSMUSG00000068742"
##
## $`R-MMU-1368110`
##  [1] "ENSMUSG00000020038" "ENSMUSG00000020572" "ENSMUSG00000020889"
##  [4] "ENSMUSG00000020893" "ENSMUSG00000030103" "ENSMUSG00000030256"
##  [7] "ENSMUSG00000032238" "ENSMUSG00000055866" "ENSMUSG00000059824"
## [10] "ENSMUSG00000068742"
##
## $`R-MMU-1912408`
## [1] "ENSMUSG00000026923"
##
## $`R-MMU-2197563`
## [1] "ENSMUSG00000022528"
##
## $`R-MMU-2426168`
## [1] "ENSMUSG00000041220"
##
## $`R-MMU-400253`
## [1] "ENSMUSG00000029238" "ENSMUSG00000032238" "ENSMUSG00000055116"
##
## $`R-MMU-5617472`
## [1] "ENSMUSG00000018973" "ENSMUSG00000038692" "ENSMUSG00000048763"
## [4] "ENSMUSG00000075394" "ENSMUSG00000075588" "ENSMUSG00000079560"
##
## $`R-MMU-5667092`
## [1] "ENSMUSG00000020889" "ENSMUSG00000029238" "ENSMUSG00000055116"

## filtering transcripts which the row sum is 0 across all samples...

## transforming the data to log2 counts...

## Calculating gene-by-gene comparisons...Done.
## Aggregating gene data for gene sets.
## Low sample size detected. Increasing n.points in aggregateGeneSet...Done.
## Calculating variance inflation factors...Done.

## pathway activity statistics for 10 activated pathways

##     pathway.name log.fold.change     p.Value        FDR
## 7  R-MMU-2426168      16.9183811 0.005925984 0.05925984
## 1  R-MMU-1368082      -2.7140053 0.216051444 0.69429685
## 8   R-MMU-400253       2.7176880 0.223757413 0.69429685
## 5  R-MMU-1912408      -5.5214461 0.277718740 0.69429685
## 9  R-MMU-5617472      -0.1039534 0.653937328 0.85582100
## 3  R-MMU-1368108       3.9604988 0.654368890 0.85582100
## 4  R-MMU-1368110       3.9604988 0.654368890 0.85582100
```

```
## 2  R-MMU-1368092      -2.0647105 0.696464327 0.85582100
## 10 R-MMU-5667092       0.2814162 0.770238897 0.85582100
## 6  R-MMU-2197563       1.4769411 0.887980316 0.88798032
```

```
##  [1] 0.216051444 0.696464327 0.654368890 0.654368890 0.277718740
##  [6] 0.887980316 0.005925984 0.223757413 0.653937328 0.770238897
```

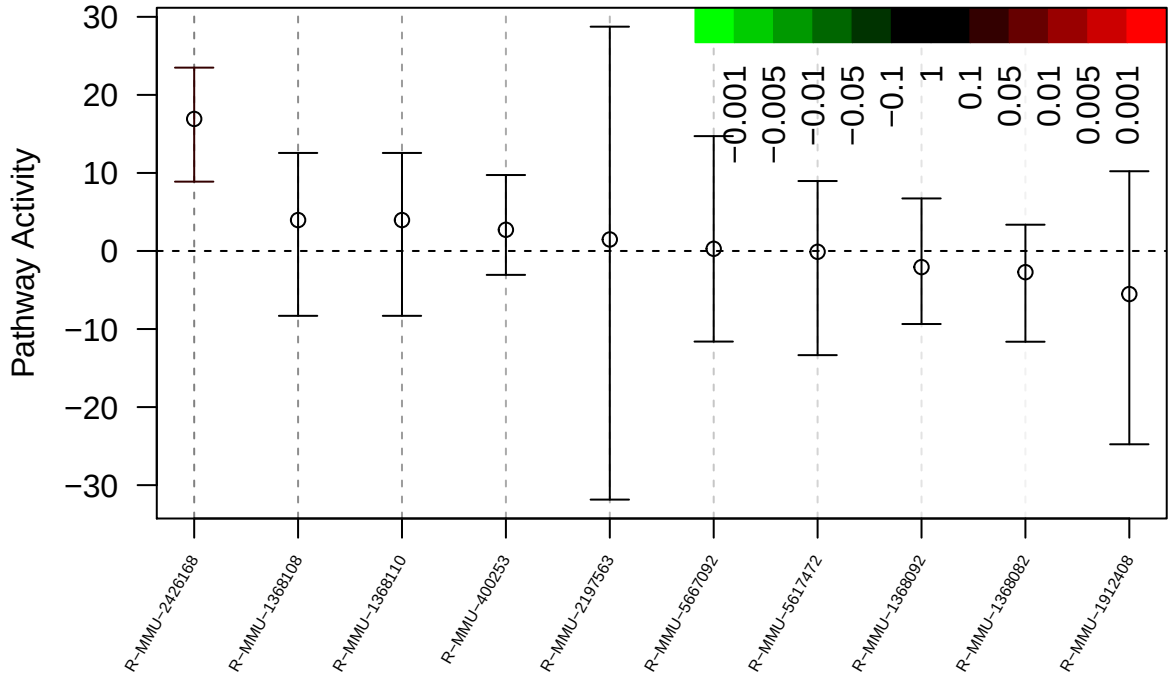



```
## the fdr adjusted p.vals of each gene set is:
```

```
##    names.gn.Results.pathways.     q.vals
## 1               R-MMU-1368082 0.69429685
## 2               R-MMU-1368092 0.85582100
## 3               R-MMU-1368108 0.85582100
## 4               R-MMU-1368110 0.85582100
## 5               R-MMU-1912408 0.69429685
## 6               R-MMU-2197563 0.88798032
## 7               R-MMU-2426168 0.05925984
## 8                R-MMU-400253 0.69429685
## 9               R-MMU-5617472 0.85582100
## 10              R-MMU-5667092 0.85582100
```

```
##     pathway.name log.fold.change     p.Value        FDR
## 7  R-MMU-2426168      16.9183811 0.005925984 0.05925984
## 1  R-MMU-1368082      -2.7140053 0.216051444 0.69429685
## 8   R-MMU-400253       2.7176880 0.223757413 0.69429685
## 5  R-MMU-1912408      -5.5214461 0.277718740 0.69429685
## 9  R-MMU-5617472      -0.1039534 0.653937328 0.85582100
## 3  R-MMU-1368108       3.9604988 0.654368890 0.85582100
## 4  R-MMU-1368110       3.9604988 0.654368890 0.85582100
## 2  R-MMU-1368092      -2.0647105 0.696464327 0.85582100
## 10 R-MMU-5667092       0.2814162 0.770238897 0.85582100
## 6  R-MMU-2197563       1.4769411 0.887980316 0.88798032
```

```
## plotting confidence intervals of pathways
```




```
## printing Reactome Urls for exploration...
```

	pathway.name	log.fold.change	p.Value	FDR	gn.Url
7	R-MMU-2426168	16.9183811	0.005925984	0.05925984	http://www.reactome.org/PathwayBrowser/#/R-MMU-2426168
1	R-MMU-1368082	-2.7140053	0.216051444	0.69429685	http://www.reactome.org/PathwayBrowser/#/R-MMU-1368082
8	R-MMU-400253	2.7176880	0.223757413	0.69429685	http://www.reactome.org/PathwayBrowser/#/R-MMU-400253
5	R-MMU-1912408	-5.5214461	0.277718740	0.69429685	http://www.reactome.org/PathwayBrowser/#/R-MMU-1912408
9	R-MMU-5617472	-0.1039534	0.653937328	0.85582100	http://www.reactome.org/PathwayBrowser/#/R-MMU-5617472
3	R-MMU-1368108	3.9604988	0.654368890	0.85582100	http://www.reactome.org/PathwayBrowser/#/R-MMU-1368108
4	R-MMU-1368110	3.9604988	0.654368890	0.85582100	http://www.reactome.org/PathwayBrowser/#/R-MMU-1368110
2	R-MMU-1368092	-2.0647105	0.696464327	0.85582100	http://www.reactome.org/PathwayBrowser/#/R-MMU-1368092
10	R-MMU-5667092	0.2814162	0.770238897	0.85582100	http://www.reactome.org/PathwayBrowser/#/R-MMU-5667092
6	R-MMU-2197563	1.4769411	0.887980316	0.88798032	http://www.reactome.org/PathwayBrowser/#/R-MMU-2197563