HIV RNASeq

Guannan Shen

November 21, 2018

Contents

```
###################### Set up workspace
rm(list = ls())
library(edgeR)
library(EDASeq)
library(DESeq2)
library(knitr)
library(tidyverse)
library(magrittr)
library(stats)
library(BiocParallel)
library(readxl)
library(openxlsx)
library(limma)
library(scater)
library(rgl)
library(pca3d)
library(EnhancedVolcano)
options(stringsAsFactors = F)
options(dplyr.width = Inf)
getwd()
```

```
## [1] "/home/guanshim/Documents/gitlab/Cario_RNASeq_Microbiom_Inte/DataRaw"
```

```
## not in function
"%nin%" <- Negate("%in%")

# ######## clean memory ##################### rm(list =
# ls()) gc() is(dds) slotNames(dds)
```

1 Normalization

1.1 Background

HIV patients untreated, health control RNASeq data Normalization and QC (quality control).

Start with the counts table, and compare different normalization methods. DESeq2, TPM, TMM...

DESeq2 is inter-sample comparison normalization method, assuming the majority of the genes are not differentially expressed.

The top commonly used methods are DESeq (median-of-ratios) and TMM (Trimmed Mean of M values)-edgeR. DESeq and TMM-edgeR were reported to have overall better performance, based on the false positive rate and detection power.

1.2 Filter Criteria and QC

```r
# import unnormalized counts table
cnts.raw <- read.delim("All_Sample_geneCounts_raw_counts.txt",
    header = TRUE, sep = "\t")
cnts.treated.raw <- read.xlsx("HIV-1_infected_HAART_treated_Raw_Counts.xlsx")
head(cnts.raw)
```

```
##              Gene_ID   Symbol Length C138 C178 C255 C278 C361 C404 C493
## 1 ENSG00000000003.14   TSPAN6   4535  360  485 1862 2225 2550 2559 1158
## 2  ENSG00000000005.5     TNMD   1610    2    8   20   21   18   39   17
## 3 ENSG00000000419.12     DPM1   1207   34   45   95  259  383  247   98
## 4 ENSG00000000457.13    SCYL3   6883   14   16   57  102  114  141   53
## 5 ENSG00000000460.16  C1orf112  5967    3    6   12   21   15   25    9
## 6 ENSG00000000938.12      FGR   3474   17   12  113   35   71  186  104
##    C582 C708 C716 C914 C947 C972 H124 H132 H154 H188 H217 H286 H307 H323
## 1  2612 1592 6849 2481  786 3379 1596 1227 1648 1740 1116  564 1591 1170
## 2    50   11   84   24    5   36   43   14   20    5    5    9   23   12
## 3   233  273 1196  398   52 1086   79   75   80  324  119   63   64   99
## 4    95   80  235  142   20  156   46   61   46   86   50   22   51   60
## 5    28   23   47   28   11   52    9   21    6   10   10    3   14   21
## 6    76   55  168   54   44   93   58  159   99  396   85   43   99  306
##    H391 H428 H594 H622 H648 H683 H819 H825 H839 H965 H998
## 1  1060  216 6647 1112  921  274  719 1396  954  194 7622
## 2    20    2   34   17   25   11   10    7   18    4   54
## 3    64    7 1017  171   41   15   35   80   18   11 1573
## 4    47    9  249   44   69    8   35   60   39   16  361
## 5     4    3   44    8    6    9   10    7   20    0  107
## 6    93  232  342  104  131   54  292   31  366   36  913
```

```r
ncol(cnts.raw)
```

```
## [1] 35
```

```r
head(cnts.treated.raw)
```

```
##             Gene_ID  Symbol Length Dys273 Dys458 TR1310 TR1407 TR1411
## 1 ENSG00000274059.1 5S_rRNA     84      1      0      2      0      0
## 2 ENSG00000274408.1 5S_rRNA    123      7      0     10      0      0
## 3 ENSG00000274759.1 5S_rRNA    127      0      0      0      0      0
## 4 ENSG00000277411.1 5S_rRNA    106      0      1      0      0      0
```

```
## 5 ENSG00000271394.1       7SK     247        0        0       18        0        1
## 6 ENSG00000274303.1       7SK     298        0        0        5        3        1
##     TR1413 TR1414 TR1441 TR1465 TR1470 TR1547 TR1540 TR1543 TR1549 TR1551
## 1       0      0      0      0      0      0      0      0      1      0
## 2       0      0      0      0      0      0      0      0      0      0
## 3       0      0      0      0      0      0      0      0      0      0
## 4       0      0      0      0      0      0      0      0      0      0
## 5       0      0      0      2      0      0      6      0      3      0
## 6       1      2      1      0      0      0      2      0      0      0
##     TR1584 TR1609 TR1624 TR1667 TR1745 TR1750 TR1761 TR1762 TR1767 TR1772
## 1       0      0      1      0      0      0      0      0      0      0
## 2       0      0      0      0      0      0      0      0      0      0
## 3       0      1      0      0      0      0      0      0      0      0
## 4       0      0      0      0      0      0      0      0      0      0
## 5       0      1      0      3      1      0      0      3      2      1
## 6       4      1      0      0      0      0      4      1      1      0
##     TR1778
## 1       1
## 2       0
## 3       0
## 4       0
## 5       3
## 6       0
```

```r
## explore the gene Symbol 'unique'
print("raw data: Symbol")
```

```
## [1] "raw data: Symbol"
```

```r
anyNA(cnts.raw$Symbol)
```

```
## [1] FALSE
```

```r
length(unique(cnts.raw$Symbol)) == nrow(cnts.raw)  # there is duplication
```

```
## [1] FALSE
```

```r
gene_sym_sum <- table(cnts.raw$Symbol)
typeof(gene_sym_sum)
```

```
## [1] "integer"
```

```r
sum(gene_sym_sum[gene_sym_sum >= 2])  #  1035 >= 2 symbols
```

```
## [1] 1035
```

```r
range(gene_sym_sum)  # Y_RNA has been used for 490 times
```

```
## [1]   1 490
```

```r
# check unique Gene_ID
print("Gene_ID is unique")
```

```
## [1] "Gene_ID is unique"
```

```r
length(unique(cnts.raw$Gene_ID)) == nrow(cnts.raw)  # Gene_ID is unique
```

```
## [1] TRUE
```

```r
# generate the common counts table
print("I used Symbol for more information")
```

```
## [1] "I used Symbol for more information"
```

```r
cnts <- cnts.raw %>% dplyr::select(-c(Symbol, Length)) %>% tibble::column_to_rownames("Gene_ID")
cnts <- as.matrix(cnts)
head(cnts)
```

```
##                   C138 C178 C255 C278 C361 C404 C493 C582 C708 C716 C914
## ENSG00000000003.14  360  485 1862 2225 2550 2559 1158 2612 1592 6849 2481
## ENSG00000000005.5     2    8   20   21   18   39   17   50   11   84   24
## ENSG00000000419.12   34   45   95  259  383  247   98  233  273 1196  398
## ENSG00000000457.13   14   16   57  102  114  141   53   95   80  235  142
## ENSG00000000460.16    3    6   12   21   15   25    9   28   23   47   28
## ENSG00000000938.12   17   12  113   35   71  186  104   76   55  168   54
##                   C947 C972 H124 H132 H154 H188 H217 H286 H307 H323 H391
## ENSG00000000003.14  786 3379 1596 1227 1648 1740 1116  564 1591 1170 1060
## ENSG00000000005.5     5   36   43   14   20    5    5    9   23   12   20
## ENSG00000000419.12   52 1086   79   75   80  324  119   63   64   99   64
## ENSG00000000457.13   20  156   46   61   46   86   50   22   51   60   47
## ENSG00000000460.16   11   52    9   21    6   10   10    3   14   21    4
## ENSG00000000938.12   44   93   58  159   99  396   85   43   99  306   93
##                   H428 H594 H622 H648 H683 H819 H825 H839 H965 H998
## ENSG00000000003.14  216 6647 1112  921  274  719 1396  954  194 7622
## ENSG00000000005.5     2   34   17   25   11   10    7   18    4   54
## ENSG00000000419.12    7 1017  171   41   15   35   80   18   11 1573
## ENSG00000000457.13    9  249   44   69    8   35   60   39   16  361
## ENSG00000000460.16    3   44    8    6    9   10    7   20    0  107
## ENSG00000000938.12  232  342  104  131   54  292   31  366   36  913
```

```r
dim(cnts)
```

```
## [1] 43297    32
```

```r
rna.pid <- colnames(cnts)
# now we have the common counts table pheno
ctrl.id <- colnames(cnts)[1:13]
ctrl.id
```

```
##  [1] "C138" "C178" "C255" "C278" "C361" "C404" "C493" "C582" "C708" "C716"
## [11] "C914" "C947" "C972"
```

```r
hiv.id <- colnames(cnts)[14:32]
hiv.id
```

```
##  [1] "H124" "H132" "H154" "H188" "H217" "H286" "H307" "H323" "H391" "H428"
## [11] "H594" "H622" "H648" "H683" "H819" "H825" "H839" "H965" "H998"
```

```r
## from dim() we know there are 32 samples
pheno <- data.frame(pid = rna.pid, txt = as.factor(c(rep("Control",
    13), rep("HIV", 19))))
pheno$txt %<>% relevel("Control")
## This is an important step so that DESeq will know to treat
## the control condition as the reference


# ## without filering # using the function from EDASeq #
```

```r
# using condition here set <-
# newSeqExpressionSet(as.matrix(round(cnts)),phenoData =
# data.frame(condition=as.factor(pheno$txt),
# row.names=colnames(cnts))) ## general QC images ## ##
# plotRLE from EDASeq plotRLE(set, outline = FALSE,
# col=c(rep('Orange', 13), rep('Green', 19)), main = 'Control
# vs. HIV RLE Plot', xlab = 'Sample', ylab = 'Relative Log
# Ratio') ## PCA plot to show clustering ### plotPCA from
# EDASeq package plotPCA(set, col= c(rep('Orange', 13),
# rep('Green', 19)) )

## add Symbol to the data
cnts <- as.data.frame(cnts)
cnts$Symbol <- cnts.raw$Symbol
cnts$Length <- cnts.raw$Length
head(cnts)
```

```
##                   C138 C178 C255 C278 C361 C404 C493 C582 C708 C716 C914
## ENSG00000000003.14  360  485 1862 2225 2550 2559 1158 2612 1592 6849 2481
## ENSG00000000005.5     2    8   20   21   18   39   17   50   11   84   24
## ENSG00000000419.12   34   45   95  259  383  247   98  233  273 1196  398
## ENSG00000000457.13   14   16   57  102  114  141   53   95   80  235  142
## ENSG00000000460.16    3    6   12   21   15   25    9   28   23   47   28
## ENSG00000000938.12   17   12  113   35   71  186  104   76   55  168   54
##                   C947 C972 H124 H132 H154 H188 H217 H286 H307 H323 H391
## ENSG00000000003.14  786 3379 1596 1227 1648 1740 1116  564 1591 1170 1060
## ENSG00000000005.5     5   36   43   14   20    5    5    9   23   12   20
## ENSG00000000419.12   52 1086   79   75   80  324  119   63   64   99   64
## ENSG00000000457.13   20  156   46   61   46   86   50   22   51   60   47
## ENSG00000000460.16   11   52    9   21    6   10   10    3   14   21    4
## ENSG00000000938.12   44   93   58  159   99  396   85   43   99  306   93
##                   H428 H594 H622 H648 H683 H819 H825 H839 H965 H998
## ENSG00000000003.14  216 6647 1112  921  274  719 1396  954  194 7622
## ENSG00000000005.5     2   34   17   25   11   10    7   18    4   54
## ENSG00000000419.12    7 1017  171   41   15   35   80   18   11 1573
## ENSG00000000457.13    9  249   44   69    8   35   60   39   16  361
## ENSG00000000460.16    3   44    8    6    9   10    7   20    0  107
## ENSG00000000938.12  232  342  104  131   54  292   31  366   36  913
##                     Symbol Length
## ENSG00000000003.14  TSPAN6   4535
## ENSG00000000005.5     TNMD   1610
## ENSG00000000419.12     DPM1   1207
## ENSG00000000457.13    SCYL3   6883
## ENSG00000000460.16 C1orf112   5967
## ENSG00000000938.12      FGR   3474
```

```r
## filter the raw data and check dim
cnts_fsym <- cnts[rowSums(cnts[, 1:32]) >= (5 * ncol(cnts[, 1:32])),
    ]
## should end up around 15 - 20K genes
ngenes <- nrow(cnts_fsym)
paste("The number of remaining genes: ", ngenes, sep = "")
```

```
## [1] "The number of remaining genes: 19890"
```

```
# all integer in cnts_f
cnts_f <- as.matrix(cnts_fsym[, 1:32])
typeof(as.matrix(cnts_f))
```

```
## [1] "integer"
```

```
# using the function from EDASeq
set <- newSeqExpressionSet(as.matrix(cnts_f), phenoData = data.frame(condition = as.factor(pheno$txt),
    row.names = colnames(cnts_f)))
## general QC images ## plotRLE from EDASeq boxplots of the
## log-ratios of the gene-level read counts of each sample to
## those of a reference sample (defined as the median across
## the samples).
EDASeq::plotRLE(set, outline = FALSE, col = c(rep("steelblue",
    13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (With Filtering Before Normalization)",
    xlab = "Sample", ylab = "Relative Log Ratio")
```

Control vs. HIV RLE Plot (With Filtering Before Normalization)
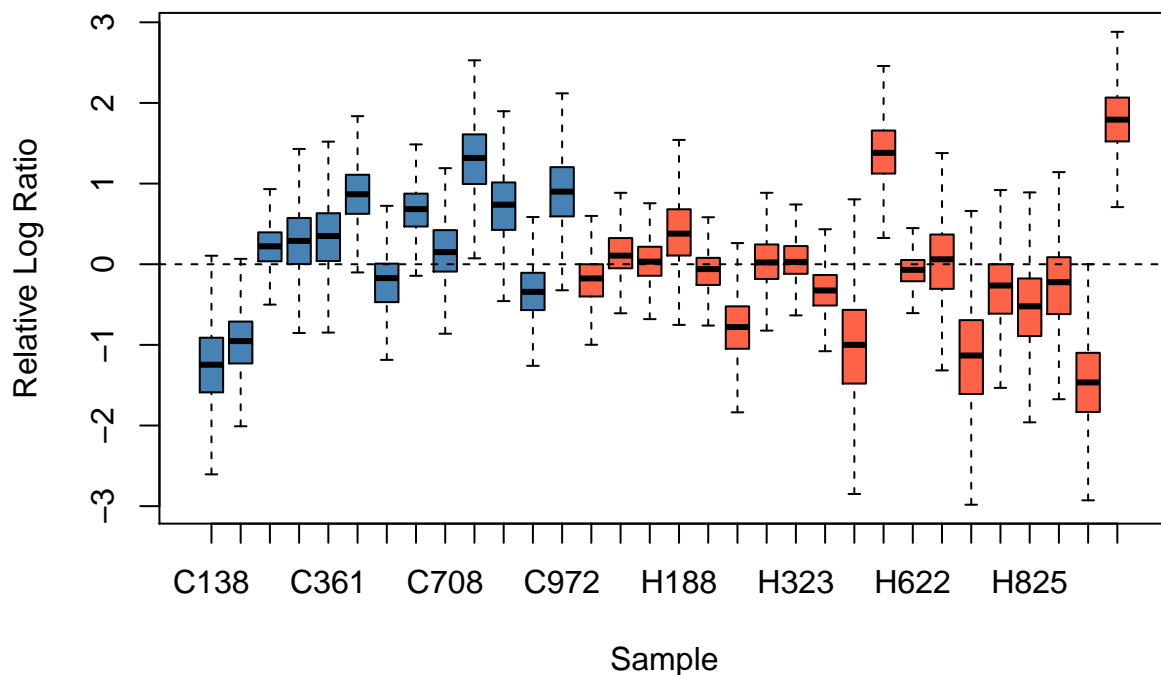

```
## PCA plot to show clustering plotPCA from EDASeq package
```

```
EDASeq::plotPCA(set, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering Before Normalization)")
```

Control vs. HIV PCA Plot (With Filtering Before Normalization)


```
EDASeq::plotPCA(set, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering Before Normalization)",
    k = 3)
```

Control vs. HIV PCA Plot (With Filtering Before Normalization)
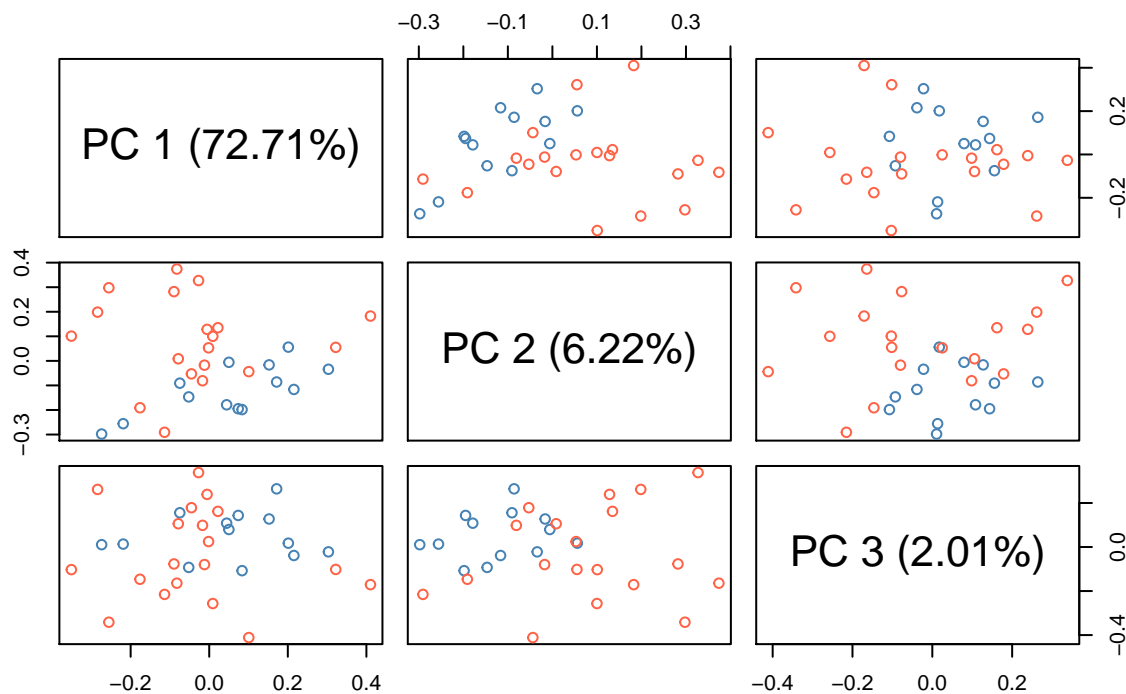
```
## PCA of prcomp pc <- princomp(cnts_f, cor=TRUE, scores=TRUE)
## pc$scores
cnts.f.pca <- prcomp(t(cnts_f), center = TRUE, scale. = TRUE,
    retx = TRUE)
plot(cnts.f.pca)
```
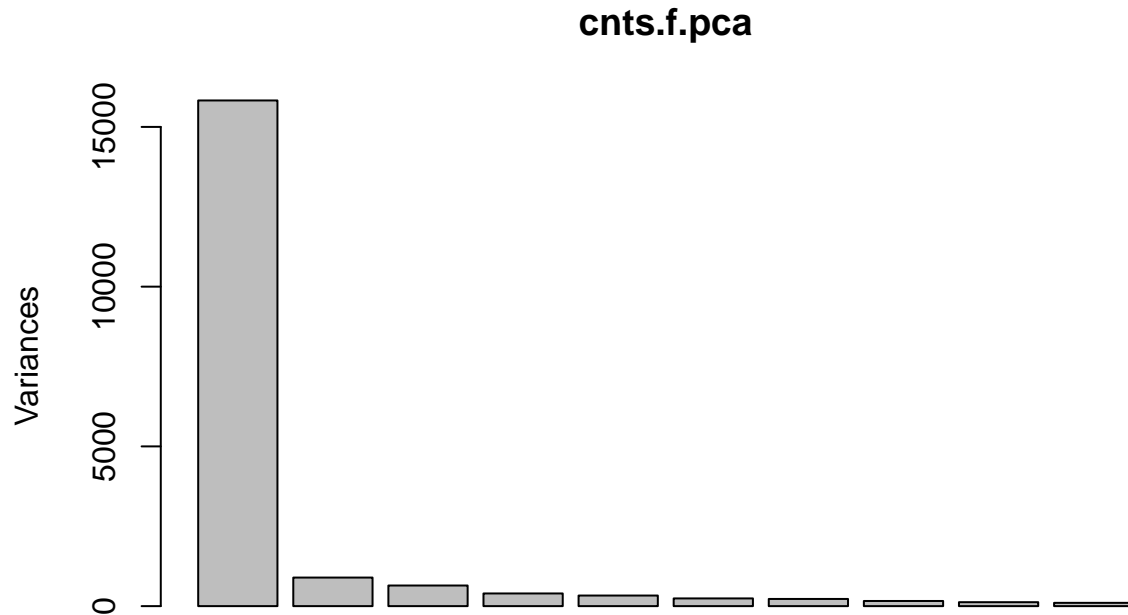
cnts.f.pca


```
pca3d(cnts.f.pca, components = 1:3, col = c(rep("steelblue",
    13), rep("tomato", 19)), title = "Control vs. HIV PCA Plot (With Filtering Before Normalization)",
    radius = 1.5, show.labels = TRUE)
```

```
## [1] 14.017898  3.263338  3.309588
## Creating new device
## boxplot
```

```
boxplot(log2(cnts_f), main = "Control vs. HIV Boxplot (With Filtering Before Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

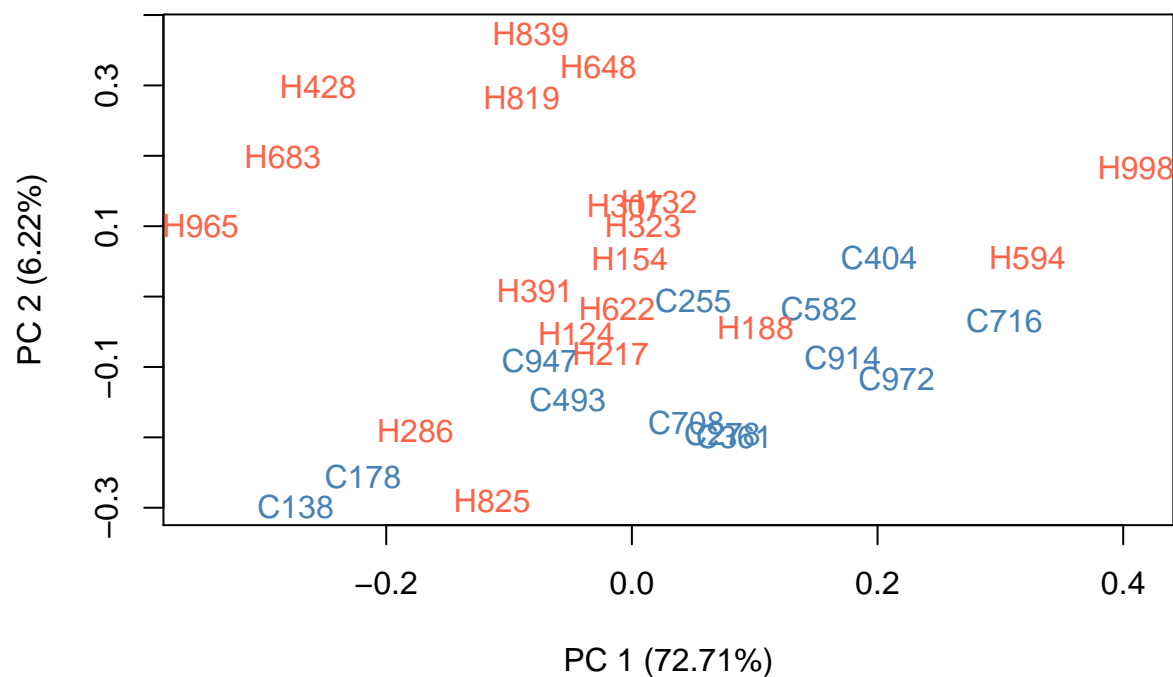**Control vs. HIV Boxplot (With Filtering Before Normalization)**
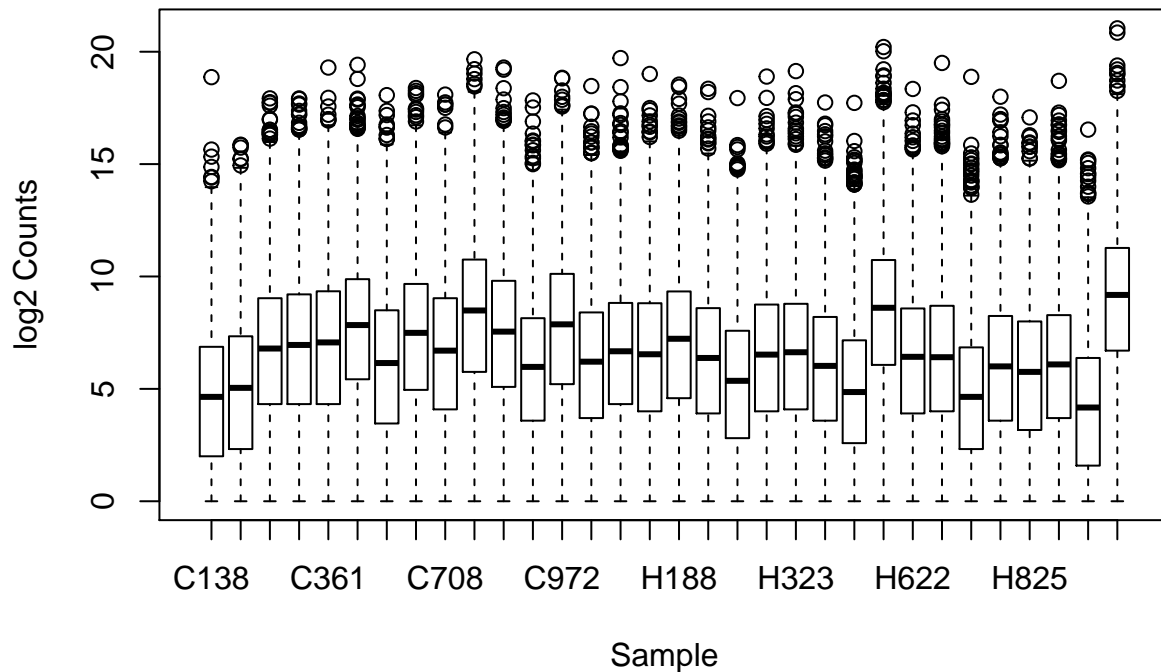
1.3 Comparison of DESeq2, TMM and TPM Normalization Methods

```
################# deseq2 ######################### counts from EDASeq
################ (DESeq2) pData is phenoData from Biobase
countData <- counts(set)  #Matrix with transcripts IDs as rows and sample IDs as columns
colData <- pData(set)  #Vector of type list in which the condition column is the treat/control identfie

# Run DESeq function using above objects
print("this is a single factor: condition, and 2 conditions design (2 levels)")
```

```
## [1] "this is a single factor: condition, and 2 conditions design (2 levels)"
```

```
## now using deseq2
dds <- DESeqDataSetFromMatrix(countData = counts(set), colData = pData(set),
    design = ~condition)
is(dds)
```

```
## [1] "DESeqDataSet"          "RangedSummarizedExperiment"
## [3] "SummarizedExperiment"  "Vector"
## [5] "Annotated"
```

```
slotNames(dds)
```

```
## [1] "design"          "dispersionFunction" "rowRanges"
## [4] "colData"         "assays"             "NAMES"
## [7] "elementMetadata" "metadata"
```

```
dds <- estimateSizeFactors(dds)
## normalization factors
sizeFactors(dds)
```

```
##      C138      C178      C255      C278      C361      C404      C493
## 0.2801477 0.3829072 1.2625914 1.3744154 1.4832384 2.3577403 0.8480453
##      C582      C708      C716      C914      C947      C972      H124
## 2.0025479 1.1997877 3.9008838 2.1250832 0.6948343 2.5525922 0.8290624
##      H132      H154      H188      H217      H286      H307      H323
## 1.1309331 1.0691897 1.4909671 0.9222770 0.4492812 1.0551965 1.0524649
##      H391      H428      H594      H622      H648      H683      H819
## 0.7188160 0.3511746 4.0518366 0.9162538 1.1020128 0.3013386 0.7619062
##      H825      H839      H965      H998
## 0.5903655 0.7926637 0.2150957 6.0910728
```

```r
cnts.deseq2 <- counts(dds, normalized = TRUE)
head(cnts.deseq2)
```

```
##                            C138        C178        C255       C278
## ENSG00000000003.14 1285.036449 1266.62538 1474.744705 1618.87010
## ENSG00000000005.5     7.139091   20.89279   15.840437   15.27922
## ENSG00000000419.12  121.364554  117.52194   75.242077  188.44376
## ENSG00000000457.13   49.973640   41.78558   45.145246   74.21337
## ENSG00000000460.16   10.708637   15.66959    9.504262   15.27922
## ENSG00000000938.12   60.682277   31.33918   89.498470   25.46537
##                           C361       C404       C493       C582        C708
## ENSG00000000003.14 1719.21114 1085.36126 1365.49302 1304.33834 1326.901470
## ENSG00000000005.5    12.13561   16.54126   20.04610   24.96819    9.168289
## ENSG00000000419.12  258.21877  104.76133  115.55986  116.35177  227.540265
## ENSG00000000457.13   76.85885   59.80302   62.49666   47.43956   66.678466
## ENSG00000000460.16   10.11301   10.60337   10.61264   13.98219   19.170059
## ENSG00000000938.12   47.86823   78.88910  122.63495   37.95165   45.841445
##                           C716       C914       C947       C972       H124
## ENSG00000000003.14 1755.75597 1167.48369 1131.20492 1323.75239 1925.06626
## ENSG00000000005.5    21.53358   11.29368    7.19596   14.10331   51.86582
## ENSG00000000419.12  306.59719  187.28678   74.83798  425.44987   95.28837
## ENSG00000000457.13   60.24276   66.82091   28.78384   61.11435   55.48437
## ENSG00000000460.16   12.04855   13.17595   15.83111   20.37145   10.85564
## ENSG00000000938.12   43.06716   25.41077   63.32445   36.43355   69.95855
##                           H132        H154        H188        H217
## ENSG00000000003.14 1084.94484 1541.354220 1167.027733 1210.048548
## ENSG00000000005.5    12.37916   18.705755    3.353528    5.421364
## ENSG00000000419.12   66.31692   74.823020  217.308612  129.028474
## ENSG00000000457.13   53.93776   43.023237   57.680681   54.213645
## ENSG00000000460.16   18.56874    5.611727    6.707056   10.842729
## ENSG00000000938.12  140.59187   92.593488  265.599415   92.163196
##                           H286       H307       H323       H391
## ENSG00000000003.14 1255.338479 1507.77603 1111.67607 1474.647110
## ENSG00000000005.5    20.031997   21.79689   11.40181   27.823530
## ENSG00000000419.12  140.223979   60.65221   94.06490   89.035297
## ENSG00000000457.13   48.967104   48.33223   57.00903   65.385296
## ENSG00000000460.16    6.677332   13.26767   19.95316    5.564706
## ENSG00000000938.12   95.708430   93.82139  290.74605  129.379416
##                           H428       H594       H622       H648      H683
## ENSG00000000003.14  615.078603 1640.490643 1213.637466 835.743453 909.27615
## ENSG00000000005.5     5.695172    8.391256   18.553810  22.685761  36.50379
## ENSG00000000419.12   19.933103  250.997290  186.629502  37.204649  49.77789
## ENSG00000000457.13   25.628275   61.453614   48.021626  62.612702  26.54821
## ENSG00000000460.16    8.542758   10.859273    8.731205   5.444583  29.86673
```

```
## ENSG00000000938.12 660.639981    84.406168  113.505662 118.873390 179.20041
##                             H819       H825       H839      H965       H998
## ENSG00000000003.14 943.68576 2364.63670 1203.53685 901.92407 1251.339498
## ENSG00000000005.5    13.12498   11.85706   22.70824  18.59637    8.865433
## ENSG00000000419.12   45.93742  135.50927   22.70824  51.14002  258.246790
## ENSG00000000457.13   45.93742  101.63195   49.20119  74.38549   59.267064
## ENSG00000000460.16   13.12498   11.85706   25.23138   0.00000   17.566692
## ENSG00000000938.12 383.24929   52.50984  461.73426 167.36735  149.891493
```

```r
######## edgeR TMM ############### edgeR object
group <- c(rep(1, 13), rep(2, 19))
y <- DGEList(counts = as.matrix(cnts_f), group = group)
## normalization
y <- calcNormFactors(y, method = "TMM")
y$samples
```

```
##       group lib.size norm.factors
## C138     1  3868122    0.9895760
## C178     1  5247864    0.9750415
## C255     1 17036481    0.9789004
## C278     1 19432051    0.9570101
## C361     1 20751593    0.9603412
## C404     1 27662688    1.1266179
## C493     1 12229155    0.9207324
## C582     1 25142533    1.0641553
## C708     1 16802728    0.9734736
## C716     1 52070733    1.0107776
## C914     1 27118931    1.0409382
## C947     1  8923811    1.0400461
## C972     1 34950066    1.0006561
## H124     2 10998409    1.0025227
## H132     2 15109298    1.0004424
## H154     2 15202600    0.9357510
## H188     2 19324313    1.0355081
## H217     2 12369819    0.9888849
## H286     2  5996733    1.0090366
## H307     2 14189481    0.9956865
## H323     2 14550420    0.9526013
## H391     2  9372577    1.0240987
## H428     2  5080521    0.9665669
## H594     2 52859397    1.0308786
## H622     2 11596506    1.0424652
## H648     2 15228811    0.9609311
## H683     2  4492697    0.9376369
## H819     2 10277530    0.9914025
## H825     2  8012843    0.9931283
## H839     2 10902833    0.9624871
## H965     2  2867125    1.0502074
## H998     2 72938480    1.1158562
```

```r
cnts.edger <- edgeR::cpm(y)
head(cnts.edger)
```

```
##                           C138      C178       C255       C278       C361
## ENSG00000000003.14 94.0487833 94.784227 111.6506598 119.645082 127.9567455
```

```
## ENSG00000000005.5    0.5224932   1.563451   1.1992552    1.129234    0.9032241
## ENSG00000000419.12   8.8823851   8.794413   5.6964622   13.927225   19.2186014
## ENSG00000000457.13   3.6574527   3.126902   3.4178773    5.484853    5.7204192
## ENSG00000000460.16   0.7837399   1.172588   0.7195531    1.129234    0.7526867
## ENSG00000000938.12   4.4411925   2.345177   6.7757919    1.882057    3.5627172
##                            C404        C493       C582        C708        C716
## ENSG00000000003.14 82.1106084 102.8439394 97.624574 97.3282844 130.130125
## ENSG00000000005.5    1.2513926   1.5097988   1.868771   0.6724944    1.595989
## ENSG00000000419.12   7.9254866   8.7035458   8.708471 16.6900890   22.723847
## ENSG00000000457.13   4.5242656   4.7070197   3.550664   4.8908686    4.464970
## ENSG00000000460.16   0.8021748   0.7993052   1.046512   1.4061247    0.892994
## ENSG00000000938.12   5.9681802   9.2364160   2.840531   3.3624721    3.191979
##                            C914        C947       C972       H124       H132
## ENSG00000000003.14 87.8879339 84.6875507 96.617397 144.746739 81.172364
## ENSG00000000005.5    0.8501856   0.5387249   1.029366    3.899818   0.926172
## ENSG00000000419.12 14.0989108   5.6027387 31.052528    7.164782   4.961636
## ENSG00000000457.13   5.0302647   2.1548995   4.460584    4.171898   4.035464
## ENSG00000000460.16   0.9918832   1.1851947   1.486861    0.816241   1.389258
## ENSG00000000938.12   1.9129175   4.7407789   2.659194    5.260220 10.518668
##                             H154        H188       H217        H286        H307
## ENSG00000000003.14 115.8454658 86.9544222 91.233666 93.2089171 112.6110582
## ENSG00000000005.5     1.4058916   0.2498690   0.408753   1.4873763    1.6279411
## ENSG00000000419.12    5.6235663 16.1915131   9.728321 10.4116344    4.5299231
## ENSG00000000457.13    3.2335506   4.2977473   4.087530   3.6358088    3.6097825
## ENSG00000000460.16    0.4217675   0.4997381   0.817506   0.4957921    0.9909207
## ENSG00000000938.12    6.9591633 19.7896271   6.948801   7.1063536    7.0072249
##                            H323        H391       H428        H594
## ENSG00000000003.14 84.4110206 110.4345716 43.9859123 121.9820616
## ENSG00000000005.5    0.8657541   2.0836712   0.4072770    0.6239492
## ENSG00000000419.12   7.1424710   6.6677477   1.4254694   18.6634206
## ENSG00000000457.13   4.3287703   4.8966272   1.8327463    4.5695101
## ENSG00000000460.16   1.5150696   0.4167342   0.6109154    0.8074636
## ENSG00000000938.12 22.0767285   9.6890709 47.2441280    6.2761945
##                            H622       H648       H683       H819        H825
## ENSG00000000003.14 91.9847984 62.9363261 65.044224 70.5651255 175.4257885
## ENSG00000000005.5    1.4062424   1.7083693   2.611264   0.9814343    0.8796422
## ENSG00000000419.12 14.1451444   2.8017257   3.560815   3.4350200   10.0530538
## ENSG00000000457.13   3.6396863   4.7150993   1.899101   3.4350200    7.5397903
## ENSG00000000460.16   0.6617611   0.4100086   2.136489   0.9814343    0.8796422
## ENSG00000000938.12   8.6028948   8.9518553 12.818935 28.6578813    3.8955583
##                            H839       H965       H998
## ENSG00000000003.14 90.910511 64.428796 93.6491848
## ENSG00000000005.5    1.715293   1.328429   0.6634815
## ENSG00000000419.12   1.715293   3.653179 19.3269703
## ENSG00000000457.13   3.716467   5.313715   4.4354967
## ENSG00000000460.16   1.905881   0.000000   1.3146763
## ENSG00000000938.12 34.877617 11.955859 11.2177520
```

```r
########## TPM #########
cnts.tpm <- calculateTPM(cnts_f, effective_length = cnts_fsym$Length)
head(cnts.tpm)
```

```
##                             C138       C178       C255       C278       C361
## ENSG00000000003.14 48.6243312 58.4871798 66.8216853 69.4951133 72.3420955
## ENSG00000000005.5    0.7609087   2.7174424   2.0217114   1.8475447   1.4383839
```

```
## ENSG00000000419.12 17.2544086 20.3892606 12.8094763 30.3944324 40.8243896
## ENSG00000000457.13  1.2458871  1.2712719  1.3477586  2.0990556  2.1308618
## ENSG00000000460.16  0.3079595  0.5499098  0.3272957  0.4984996  0.3234174
## ENSG00000000938.12  2.9974196  1.8890683  5.2937529  1.4270519  2.6294004
##                            C404       C493       C582       C708       C716
## ENSG00000000003.14 55.6105176 58.3950290 65.6466838 63.5524974 85.7278581
## ENSG00000000005.5   2.3872762  2.4147249  3.5396559  1.2368973  2.9615939
## ENSG00000000419.12 20.1675725 18.5679268 22.0021723 40.9470130 56.2465653
## ENSG00000000457.13  2.0188557  1.7609325  1.5731232  2.1041615  1.9380376
## ENSG00000000460.16  0.4129029  0.3449301  0.5348339  0.6978123  0.4471095
## ENSG00000000938.12  5.2765137  6.8461772  2.4934501  2.8661553  2.7450583
##                            C914       C947       C972       H124       H132
## ENSG00000000003.14 61.3137976 56.2713035 63.0124549 82.2786677 45.9034845
## ENSG00000000005.5   1.6706832  1.0082909  1.8910026  6.2441630  1.4753007
## ENSG00000000419.12 36.9559648 13.9874258 76.0918344 15.3021155 10.5422273
## ENSG00000000457.13  2.3121676  0.9433958  1.9167361  1.5624701  1.5035935
## ENSG00000000460.16  0.5259092  0.5985196  0.7369921  0.3526291  0.5970925
## ENSG00000000938.12  1.7420984  4.1121087  2.2639594  3.9032812  7.7650757
##                           H154       H188       H217       H286       H307
## ENSG00000000003.14 59.911318 56.9422460 56.2044169 52.9874919 65.2329377
## ENSG00000000005.5   2.048015  0.4609001  0.7092963  2.3817062  2.6562932
## ENSG00000000419.12 10.927270 39.8382614 22.5176588 22.2384662  9.8593152
## ENSG00000000457.13  1.101816  1.8543142  1.6591123  1.3618098  1.3777374
## ENSG00000000460.16  0.165777  0.2487176  0.3827608  0.2142085  0.4362607
## ENSG00000000938.12  4.698231 16.9171815  5.5882092  5.2736365  5.2988232
##                           H323      H391       H428       H594       H622
## ENSG00000000003.14 44.6944047 67.265578 22.9914375 80.7108990 58.0540918
## ENSG00000000005.5   1.2912191  3.574937  0.5996444  1.1628852  2.4999331
## ENSG00000000419.12 14.2092944 15.259384  2.7994998 46.3978098 33.5424036
## ENSG00000000457.13  1.5101430  1.965099  0.6311817  1.9920736  1.5134924
## ENSG00000000460.16  0.6096883  0.192916  0.2426917  0.4060509  0.3174237
## ENSG00000000938.12 15.2593558  7.704021 32.2364966  5.4210085  7.0877577
##                           H648       H683       H819        H825       H839
## ENSG00000000003.14 31.875532 28.9417890 40.1731668 104.7910910 44.9394673
## ENSG00000000005.5   2.437189  3.2727958  1.5738328   1.4800909  2.3883802
## ENSG00000000419.12  5.331528  5.9530029  7.3475956  22.5631095  3.1858261
## ENSG00000000457.13  1.573426  0.5567552  1.2884713   2.9674931  1.2104411
## ENSG00000000460.16  0.157823  0.7225012  0.4246474   0.3993542  0.7160293
## ENSG00000000938.12  5.918567  7.4458803 21.2979354   3.0377226 22.5065075
##                          H965       H998
## ENSG00000000003.14 37.809793 65.6657564
## ENSG00000000005.5   2.195907  1.3104341
## ENSG00000000419.12  8.054995 50.9176968
## ENSG00000000457.13  2.054575  2.0491641
## ENSG00000000460.16  0.000000  0.7006079
## ENSG00000000938.12  9.159095 10.2680568
```

```r
######### plots ################# cnts.deseq2 using the function
######### from EDASeq set <-
######### newSeqExpressionSet(cnts.deseq2,phenoData =
######### data.frame(condition=as.factor(pheno$txt),
######### row.names=colnames(cnts_f))) general QC images ## plotRLE
######### from EDASeq
EDASeq::plotRLE(cnts.deseq2, outline = FALSE, col = c(rep("steelblue",
```

```
13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (With Filtering DESeq2 Normalization)",
    xlab = "Sample", ylab = "Relative Log Ratio")
```

Control vs. HIV RLE Plot (With Filtering DESeq2 Normalization)
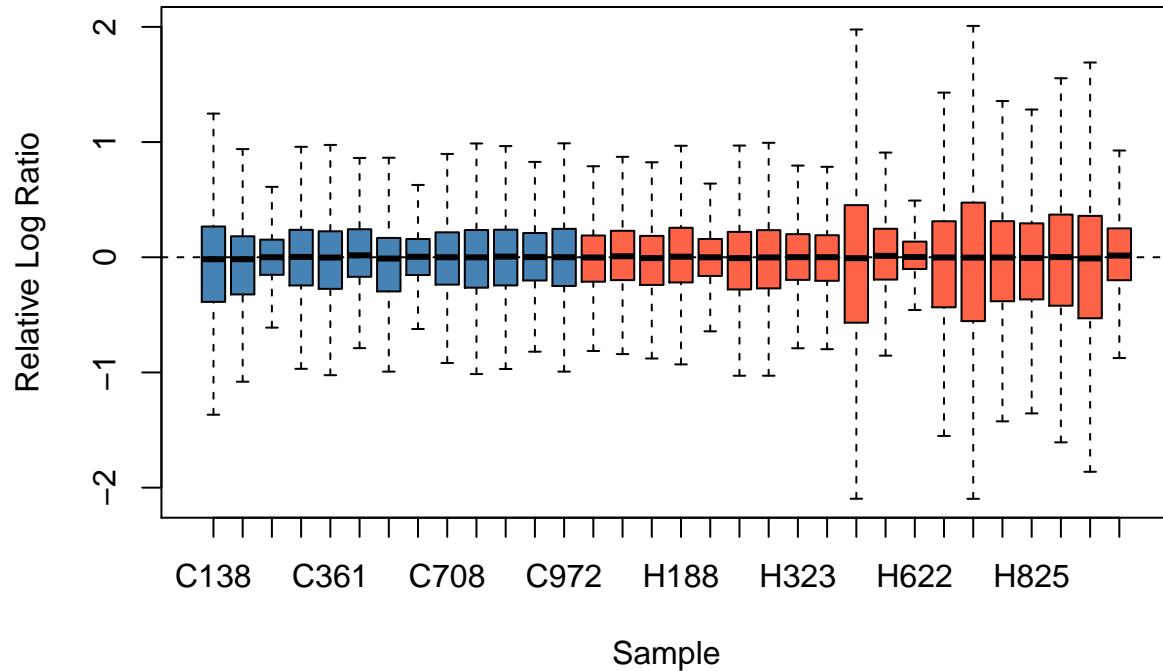

```
## PCA plot to show clustering plotPCA from EDASeq package
```

```
EDASeq::plotPCA(cnts.deseq2, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)")
```

Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)


```
EDASeq::plotPCA(cnts.deseq2, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)",
    k = 3)
```

Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)

```
cnts.deseq2.pca <- prcomp(t(cnts.deseq2), center = TRUE, scale. = TRUE,
    retx = TRUE)
plot(cnts.deseq2.pca)
```

cnts.deseq2.pca


```
pca3d(cnts.deseq2.pca, components = 1:3, col = c(rep("steelblue",
    13), rep("tomato", 19)), title = "Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)",
    radius = 1.5, show.labels = TRUE)
```

```
## [1] 4.970549 2.894644 2.648297
```

```
pca2d(cnts.deseq2.pca, components = 1:2, col = c(rep("steelblue",
    13), rep("tomato", 19)), title = "Control vs. HIV PCA Plot (With Filtering DESeq2 Normalization)",
    radius = 1.5)
```
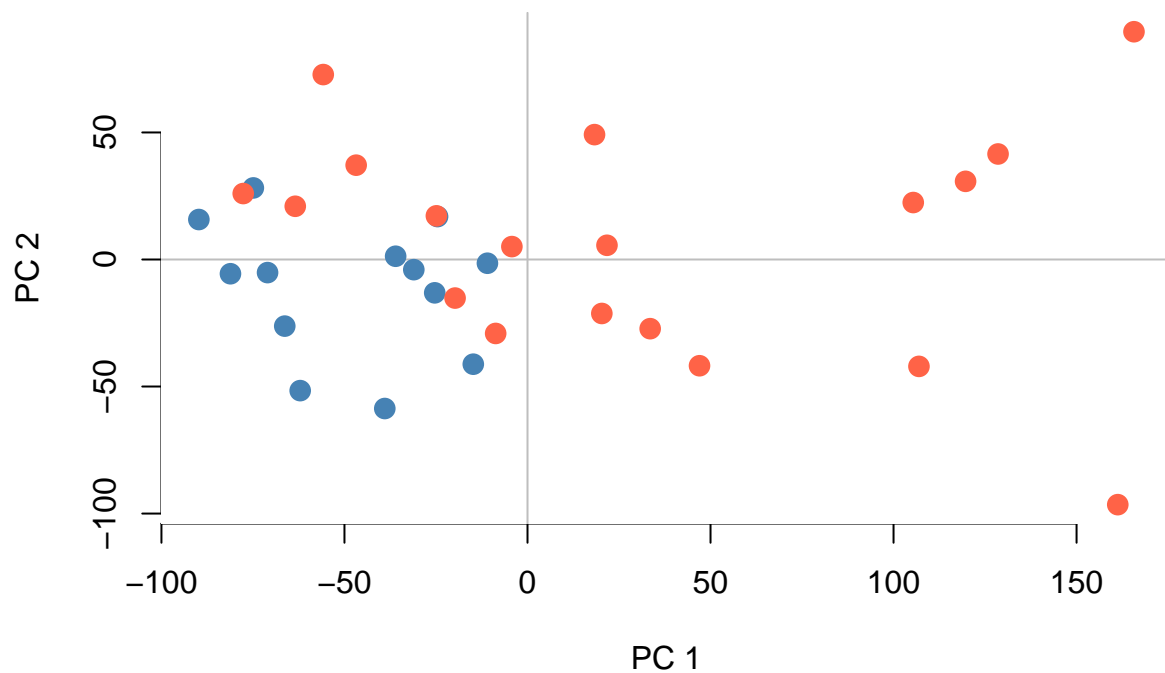
```
## boxplot
boxplot(log2(cnts.deseq2), main = "Control vs. HIV Boxplot (With Filtering DESeq2 Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

Control vs. HIV Boxplot (With Filtering DESeq2 Normalization)
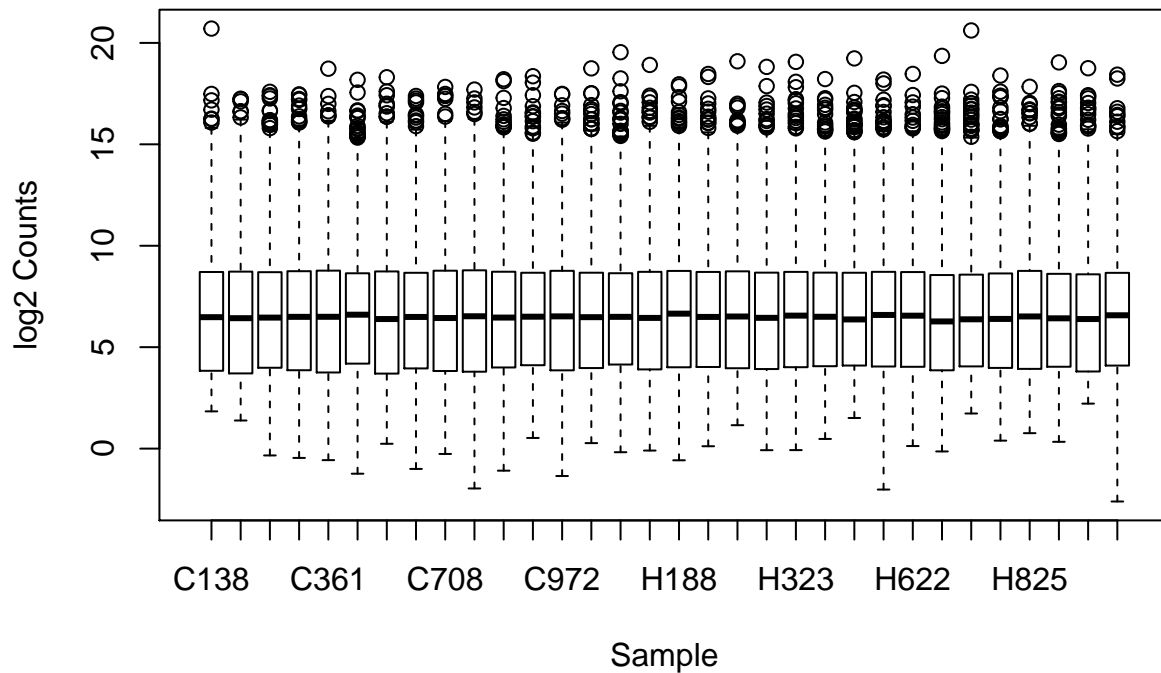

```
########### TMM and edgeR plotRLE from EDASeq
EDASeq::plotRLE(cnts.edger, outline = FALSE, col = c(rep("steelblue",
    13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (With Filtering TMM (edgeR) Normalization)
    xlab = "Sample", ylab = "Relative Log Ratio")
```

Control vs. HIV RLE Plot (With Filtering TMM (edgeR) Normalization
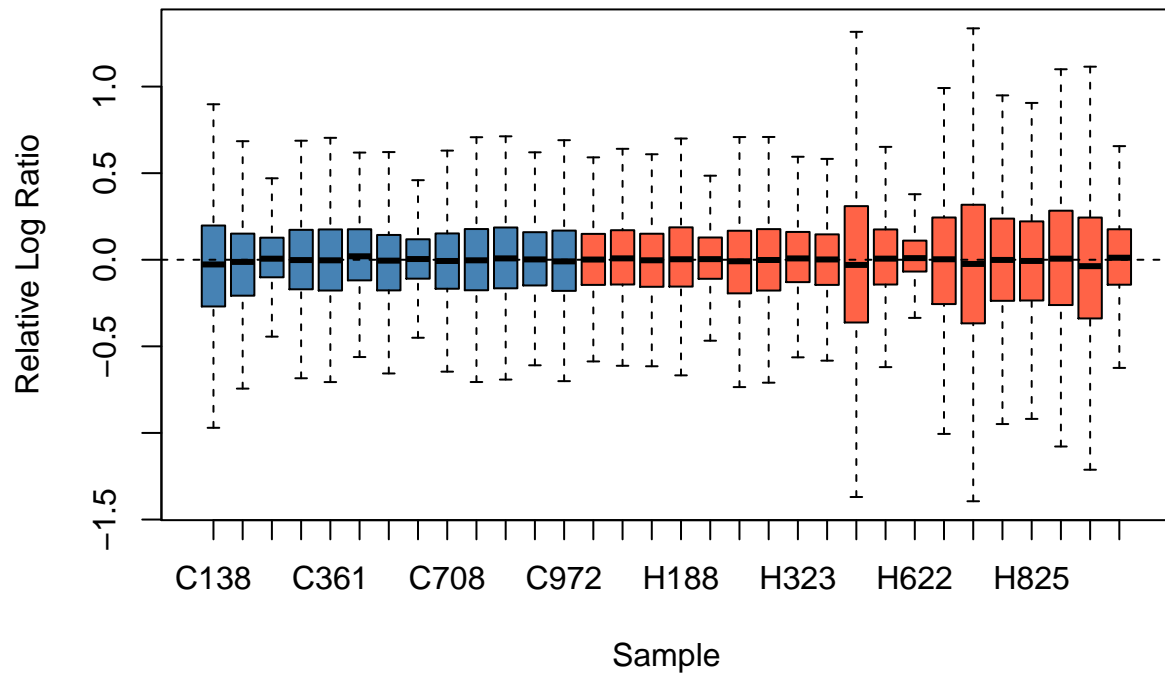

```
EDASeq::plotPCA(cnts.edger, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering TMM (edgeR) Normalization)")
```

Control vs. HIV PCA Plot (With Filtering TMM (edgeR) Normalization
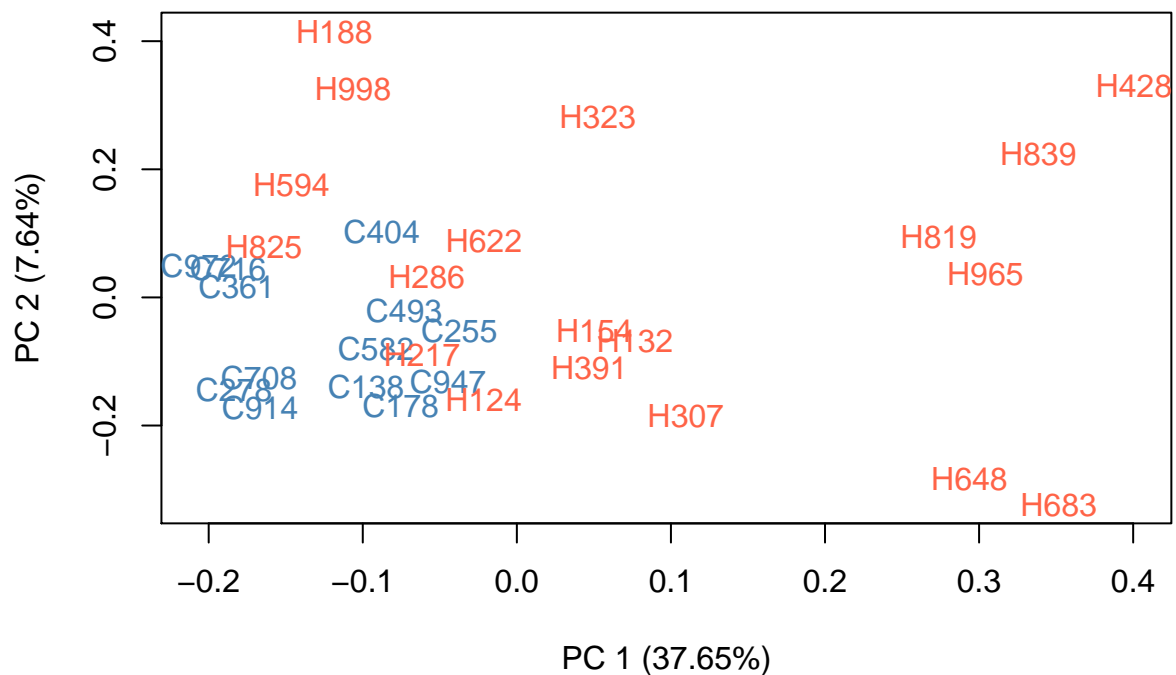

```
EDASeq::plotPCA(cnts.edger, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering TMM (edgeR) Normalization)",
```

```
    k = 3)
```

Control vs. HIV PCA Plot (With Filtering TMM (edgeR) Normalization)


```
cnts.edger.pca <- prcomp(t(cnts.edger), center = TRUE, scale. = TRUE,
    retx = TRUE)
plot(cnts.edger.pca)
```

cnts.edger.pca
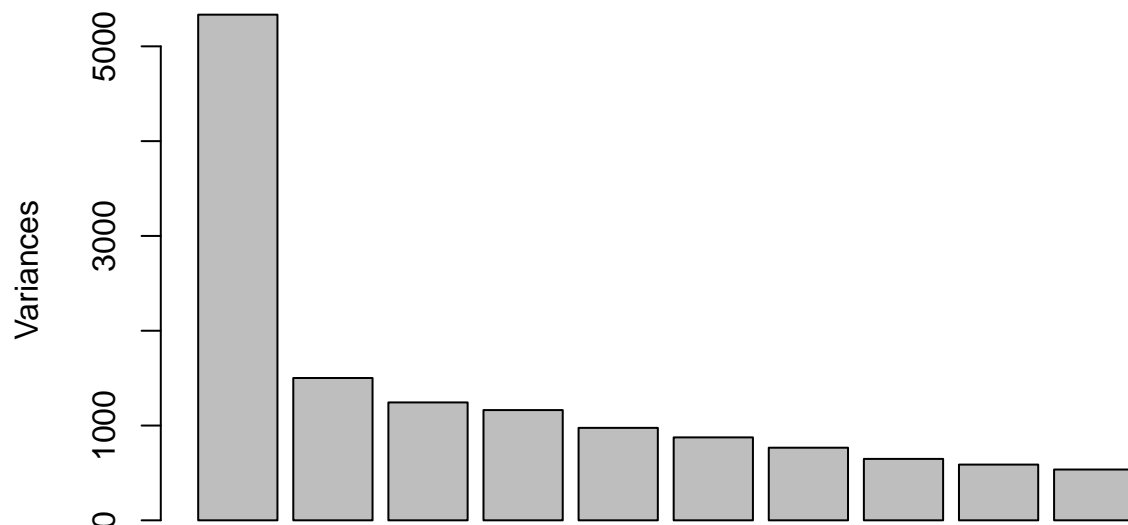

```
pca3d(cnts.edger.pca, components = 1:3, col = c(rep("steelblue",
    13), rep("tomato", 19)), title = "Control vs. HIV PCA Plot (With Filtering TMM Normalization)",
    radius = 1.5, show.labels = TRUE)
```

```
## [1] 4.824598 2.684539 2.389589
```

```r
pca2d(cnts.edger.pca, components = 1:2, col = c(rep("steelblue",
    13), rep("tomato", 19)), title = "Control vs. HIV PCA Plot (With Filtering TNN Normalization)",
    radius = 1.5)
```
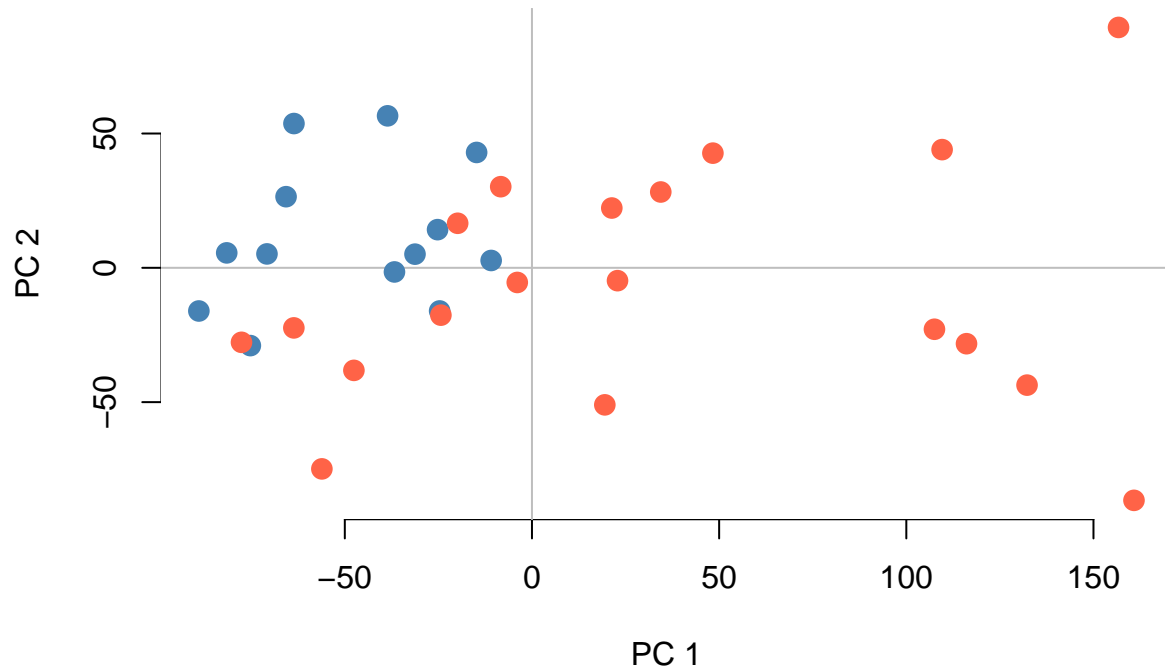


```r
boxplot(log2(cnts.edger), main = "Control vs. HIV Boxplot (With Filtering TMM (edgeR) Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

Control vs. HIV Boxplot (With Filtering TMM (edgeR) Normalization)
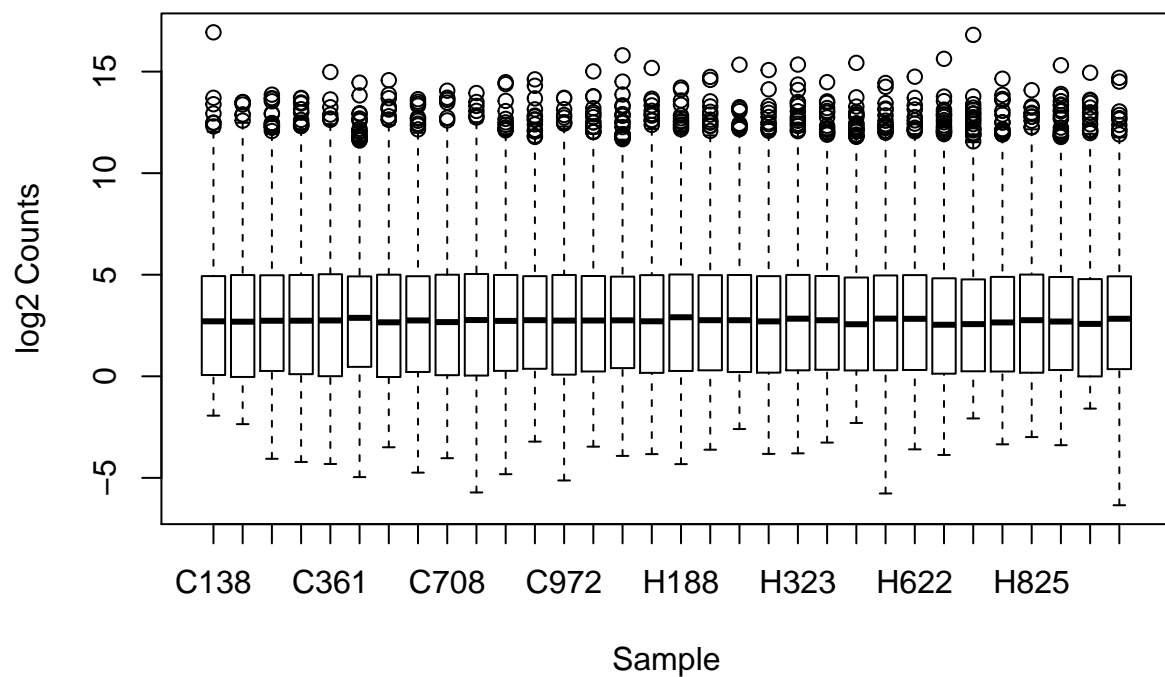
```
########## TPM
EDASeq::plotRLE(cnts.tpm, outline = FALSE, col = c(rep("steelblue",
    13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (With Filtering TPM Normalization)",
    xlab = "Sample", ylab = "Relative Log Ratio")
```
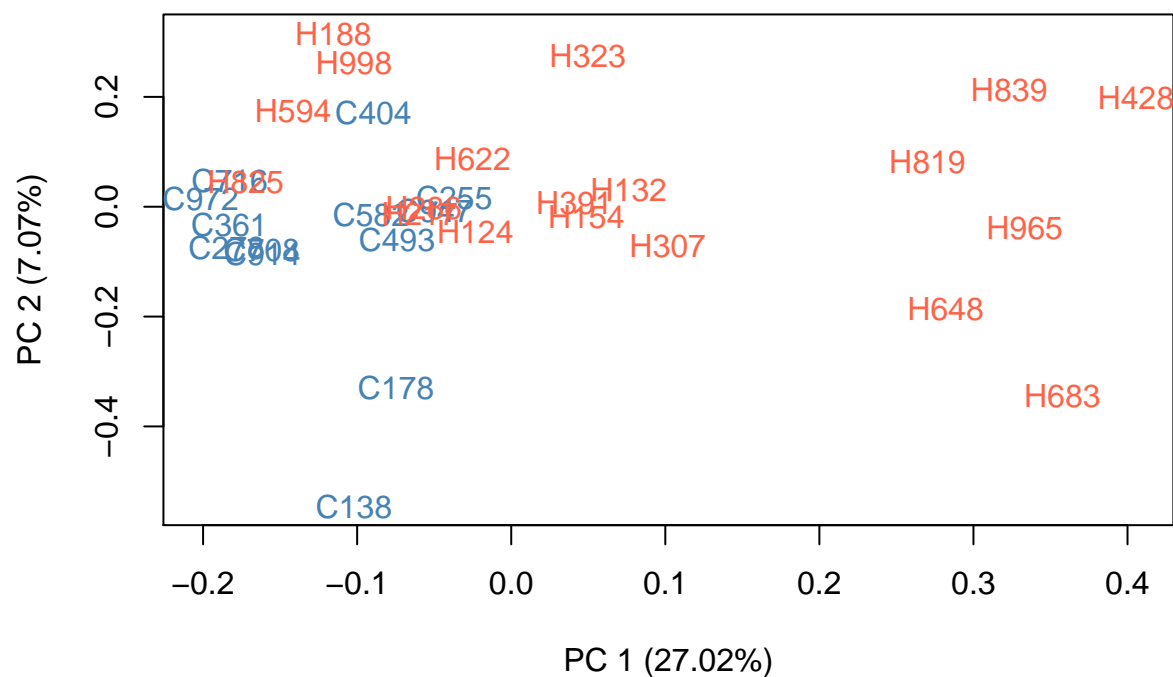
Control vs. HIV RLE Plot (With Filtering TPM Normalization)
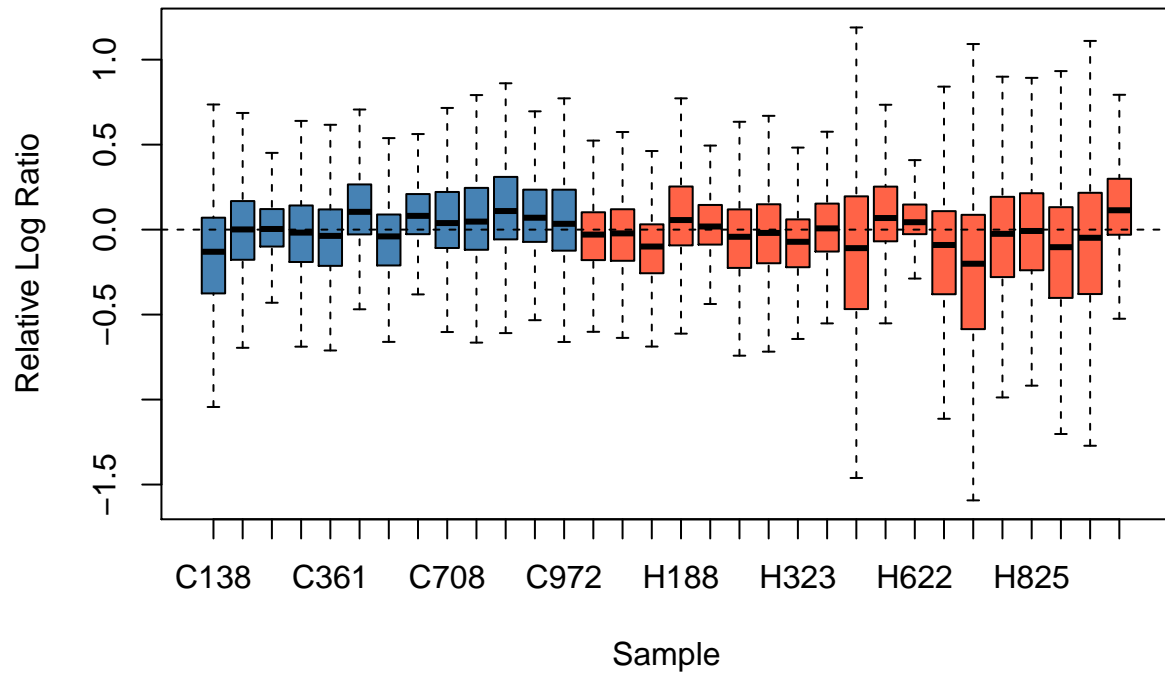

```
EDASeq::plotPCA(cnts.tpm, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering TPM Normalization)")
```

Control vs. HIV PCA Plot (With Filtering TPM Normalization)
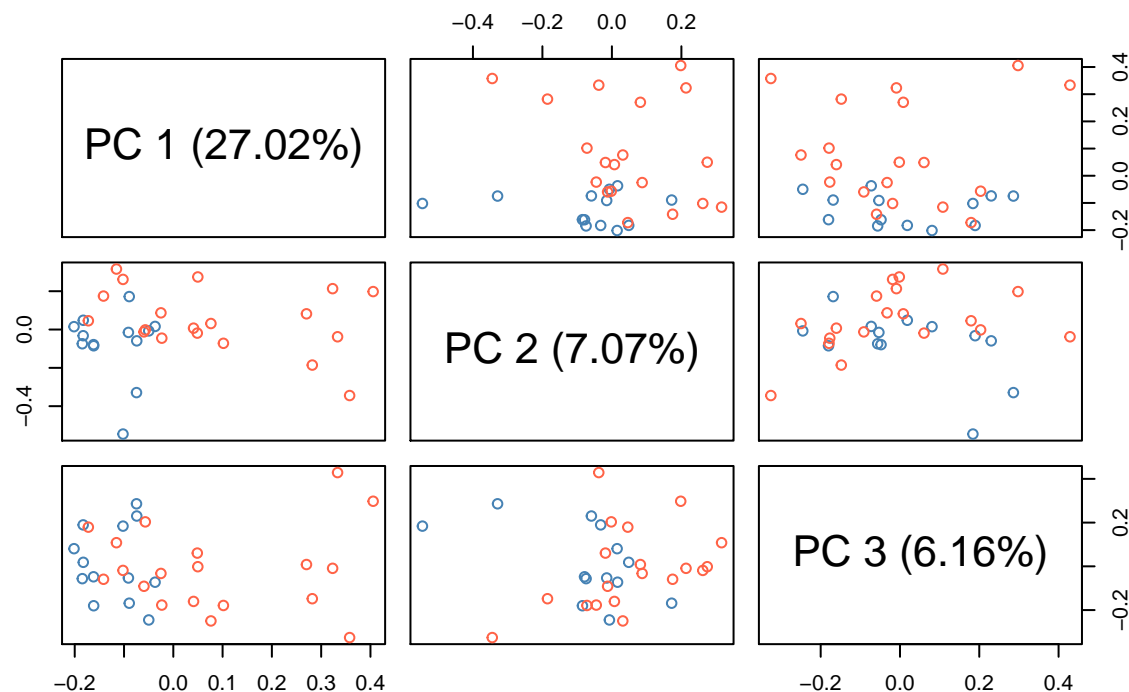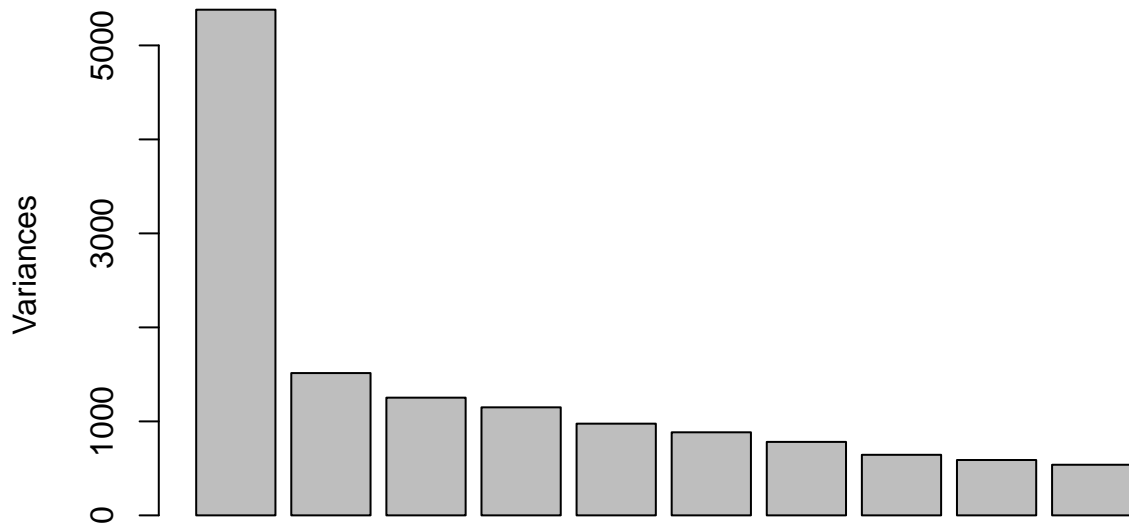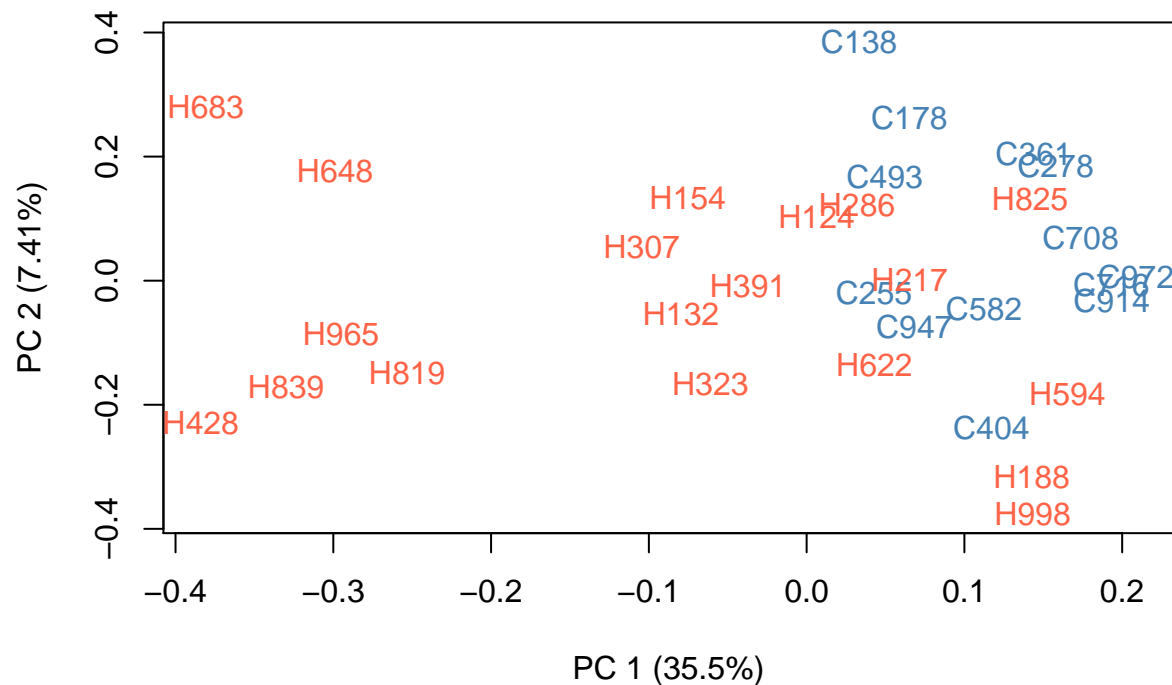


```
EDASeq::plotPCA(cnts.tpm, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (With Filtering TPM Normalization)",
    k = 3)
```

Control vs. HIV PCA Plot (With Filtering TPM Normalization)

```
boxplot(log2(cnts.tpm), main = "Control vs. HIV Boxplot (With Filtering TPM Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

Control vs. HIV Boxplot (With Filtering TPM Normalization)
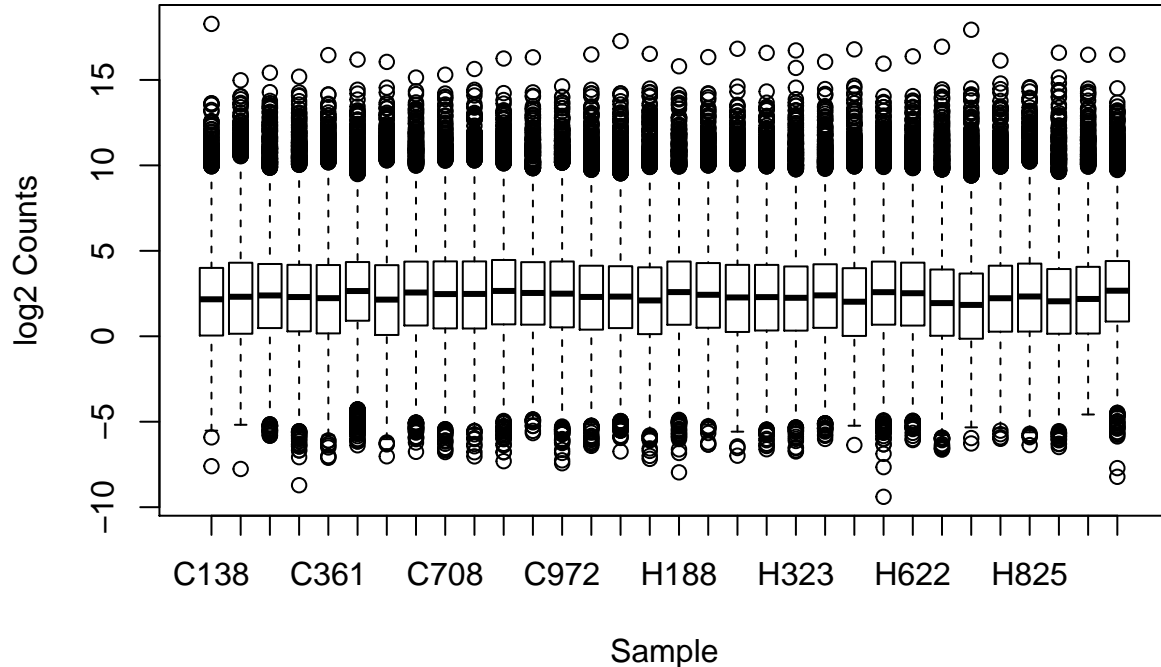
Based on the RLE plots, Boxplots and PCA plots, DESeq2 and TMM of edgeR normalization methods are better. Based on the medians in the RLE plots, the DESeq normalization method was chosen. # Differential Expression Analysis

1.4 DESeq2 Method

The standard differential expression analysis steps in DESeq2 were chosen. The adjusted p value cutoff was set as 0.1 or 0.05. The Benjamini–Hochberg procedure controling false discovery rate (FDR) was used to conduct the p-values adjustment.

```
## deseq normalization and DE analysis
register(MulticoreParam(6))
dds <- DESeq(dds)

## the results
res <- results(dds)
summary(res)

##
## out of 19890 with nonzero total read count
## adjusted p-value < 0.1
## LFC > 0 (up)       : 3705, 19%
## LFC < 0 (down)     : 2880, 14%
## outliers [1]       : 0, 0%
## low counts [2]     : 0, 0%
## (mean count < 0)
```

```
## [1] see 'cooksCutoff' argument of ?results
## [2] see 'independentFiltering' argument of ?results
```

```
## add gene symbol information to the results
res.sym <- res
rownames(res.sym) <- cnts_fsym$Symbol
## res is the result
resOrdered <- res.sym[order(res.sym$pvalue), ]
head(resOrdered[, c(2, 6)], 10)
```

```
## log2 fold change (MLE): condition HIV vs Control
##
## DataFrame with 10 rows and 2 columns
##          log2FoldChange                 padj
##               <numeric>            <numeric>
## EOMES   3.50192736966002 1.54045751502736e-35
## GZMH    3.90022933499764 1.31713099517147e-30
## KLRG1   2.46990130046568 4.80903229558716e-23
## NKG7    3.00419398588898 3.07957735051818e-19
## CD8A    2.18568001019696 1.35752827013163e-18
## DTHD1   3.18047962895702 1.35752827013163e-18
## BTN3A3 1.56853411161155 1.98773358612409e-18
## NLRC5  1.81911417622931 1.34199844319031e-16
## CCL5    2.16985711515286 1.59551696334332e-16
## TAP1     1.5446206860865 1.59551696334332e-16
```

```
## cutoff 0.1 or 0.05
res.deseq.1 <- resOrdered[resOrdered$padj <= 0.1, ]
dim(res.deseq.1)
```

```
## [1] 6585    6
```

```
res.deseq.05 <- resOrdered[resOrdered$padj <= 0.05, ]
dim(res.deseq.05)
```

```
## [1] 4730    6
```

```
# minimum padj
res[which.min(res$padj), ]
```

```
## log2 fold change (MLE): condition HIV vs Control
## Wald test p-value: condition HIV vs Control
## DataFrame with 1 row and 6 columns
##                           baseMean    log2FoldChange              lfcSE
##                          <numeric>         <numeric>          <numeric>
## ENSG00000163508.12 148.172487119719 3.50192736966002 0.265108926129653
##                               stat             pvalue
##                          <numeric>          <numeric>
## ENSG00000163508.12 13.2093906485343 7.74488443955435e-40
##                                padj
##                           <numeric>
## ENSG00000163508.12 1.54045751502736e-35
```

```
res.sym[which.min(res.sym$padj), ]
```

```
## log2 fold change (MLE): condition HIV vs Control
## Wald test p-value: condition HIV vs Control
## DataFrame with 1 row and 6 columns
```

```
##                baseMean   log2FoldChange                 lfcSE                 stat
##               <numeric>        <numeric>             <numeric>            <numeric>
## EOMES 148.172487119719 3.50192736966002 0.265108926129653 13.2093906485343
##                 pvalue             padj
##              <numeric>        <numeric>
## EOMES 7.74488443955435e-40 1.54045751502736e-35
```
```r
# plots shrinkage of log2 fc to visualize
resultsNames(dds)
```
```
## [1] "Intercept"              "condition_HIV_vs_Control"
```
```r
resLFC <- lfcShrink(dds, coef = "condition_HIV_vs_Control", type = "apeglm")
## MA plot
plotMA(resLFC, ylim = c(-5, 5))
```
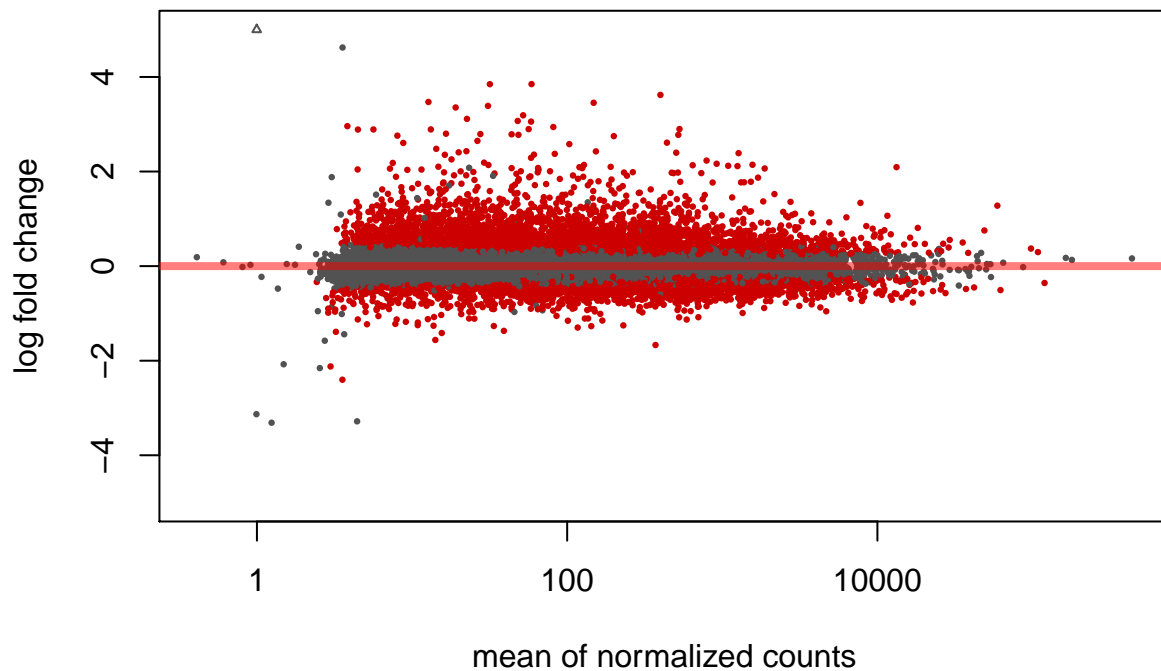


```r
## plot counts of minimum padj
plotCounts(dds, gene = which.min(res$padj), intgroup = "condition",
    main = "EOMES")
```

EOMES
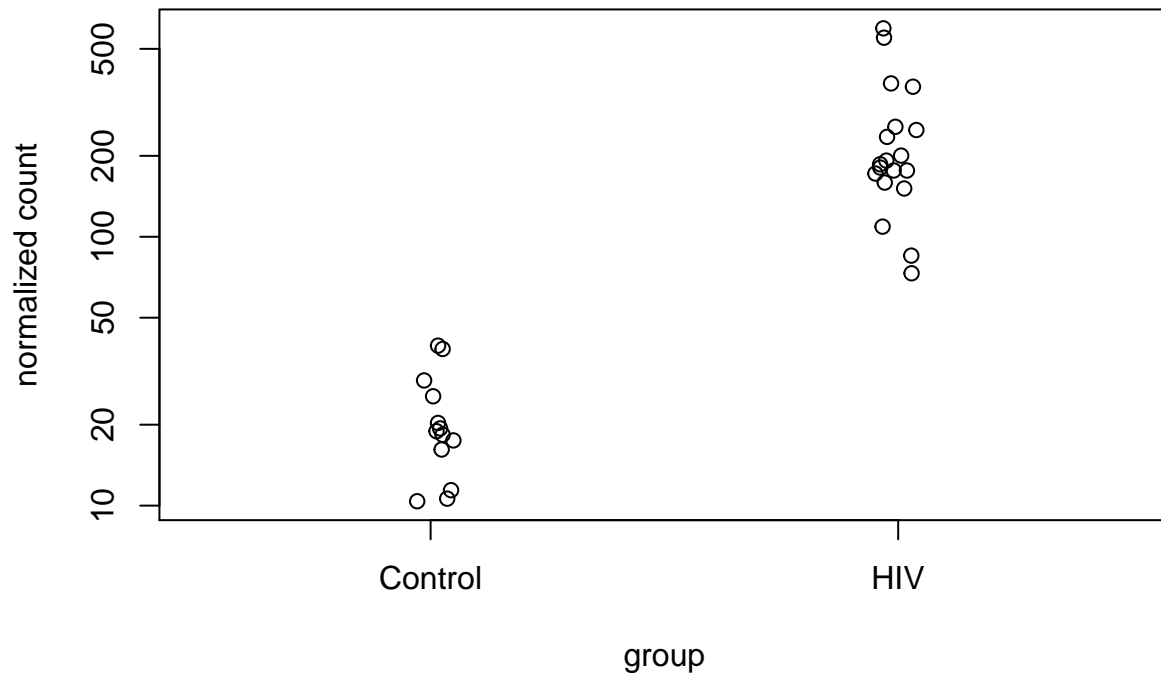

```
## DE analysis of edger y <- estimateDisp(y) et <-
## exactTest(y) topTags(et)
```

2 Core gene lists

2.1 Core ISGs

Genes that were induced by all the type I interferons tested in vitro.

2.2 'IFN-beta specific genes'

Genes that were induced specifically by IFN-beta, but not the IFN-alpha subtypes tested

```
# the list of DE genes
########## by symbol #####
## 4730 out of 19890
sym.deseq.1 <- rownames(res.deseq.1)
## 6585 out of 19890
sym.deseq.05 <- rownames(res.deseq.05)
###### by gene_id
res.order.geneid <- res[order(res$pvalue),]
gid.deseq.1 <- rownames(res.order.geneid[res.order.geneid$padj <= 0.1,])
gid.deseq.05 <- rownames(res.order.geneid[res.order.geneid$padj <= 0.05,])
### summary of results
res.deseq.sum1 <- data.frame(Gene_ID = rownames(res.order.geneid),
                             Symbol = rownames(resOrdered),
                             Log2FoldChange = resOrdered[,2],
```

```
                     pvalue = resOrdered[,5],
                     padj = resOrdered[,6])
kable(head(res.deseq.sum1,10), main = "Top10 Genes Control Vs HIV Untreated",
      digits = c(2,2,2,50,50))
```

Gene_ID	Symbol	Log2FoldChange	pvalue	padj
ENSG00000163508.12	EOMES	3.50	7.744884e-40	1.540458e-35
ENSG00000100450.12	GZMH	3.90	1.324415e-34	1.317131e-30
ENSG00000139187.9	KLRG1	2.47	7.253442e-27	4.809032e-23
ENSG00000105374.9	NKG7	3.00	6.193217e-23	3.079577e-19
ENSG00000153563.15	CD8A	2.19	3.599578e-22	1.357528e-18
ENSG00000197057.8	DTHD1	3.18	4.095108e-22	1.357528e-18
ENSG00000111801.15	BTN3A3	1.57	6.995543e-22	1.987734e-18
ENSG00000140853.15	NLRC5	1.82	5.397681e-20	1.341998e-16
ENSG00000271503.5	CCL5	2.17	7.943404e-20	1.595517e-16
ENSG00000168394.10	TAP1	1.54	8.021704e-20	1.595517e-16

```
## import pre-defined gene lists
############## core ISGs ###############
isgs <- as.data.frame(read.delim("coreISG"))
dim(isgs)
```

```
## [1] 230    2
## DE genes in the core ISGs list
## directions of regulation
isgs.de <- base::merge(res.deseq.sum1, isgs, by = "Gene_ID") %>% .[order(.$pvalue), ] %>%
     dplyr::mutate(Direction = ifelse(.$Log2FoldChange > 0, "Up-regulated", "Down-regulated"))
dim(isgs.de)
```

```
## [1] 230    7
##   all symbols are equal, no 0 fold change
sum(isgs.de$Symbol.x != isgs.de$Symbol.y)
```

```
## [1] 0
sum(isgs.de$Log2FoldChange == 0)
```

```
## [1] 0
## 230 genes table
kable(isgs.de[, c(1:5,7)], digits = c(2,2,2,30,30), col.names =
        c("Gene_ID", "Symbol", "Log2FoldChange", "pvalue", "padj","Direction"))
```

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000140853.15	NLRC5	1.82	5.397681e-20	1.341998e-16	Up-regulated
ENSG00000240065.7	PSMB9	2.11	2.094608e-18	3.787432e-15	Up-regulated
ENSG00000259529.1	RP11-468E2.4	2.07	6.757105e-16	8.319545e-13	Up-regulated
ENSG00000089692.8	LAG3	2.66	7.110722e-16	8.319545e-13	Up-regulated
ENSG00000025708.13	TYMP	2.48	1.140122e-15	1.259835e-12	Up-regulated
ENSG00000213928.8	IRF9	1.98	3.533740e-15	3.498683e-12	Up-regulated
ENSG00000154451.14	GBP5	2.85	1.313748e-14	1.136107e-11	Up-regulated
ENSG00000225492.6	GBP1P1	3.02	4.126825e-13	2.647824e-10	Up-regulated

27

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000185880.12	TRIM69	1.28	8.886165e-13	5.124502e-10	Up-regulated
ENSG00000117228.9	GBP1	2.21	2.016247e-11	8.354825e-09	Up-regulated
ENSG00000132530.16	XAF1	2.57	3.123532e-10	9.003921e-08	Up-regulated
ENSG00000111335.12	OAS2	2.10	2.085092e-09	4.867105e-07	Up-regulated
ENSG00000162654.8	GBP4	1.89	3.495385e-09	7.556870e-07	Up-regulated
ENSG00000177989.13	ODF3B	1.63	3.674749e-09	7.817591e-07	Up-regulated
ENSG00000225963.7	AC009950.2	2.34	4.900264e-09	9.845075e-07	Up-regulated
ENSG00000100342.20	APOL1	1.54	7.104804e-09	1.325507e-06	Up-regulated
ENSG00000115415.18	STAT1	1.13	7.330607e-09	1.325507e-06	Up-regulated
ENSG00000100911.14	PSME2	1.17	8.629934e-09	1.492603e-06	Up-regulated
ENSG00000137959.15	IFI44L	2.96	1.164527e-08	1.962919e-06	Up-regulated
ENSG00000140464.19	PML	1.24	1.686666e-08	2.672563e-06	Up-regulated
ENSG00000187608.8	ISG15	2.57	5.818982e-08	7.233722e-06	Up-regulated
ENSG00000102524.11	TNFSF13B	1.13	9.377745e-08	1.030516e-05	Up-regulated
ENSG00000137965.10	IFI44	2.24	1.373260e-07	1.365707e-05	Up-regulated
ENSG00000004468.12	CD38	1.24	1.456724e-07	1.420306e-05	Up-regulated
ENSG00000221963.5	APOL6	0.80	1.804339e-07	1.716385e-05	Up-regulated
ENSG00000125826.19	RBCK1	0.93	2.059698e-07	1.862264e-05	Up-regulated
ENSG00000130813.17	C19orf66	0.97	2.173410e-07	1.929872e-05	Up-regulated
ENSG00000157601.13	MX1	2.35	2.674571e-07	2.263711e-05	Up-regulated
ENSG00000119917.13	IFIT3	1.73	2.794244e-07	2.345043e-05	Up-regulated
ENSG00000136213.9	CHST12	0.80	3.056676e-07	2.533220e-05	Up-regulated
ENSG00000163840.9	DTX3L	0.88	3.213880e-07	2.646797e-05	Up-regulated
ENSG00000130303.12	BST2	1.63	3.582571e-07	2.827672e-05	Up-regulated
ENSG00000184979.9	USP18	1.67	3.604840e-07	2.829244e-05	Up-regulated
ENSG00000142089.15	IFITM3	1.64	5.374635e-07	3.906277e-05	Up-regulated
ENSG00000239713.7	APOBEC3G	1.14	7.024199e-07	4.884140e-05	Up-regulated
ENSG00000173193.13	PARP14	1.12	9.932033e-07	6.291342e-05	Up-regulated
ENSG00000177409.11	SAMD9L	1.23	1.185977e-06	7.303119e-05	Up-regulated
ENSG00000198133.8	TMEM229B	1.15	1.480718e-06	8.713455e-05	Up-regulated
ENSG00000182179.11	UBA7	0.82	1.655386e-06	9.488651e-05	Up-regulated
ENSG00000148175.12	STOM	0.99	1.882574e-06	1.037241e-04	Up-regulated
ENSG00000126709.14	IFI6	2.46	1.974455e-06	1.081871e-04	Up-regulated
ENSG00000272669.1	RP3-508I15.21	1.09	2.096097e-06	1.142229e-04	Up-regulated
ENSG00000160932.10	LY6E	1.53	2.515996e-06	1.320400e-04	Up-regulated
ENSG00000134326.11	CMPK2	1.53	3.334493e-06	1.586676e-04	Up-regulated
ENSG00000173821.19	RNF213	1.01	3.510660e-06	1.646864e-04	Up-regulated
ENSG00000156587.15	UBE2L6	1.09	4.775378e-06	2.096739e-04	Up-regulated
ENSG00000170581.13	STAT2	0.85	5.914078e-06	2.450646e-04	Up-regulated
ENSG00000124201.14	ZNFX1	1.21	6.097721e-06	2.500694e-04	Up-regulated
ENSG00000124256.14	ZBP1	1.34	6.594403e-06	2.639671e-04	Up-regulated
ENSG00000178685.13	PARP10	1.47	6.650595e-06	2.650909e-04	Up-regulated
ENSG00000100918.12	REC8	0.99	7.637352e-06	2.921287e-04	Up-regulated
ENSG00000111331.12	OAS3	1.46	8.241718e-06	3.081349e-04	Up-regulated
ENSG00000141971.12	MVB12A	0.76	1.156595e-05	4.043000e-04	Up-regulated
ENSG00000163328.13	GPR155	0.86	1.243558e-05	4.257205e-04	Up-regulated
ENSG00000123609.10	NMI	0.61	2.090727e-05	6.151562e-04	Up-regulated
ENSG00000108771.12	DHX58	0.87	2.367166e-05	6.735756e-04	Up-regulated
ENSG00000079263.18	SP140	1.21	2.666372e-05	7.370577e-04	Up-regulated
ENSG00000127311.9	HELB	0.92	2.774119e-05	7.589714e-04	Up-regulated
ENSG00000185201.16	IFITM2	1.16	3.855159e-05	9.566823e-04	Up-regulated
ENSG00000017483.14	SLC38A5	0.99	3.863762e-05	9.570389e-04	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000010030.13	ETV7	1.51	3.994556e-05	9.757803e-04	Up-regulated
ENSG00000160710.15	ADAR	0.42	4.238036e-05	1.020515e-03	Up-regulated
ENSG00000002549.12	LAP3	0.95	4.297356e-05	1.031054e-03	Up-regulated
ENSG00000173786.16	CNP	0.52	4.758840e-05	1.115100e-03	Up-regulated
ENSG00000169871.12	TRIM56	0.65	5.346495e-05	1.201602e-03	Up-regulated
ENSG00000110057.7	UNC93B1	0.72	6.513912e-05	1.408279e-03	Up-regulated
ENSG00000135899.16	SP110	0.79	7.292209e-05	1.539724e-03	Up-regulated
ENSG00000163568.14	AIM2	1.23	8.485405e-05	1.715190e-03	Up-regulated
ENSG00000138642.14	HERC6	1.30	8.565516e-05	1.729626e-03	Up-regulated
ENSG00000185745.9	IFIT1	2.02	8.998538e-05	1.793396e-03	Up-regulated
ENSG00000183486.12	MX2	1.02	1.252023e-04	2.259777e-03	Up-regulated
ENSG00000155363.18	MOV10	0.54	1.378230e-04	2.423784e-03	Up-regulated
ENSG00000187741.14	FANCA	0.71	1.795432e-04	2.908073e-03	Up-regulated
ENSG00000132274.15	TRIM22	1.02	1.829748e-04	2.951638e-03	Up-regulated
ENSG00000068079.7	IFI35	0.85	1.930199e-04	3.066572e-03	Up-regulated
ENSG00000171115.3	GIMAP8	0.60	2.308569e-04	3.499804e-03	Up-regulated
ENSG00000105287.12	PRKD2	0.63	2.989399e-04	4.244051e-03	Up-regulated
ENSG00000112343.10	TRIM38	0.41	3.056325e-04	4.314429e-03	Up-regulated
ENSG00000196141.13	SPATS2L	-0.29	4.182823e-04	5.339795e-03	Down-regulated
ENSG00000120217.13	CD274	1.30	4.233432e-04	5.387265e-03	Up-regulated
ENSG00000102699.5	PARP4	-0.37	6.115102e-04	6.915663e-03	Down-regulated
ENSG00000234127.8	TRIM26	0.60	6.308902e-04	7.073509e-03	Up-regulated
ENSG00000168961.16	LGALS9	0.70	6.314800e-04	7.076134e-03	Up-regulated
ENSG00000101347.8	SAMHD1	0.76	6.338000e-04	7.090148e-03	Up-regulated
ENSG00000168026.17	TTC21A	0.70	6.556078e-04	7.240444e-03	Up-regulated
ENSG00000136874.10	STX17	0.29	7.352822e-04	7.854330e-03	Up-regulated
ENSG00000166750.9	SLFN5	1.00	8.891500e-04	8.947594e-03	Up-regulated
ENSG00000196954.13	CASP4	0.52	9.762258e-04	9.556747e-03	Up-regulated
ENSG00000138760.8	SCARB2	-0.53	1.141620e-03	1.067050e-02	Down-regulated
ENSG00000163512.13	AZI2	-0.33	1.194056e-03	1.099018e-02	Down-regulated
ENSG00000121858.10	TNFSF10	0.68	1.581519e-03	1.340878e-02	Up-regulated
ENSG00000161692.17	DBF4B	0.85	1.902975e-03	1.528065e-02	Up-regulated
ENSG00000169047.5	IRS1	-0.39	2.276688e-03	1.723110e-02	Down-regulated
ENSG00000172493.20	AFF1	-0.69	2.676602e-03	1.926805e-02	Down-regulated
ENSG00000120549.17	KIAA1217	-0.33	2.763958e-03	1.969729e-02	Down-regulated
ENSG00000116663.10	FBXO6	0.97	2.797230e-03	1.982077e-02	Up-regulated
ENSG00000197536.10	C5orf56	0.56	2.859860e-03	2.012119e-02	Up-regulated
ENSG00000108679.12	LGALS3BP	0.43	3.206827e-03	2.170287e-02	Up-regulated
ENSG00000132965.9	ALOX5AP	0.47	3.641619e-03	2.360111e-02	Up-regulated
ENSG00000128335.13	APOL2	0.79	3.806030e-03	2.422342e-02	Up-regulated
ENSG00000135114.12	OASL	0.91	3.853104e-03	2.443822e-02	Up-regulated
ENSG00000204147.9	ASAH2B	-0.89	4.205802e-03	2.582692e-02	Down-regulated
ENSG00000196116.7	TDRD7	-0.93	4.264747e-03	2.610025e-02	Down-regulated
ENSG00000185722.16	ANKFY1	0.40	4.608133e-03	2.732730e-02	Up-regulated
ENSG00000201649.1	RNY4P34	0.74	5.017557e-03	2.886873e-02	Up-regulated
ENSG00000067066.16	SP100	0.42	6.002882e-03	3.234823e-02	Up-regulated
ENSG00000136560.13	TANK	-0.32	6.292337e-03	3.339236e-02	Down-regulated
ENSG00000107290.13	SETX	-0.26	6.431162e-03	3.384016e-02	Down-regulated
ENSG00000165949.12	IFI27	0.68	7.126734e-03	3.605971e-02	Up-regulated
ENSG00000115604.10	IL18R1	0.51	7.177457e-03	3.623341e-02	Up-regulated
ENSG00000106392.10	C1GALT1	-0.37	7.531599e-03	3.735748e-02	Down-regulated
ENSG00000205413.7	SAMD9	0.54	7.741949e-03	3.798406e-02	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000086065.13	CHMP5	-0.79	8.622965e-03	4.074858e-02	Down-regulated
ENSG00000112576.12	CCND3	0.41	8.677077e-03	4.087155e-02	Up-regulated
ENSG00000137628.16	DDX60	0.58	8.686605e-03	4.089386e-02	Up-regulated
ENSG00000013374.15	NUB1	0.30	9.442703e-03	4.312638e-02	Up-regulated
ENSG00000107201.9	DDX58	0.67	9.690123e-03	4.391286e-02	Up-regulated
ENSG00000092010.14	PSME1	0.30	1.055779e-02	4.633593e-02	Up-regulated
ENSG00000136514.2	RTP4	0.63	1.063528e-02	4.651243e-02	Up-regulated
ENSG00000162433.14	AK4	-0.32	1.082898e-02	4.695629e-02	Down-regulated
ENSG00000172936.12	MYD88	-0.62	1.138705e-02	4.848822e-02	Down-regulated
ENSG00000101608.12	MYL12A	-0.52	1.146977e-02	4.877562e-02	Down-regulated
ENSG00000198087.7	CD2AP	-0.28	1.179471e-02	4.970272e-02	Down-regulated
ENSG00000137752.22	CASP1	0.54	1.181996e-02	4.977748e-02	Up-regulated
ENSG00000070190.12	DAPP1	0.59	1.244732e-02	5.168626e-02	Up-regulated
ENSG00000146409.10	SLC18B1	0.22	1.382431e-02	5.557104e-02	Up-regulated
ENSG00000185507.19	IRF7	0.71	1.438307e-02	5.708162e-02	Up-regulated
ENSG00000154760.13	SLFN13	0.57	1.440906e-02	5.714778e-02	Up-regulated
ENSG00000122729.18	ACO1	0.22	1.489599e-02	5.853467e-02	Up-regulated
ENSG00000196684.12	HSH2D	0.47	1.527056e-02	5.953183e-02	Up-regulated
ENSG00000133106.14	EPSTI1	0.61	1.660199e-02	6.271863e-02	Up-regulated
ENSG00000262979.1	CTD-2047H16.2	0.92	1.687516e-02	6.343734e-02	Up-regulated
ENSG00000163131.10	CTSS	0.32	1.755311e-02	6.519726e-02	Up-regulated
ENSG00000115271.10	GCA	-0.41	1.764730e-02	6.543931e-02	Down-regulated
ENSG00000106785.14	TRIM14	0.27	1.966988e-02	7.041647e-02	Up-regulated
ENSG00000163644.14	PPM1K	0.41	1.973311e-02	7.054125e-02	Up-regulated
ENSG00000152818.18	UTRN	0.28	2.578869e-02	8.437851e-02	Up-regulated
ENSG00000181381.13	DDX60L	0.55	2.587846e-02	8.450544e-02	Up-regulated
ENSG00000134321.11	RSAD2	1.09	2.658576e-02	8.621058e-02	Up-regulated
ENSG00000130589.16	HELZ2	0.46	2.887916e-02	9.150768e-02	Up-regulated
ENSG00000108424.9	KPNB1	0.30	2.892893e-02	9.159445e-02	Up-regulated
ENSG00000167207.11	NOD2	0.51	2.985403e-02	9.348716e-02	Up-regulated
ENSG00000086061.15	DNAJA1	-0.32	3.033907e-02	9.452446e-02	Down-regulated
ENSG00000251301.6	RP11-81H14.2	0.56	3.244979e-02	9.870414e-02	Up-regulated
ENSG00000155313.15	USP25	-0.26	3.272773e-02	9.930678e-02	Down-regulated
ENSG00000135535.15	CD164	-0.56	3.340682e-02	1.006913e-01	Down-regulated
ENSG00000117475.13	BLZF1	-0.24	3.612644e-02	1.061717e-01	Down-regulated
ENSG00000136147.17	PHF11	0.22	3.704610e-02	1.079313e-01	Up-regulated
ENSG00000074706.13	IPCEF1	0.38	3.840342e-02	1.105886e-01	Up-regulated
ENSG00000034510.5	TMSB10	-0.42	4.256083e-02	1.183106e-01	Down-regulated
ENSG00000059378.12	PARP12	0.27	4.259723e-02	1.183653e-01	Up-regulated
ENSG00000129515.18	SNX6	0.18	4.314992e-02	1.193428e-01	Up-regulated
ENSG00000138646.8	HERC5	0.59	4.484397e-02	1.223141e-01	Up-regulated
ENSG00000184898.6	RBM43	0.27	4.842461e-02	1.289717e-01	Up-regulated
ENSG00000114541.14	FRMD4B	-0.31	5.074325e-02	1.335013e-01	Down-regulated
ENSG00000065882.15	TBC1D1	0.17	6.346197e-02	1.562012e-01	Up-regulated
ENSG00000103966.10	EHD4	-0.25	6.398940e-02	1.570907e-01	Down-regulated
ENSG00000119922.9	IFIT2	0.51	7.227694e-02	1.710397e-01	Up-regulated
ENSG00000146425.10	DYNLT1	-0.57	7.947559e-02	1.824526e-01	Down-regulated
ENSG00000139618.14	BRCA2	0.28	8.242376e-02	1.871085e-01	Up-regulated
ENSG00000159322.17	ADPGK	0.26	8.284339e-02	1.878854e-01	Up-regulated
ENSG00000162437.14	RAVER2	-0.30	8.609394e-02	1.928822e-01	Down-regulated
ENSG00000135148.11	TRAFD1	-0.37	8.629088e-02	1.931929e-01	Down-regulated
ENSG00000055332.16	EIF2AK2	0.25	9.117692e-02	2.002771e-01	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000172183.14	ISG20	0.39	9.479075e-02	2.058143e-01	Up-regulated
ENSG00000149218.4	ENDOD1	-0.24	1.040455e-01	2.196885e-01	Down-regulated
ENSG00000137200.12	CMTR1	0.18	1.043449e-01	2.201464e-01	Up-regulated
ENSG00000121060.15	TRIM25	-0.33	1.055120e-01	2.219368e-01	Down-regulated
ENSG00000163565.18	IFI16	0.33	1.078531e-01	2.255255e-01	Up-regulated
ENSG00000138496.16	PARP9	0.49	1.151494e-01	2.358240e-01	Up-regulated
ENSG00000198286.9	CARD11	0.50	1.178631e-01	2.395561e-01	Up-regulated
ENSG00000114127.10	XRN1	0.19	1.200055e-01	2.423751e-01	Up-regulated
ENSG00000141664.9	ZCCHC2	0.18	1.213918e-01	2.443067e-01	Up-regulated
ENSG00000106560.10	GIMAP2	0.45	1.257161e-01	2.498744e-01	Up-regulated
ENSG00000171132.13	PRKCE	0.25	1.302553e-01	2.560563e-01	Up-regulated
ENSG00000102081.13	FMR1	0.15	1.320142e-01	2.583395e-01	Up-regulated
ENSG00000229054.1	AC074338.4	-0.45	1.375274e-01	2.659620e-01	Down-regulated
ENSG00000115267.5	IFIH1	0.34	1.432460e-01	2.737473e-01	Up-regulated
ENSG00000122643.18	NT5C3A	-0.26	1.490226e-01	2.815674e-01	Down-regulated
ENSG00000162909.17	CAPN2	-0.16	1.583694e-01	2.929384e-01	Down-regulated
ENSG00000152778.8	IFIT5	0.28	1.762283e-01	3.160098e-01	Up-regulated
ENSG00000143384.12	MCL1	-0.28	1.893682e-01	3.321901e-01	Down-regulated
ENSG00000163872.15	YEATS2	-0.16	1.913073e-01	3.343809e-01	Down-regulated
ENSG00000204397.7	CARD16	0.26	1.930455e-01	3.365045e-01	Up-regulated
ENSG00000122417.15	ODF2L	-0.13	2.035140e-01	3.487759e-01	Down-regulated
ENSG00000110492.15	MDK	0.21	2.376688e-01	3.889345e-01	Up-regulated
ENSG00000101577.9	LPIN2	-0.15	2.403457e-01	3.920994e-01	Down-regulated
ENSG00000102921.7	N4BP1	0.11	2.422102e-01	3.940745e-01	Up-regulated
ENSG00000280007.1	AC008079.10	-0.53	2.539029e-01	4.068780e-01	Down-regulated
ENSG00000138035.14	PNPT1	0.25	2.599357e-01	4.135466e-01	Up-regulated
ENSG00000117226.11	GBP3	0.23	2.738043e-01	4.282768e-01	Up-regulated
ENSG00000095380.10	NANS	-0.11	2.811532e-01	4.365788e-01	Down-regulated
ENSG00000117298.14	ECE1	0.19	2.977839e-01	4.538698e-01	Up-regulated
ENSG00000132256.18	TRIM5	0.18	2.988364e-01	4.549799e-01	Up-regulated
ENSG00000111224.13	PARP11	0.15	2.995621e-01	4.559800e-01	Up-regulated
ENSG00000152689.17	RASGRP3	0.19	3.142483e-01	4.711948e-01	Up-regulated
ENSG00000155158.20	TTC39B	0.14	3.357063e-01	4.931097e-01	Up-regulated
ENSG00000141682.11	PMAIP1	0.19	3.418249e-01	4.990748e-01	Up-regulated
ENSG00000135655.14	USP15	-0.08	3.760657e-01	5.330254e-01	Down-regulated
ENSG00000151466.11	SCLT1	0.09	3.890572e-01	5.457612e-01	Up-regulated
ENSG00000146859.6	TMEM140	0.18	4.177849e-01	5.734416e-01	Up-regulated
ENSG00000061938.16	TNK2	0.11	4.521991e-01	6.054357e-01	Up-regulated
ENSG00000096968.13	JAK2	0.10	4.543546e-01	6.072919e-01	Up-regulated
ENSG00000090104.11	RGS1	-0.24	4.772026e-01	6.280394e-01	Down-regulated
ENSG00000175550.7	DRAP1	-0.10	4.912651e-01	6.405286e-01	Down-regulated
ENSG00000169679.14	BUB1	-0.12	5.048458e-01	6.524751e-01	Down-regulated
ENSG00000162614.18	NEXN	0.10	5.167612e-01	6.622241e-01	Up-regulated
ENSG00000197265.8	GTF2E2	-0.05	5.227737e-01	6.674778e-01	Down-regulated
ENSG00000172164.13	SNTB1	-0.15	5.261288e-01	6.705563e-01	Down-regulated
ENSG00000125148.6	MT2A	-0.19	5.261989e-01	6.706027e-01	Down-regulated
ENSG00000152749.7	GPR180	-0.09	5.907949e-01	7.244258e-01	Down-regulated
ENSG00000130066.16	SAT1	0.05	6.376498e-01	7.617023e-01	Up-regulated
ENSG00000187479.5	C11orf96	0.13	6.469638e-01	7.690259e-01	Up-regulated
ENSG00000112773.15	FAM46A	-0.06	6.702857e-01	7.873563e-01	Down-regulated
ENSG00000188313.12	PLSCR1	-0.06	6.745718e-01	7.905583e-01	Down-regulated
ENSG00000101596.14	SMCHD1	0.04	6.788307e-01	7.936717e-01	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000089127.12	OAS1	0.08	7.032714e-01	8.108554e-01	Up-regulated
ENSG00000281100.1	RP11-640L9.2	0.07	7.251363e-01	8.270520e-01	Up-regulated
ENSG00000141574.7	SECTM1	0.08	7.586062e-01	8.506481e-01	Up-regulated
ENSG00000153898.12	MCOLN2	-0.08	7.633815e-01	8.538780e-01	Down-regulated
ENSG00000107798.17	LIPA	0.05	8.384052e-01	9.018376e-01	Up-regulated
ENSG00000136169.16	SETDB2	0.02	8.581409e-01	9.144478e-01	Up-regulated
ENSG00000133943.20	C14orf159	0.01	8.626702e-01	9.173711e-01	Up-regulated
ENSG00000168016.13	TRANK1	-0.03	8.943764e-01	9.371587e-01	Down-regulated
ENSG00000155287.10	SLC25A28	0.02	9.117488e-01	9.482187e-01	Up-regulated
ENSG00000132109.9	TRIM21	0.02	9.128872e-01	9.487577e-01	Up-regulated
ENSG00000120539.14	MASTL	0.02	9.162196e-01	9.510781e-01	Up-regulated
ENSG00000136682.14	CBWD2	-0.01	9.387742e-01	9.652974e-01	Down-regulated
ENSG00000197121.14	PGAP1	0.01	9.743297e-01	9.853774e-01	Up-regulated
ENSG00000164342.12	TLR3	0.00	9.924220e-01	9.960778e-01	Up-regulated

```r
## FDR 0.05 list
n.isgs.05 <- nrow(isgs.de[isgs.de$padj <= 0.05, ])
paste("Number of Core ISGs with FDR less than or equal to 0.05", n.isgs.05)
```

```
## [1] "Number of Core ISGs with FDR less than or equal to 0.05 124"
```

```r
## volcano plot
rownames(isgs.de) <- isgs.de$Symbol.x

EnhancedVolcano(isgs.de,
        lab = rownames(isgs.de),
        x = "Log2FoldChange",
        y = "padj",
        pCutoff = 5e-2,
        FCcutoff = 1,
        pLabellingCutoff = 5e-2,
        ## select labels to show
        # selectLab = c("cg18587484","cg00803922", " cg19425295"),
        ## point and label size
        transcriptPointSize = 2.0,
        transcriptLabSize = 3.5,
        xlab = bquote(~Log[2]~ "Fold Change"),
        ylab = bquote(~-Log[10]~adjusted~italic(P)),
        title = "Core ISGs: HIV Infected vs Health Control",
        #Modify border and remove gridlines
        gridlines.major = FALSE,
        gridlines.minor = FALSE,
        border = "full",
        borderWidth = 1.0,
        borderColour = "black",
        # the transparence of the dots
        colAlpha = 0.8,
        xlim = c(-4, 4),
        ylim = c(0, -log10(10e-25)),
        # adjust the legend
        legend=c("NS","log2 Fold Change >= 1","adjusted p-value <= 0.05",
            "adjusted p-value <= 0.05 & log2 Fold Change >= 1"),
```

```
legendPosition = "bottom",
legendLabSize = 9,
legendIconSize = 3,
# connectors
DrawConnectors = TRUE,
#
widthConnectors = 0.3,
#
colConnectors = "grey40",
col = c("grey30", "forestgreen", "royalblue", "tomato")
)
```

Core ISGs: HIV Infected vs Health Control


```
EnhancedVolcano(isgs.de,
      lab = rownames(isgs.de),
      x = "Log2FoldChange",
      y = "padj",
      pCutoff = 5e-2,
      FCcutoff = 1.5,
      pLabellingCutoff = 5e-2,
      ## select labels to show
      # selectLab = c("cg18587484","cg00803922", " cg19425295"),
      ## point and label size
      transcriptPointSize = 2.0,
      transcriptLabSize = 3.5,
      xlab = bquote(~Log[2]~ "Fold Change"),
      ylab = bquote(~-Log[10]~adjusted~italic(P)),
      title = "Core ISGs: HIV Infected vs Health Control",
      #Modify border and remove gridlines
      gridlines.major = FALSE,
```

```
       gridlines.minor = FALSE,
       border = "full",
       borderWidth = 1.0,
       borderColour = "black",
       # the transparence of the dots
       colAlpha = 0.8,
       xlim = c(-4, 4),
       ylim = c(0, -log10(10e-25)),
       # adjust the legend
       legend=c("NS","log2 Fold Change >= 1.5","adjusted p-value <= 0.05",
           "adjusted p-value <= 0.05 & log2 Fold Change >= 1.5"),
       legendPosition = "bottom",
       legendLabSize = 9,
       legendIconSize = 3,
       # connectors
       DrawConnectors = TRUE,
       #
       widthConnectors = 0.3,
       #
       colConnectors = "grey40",
       col = c("grey30", "forestgreen", "royalblue", "tomato")
       )
```

Core ISGs: HIV Infected vs Health Control
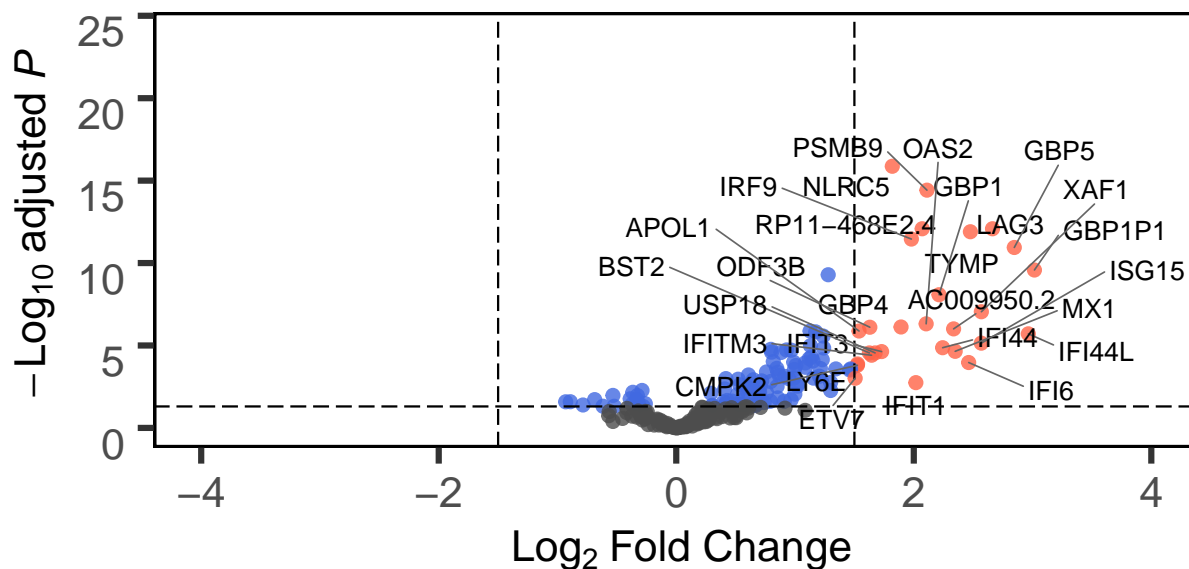

```
######### Beta specific ##############
genesbeta <- as.data.frame(read.delim("genesbeta"))
dim(genesbeta)
```

```
## [1] 423   2
```

```
## DE genes in the core genesbeta list
## directions of regulation
genesbeta.de <- base::merge(res.deseq.sum1, genesbeta, by = "Gene_ID") %>% .[order(.$pvalue), ] %>%
    dplyr::mutate(Direction = ifelse(.$Log2FoldChange > 0, "Up-regulated", "Down-regulated"))
dim(genesbeta.de)
```

```
## [1] 423   7
```

```
##  all symbols are equal, no 0 fold change
sum(genesbeta.de$Symbol.x != genesbeta.de$Symbol.y)
```

```
## [1] 1
```

```
genesbeta.de[ which(genesbeta.de$Symbol.x != genesbeta.de$Symbol.y),]
```

```
##              Gene_ID Symbol.x Log2FoldChange       pvalue        padj
## 28 ENSG00000183291.15   15-Sep     -0.8991707 0.0005617323 0.006500521
##    Symbol.y      Direction
## 28   SEPT15 Down-regulated
```

```
sum(genesbeta.de$Log2FoldChange == 0)
```

```
## [1] 0
```

```
## 423 genes table
kable(genesbeta.de[, c(1:5,7)], digits = c(2,2,2,30,30), col.names =
        c("Gene_ID", "Symbol", "Log2FoldChange", "pvalue", "padj","Direction"))
```

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000183918.15	SH2D1A	2.08	2.998250e-14	2.385407e-11	Up-regulated
ENSG00000174946.6	GPR171	1.10	4.282535e-09	8.872876e-07	Up-regulated
ENSG00000030582.16	GRN	0.62	3.192796e-06	1.537644e-04	Up-regulated
ENSG00000255733.5	IFNG-AS1	1.07	4.129506e-06	1.844333e-04	Up-regulated
ENSG00000198431.15	TXNRD1	-0.64	5.188178e-06	2.223984e-04	Down-regulated
ENSG00000131871.14	VIMP	-0.66	2.115028e-05	6.197077e-04	Down-regulated
ENSG00000072364.12	AFF4	-0.53	3.655768e-05	9.262830e-04	Down-regulated
ENSG00000112305.14	SMAP1	-0.80	5.696594e-05	1.263158e-03	Down-regulated
ENSG00000100325.14	ASCC2	-0.47	9.334671e-05	1.845593e-03	Down-regulated
ENSG00000165487.13	MICU2	-0.37	1.176430e-04	2.150661e-03	Down-regulated
ENSG00000139116.18	KIF21A	-0.64	1.341941e-04	2.371027e-03	Down-regulated
ENSG00000170248.13	PDCD6IP	-0.74	1.366868e-04	2.408061e-03	Down-regulated
ENSG00000121774.17	KHDRBS1	-0.38	1.482928e-04	2.555931e-03	Down-regulated
ENSG00000143207.19	RFWD2	-0.76	1.929509e-04	3.066572e-03	Down-regulated
ENSG00000139990.17	DCAF5	-0.73	2.405168e-04	3.608960e-03	Down-regulated
ENSG00000198879.11	SFMBT2	0.65	2.483670e-04	3.692093e-03	Up-regulated
ENSG00000166266.13	CUL5	-0.53	2.678481e-04	3.885849e-03	Down-regulated
ENSG00000175105.6	ZNF654	-0.41	3.105999e-04	4.360646e-03	Down-regulated
ENSG00000156050.8	FAM161B	-0.53	3.540391e-04	4.783858e-03	Down-regulated
ENSG00000172939.8	OXSR1	-0.52	3.973231e-04	5.158457e-03	Down-regulated
ENSG00000272047.1	GTF2H5	-0.77	4.001450e-04	5.178194e-03	Down-regulated
ENSG00000135828.11	RNASEL	-0.47	4.528350e-04	5.638256e-03	Down-regulated
ENSG00000069493.14	CLEC2D	0.75	4.565078e-04	5.663355e-03	Up-regulated
ENSG00000066777.8	ARFGEF1	-0.62	4.643326e-04	5.716617e-03	Down-regulated
ENSG00000164117.13	FBXO8	-0.85	5.037535e-04	6.022742e-03	Down-regulated
ENSG00000198380.12	GFPT1	-0.39	5.078618e-04	6.052349e-03	Down-regulated
ENSG00000106682.14	EIF4H	-0.58	5.113726e-04	6.072359e-03	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000183291.15	15-Sep	-0.90	5.617323e-04	6.500521e-03	Down-regulated
ENSG00000167699.13	GLOD4	-0.45	5.765562e-04	6.628730e-03	Down-regulated
ENSG00000136720.6	HS6ST1	-0.97	6.653724e-04	7.315786e-03	Down-regulated
ENSG00000126882.12	FAM78A	0.75	6.718915e-04	7.367102e-03	Up-regulated
ENSG00000198677.10	TTC37	-0.34	6.778150e-04	7.407550e-03	Down-regulated
ENSG00000120690.14	ELF1	-0.32	7.431297e-04	7.912385e-03	Down-regulated
ENSG00000176731.11	C8orf59	-0.51	7.755267e-04	8.122815e-03	Down-regulated
ENSG00000074319.12	TSG101	-0.64	8.105235e-04	8.394555e-03	Down-regulated
ENSG00000115548.16	KDM3A	-0.47	1.031983e-03	9.940021e-03	Down-regulated
ENSG00000151929.9	BAG3	-1.01	1.037895e-03	9.982344e-03	Down-regulated
ENSG00000205133.11	TRIQK	-0.70	1.198620e-03	1.102198e-02	Down-regulated
ENSG00000155744.9	FAM126B	-0.98	1.216608e-03	1.114617e-02	Down-regulated
ENSG00000162434.11	JAK1	-0.35	1.347890e-03	1.198707e-02	Down-regulated
ENSG00000121578.12	B4GALT4	-1.08	1.386631e-03	1.223456e-02	Down-regulated
ENSG00000100575.13	TIMM9	-0.53	1.414419e-03	1.236607e-02	Down-regulated
ENSG00000135932.10	CAB39	-0.90	1.486319e-03	1.279779e-02	Down-regulated
ENSG00000137845.14	ADAM10	-0.53	1.641021e-03	1.374312e-02	Down-regulated
ENSG00000101346.12	POFUT1	-0.63	1.642555e-03	1.375017e-02	Down-regulated
ENSG00000159459.11	UBR1	-0.58	1.694729e-03	1.406264e-02	Down-regulated
ENSG00000154582.16	TCEB1	-0.64	1.782484e-03	1.459597e-02	Down-regulated
ENSG00000197747.8	S100A10	-0.67	1.841014e-03	1.493384e-02	Down-regulated
ENSG00000118680.12	MYL12B	-0.89	1.883261e-03	1.518365e-02	Down-regulated
ENSG00000138750.14	NUP54	-0.50	1.930132e-03	1.543020e-02	Down-regulated
ENSG00000182118.6	FAM89A	-0.64	2.043211e-03	1.603768e-02	Down-regulated
ENSG00000143933.16	CALM2	-0.75	2.070046e-03	1.619717e-02	Down-regulated
ENSG00000137947.11	GTF2B	-0.54	2.079162e-03	1.624294e-02	Down-regulated
ENSG00000134716.9	CYP2J2	-0.90	2.235390e-03	1.702528e-02	Down-regulated
ENSG00000145247.11	OCIAD2	-0.84	2.327094e-03	1.747297e-02	Down-regulated
ENSG00000085491.15	SLC25A24	-0.63	2.402906e-03	1.785349e-02	Down-regulated
ENSG00000115446.11	UNC50	-0.75	2.424188e-03	1.795946e-02	Down-regulated
ENSG00000147654.14	EBAG9	-0.26	2.473459e-03	1.820766e-02	Down-regulated
ENSG00000110768.11	GTF2H1	-0.56	2.582803e-03	1.874204e-02	Down-regulated
ENSG00000174109.4	C16orf91	-1.02	2.679168e-03	1.927954e-02	Down-regulated
ENSG00000157593.17	SLC35B2	-1.43	2.731947e-03	1.953734e-02	Down-regulated
ENSG00000198898.12	CAPZA2	-0.45	2.849384e-03	2.008372e-02	Down-regulated
ENSG00000196850.5	PPTC7	-0.44	3.001806e-03	2.080324e-02	Down-regulated
ENSG00000103978.15	TMEM87A	-0.87	3.226748e-03	2.177070e-02	Down-regulated
ENSG00000141646.13	SMAD4	-0.57	3.300482e-03	2.216292e-02	Down-regulated
ENSG00000023697.12	DERA	-0.96	3.363816e-03	2.248605e-02	Down-regulated
ENSG00000126903.15	SLC10A3	-0.75	3.423366e-03	2.273481e-02	Down-regulated
ENSG00000100814.17	CCNB1IP1	-0.48	3.447955e-03	2.283710e-02	Down-regulated
ENSG00000111832.12	RWDD1	-0.65	3.452810e-03	2.285404e-02	Down-regulated
ENSG00000010017.12	RANBP9	-0.67	3.471181e-03	2.294647e-02	Down-regulated
ENSG00000188342.11	GTF2F2	-0.43	3.533045e-03	2.315396e-02	Down-regulated
ENSG00000056050.6	HPF1	-0.78	3.538568e-03	2.316725e-02	Down-regulated
ENSG00000136021.18	SCYL2	-0.32	3.551039e-03	2.321070e-02	Down-regulated
ENSG00000155093.17	PTPRN2	-0.78	3.572654e-03	2.332018e-02	Down-regulated
ENSG00000109390.11	NDUFC1	-0.89	3.626312e-03	2.353802e-02	Down-regulated
ENSG00000257093.6	KIAA1147	-0.39	3.658684e-03	2.364687e-02	Down-regulated
ENSG00000206503.11	HLA-A	0.46	3.695542e-03	2.377149e-02	Up-regulated
ENSG00000159658.10	EFCAB14	-0.54	3.743440e-03	2.395657e-02	Down-regulated
ENSG00000181788.3	SIAH2	-0.74	3.799019e-03	2.420323e-02	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000131115.15	ZNF227	-0.92	3.942336e-03	2.478054e-02	Down-regulated
ENSG00000185009.12	AP3M1	-0.58	3.957562e-03	2.482369e-02	Down-regulated
ENSG00000135829.16	DHX9	-0.39	4.157778e-03	2.559524e-02	Down-regulated
ENSG00000175376.8	EIF1AD	-1.00	4.263440e-03	2.610025e-02	Down-regulated
ENSG00000127922.9	SHFM1	-0.83	4.408380e-03	2.661083e-02	Down-regulated
ENSG00000164828.17	SUN1	-0.90	4.450752e-03	2.672077e-02	Down-regulated
ENSG00000047188.15	YTHDC2	-0.46	4.453896e-03	2.672338e-02	Down-regulated
ENSG00000151883.17	PARP8	0.33	4.684483e-03	2.764818e-02	Up-regulated
ENSG00000138768.14	USO1	-0.39	4.700878e-03	2.768743e-02	Down-regulated
ENSG00000184371.13	CSF1	-0.68	4.717328e-03	2.775378e-02	Down-regulated
ENSG00000059573.8	ALDH18A1	-0.92	4.904968e-03	2.845969e-02	Down-regulated
ENSG00000166226.12	CCT2	-0.56	5.260794e-03	2.968086e-02	Down-regulated
ENSG00000176853.15	FAM91A1	-0.59	5.322192e-03	2.992887e-02	Down-regulated
ENSG00000213639.9	PPP1CB	-0.55	5.355360e-03	3.003895e-02	Down-regulated
ENSG00000128789.20	PSMG2	-0.70	5.422993e-03	3.033277e-02	Down-regulated
ENSG00000153879.8	CEBPG	-0.32	5.520281e-03	3.074724e-02	Down-regulated
ENSG00000104325.6	DECR1	-0.63	5.677970e-03	3.130401e-02	Down-regulated
ENSG00000055208.18	TAB2	-0.46	5.743124e-03	3.153803e-02	Down-regulated
ENSG00000111731.12	C2CD5	-0.47	5.769285e-03	3.160291e-02	Down-regulated
ENSG00000077721.15	UBE2A	-0.73	5.957078e-03	3.221487e-02	Down-regulated
ENSG00000150787.7	PTS	-0.81	6.339137e-03	3.356907e-02	Down-regulated
ENSG00000115109.13	EPB41L5	-0.41	6.376171e-03	3.368447e-02	Down-regulated
ENSG00000027697.13	IFNGR1	-0.81	6.647609e-03	3.459470e-02	Down-regulated
ENSG00000051596.9	THOC3	-1.08	6.758990e-03	3.495188e-02	Down-regulated
ENSG00000167005.13	NUDT21	-0.86	6.821396e-03	3.507693e-02	Down-regulated
ENSG00000186130.4	ZBTB6	-0.57	6.935342e-03	3.539854e-02	Down-regulated
ENSG00000198276.14	UCKL1	-0.93	7.009987e-03	3.563216e-02	Down-regulated
ENSG00000134153.9	EMC7	-0.73	7.115273e-03	3.602005e-02	Down-regulated
ENSG00000057663.13	ATG5	-0.67	7.220826e-03	3.638769e-02	Down-regulated
ENSG00000259330.1	INAFM2	-0.94	7.318170e-03	3.669231e-02	Down-regulated
ENSG00000172732.11	MUS81	-0.71	7.446050e-03	3.712758e-02	Down-regulated
ENSG00000120685.19	PROSER1	-0.64	7.488459e-03	3.724567e-02	Down-regulated
ENSG00000154723.12	ATP5J	-0.49	7.653295e-03	3.771376e-02	Down-regulated
ENSG00000115128.6	SF3B6	-0.75	7.697851e-03	3.784238e-02	Down-regulated
ENSG00000165417.11	GTF2A1	-0.77	8.057436e-03	3.897432e-02	Down-regulated
ENSG00000143162.7	CREG1	-0.62	8.129682e-03	3.925393e-02	Down-regulated
ENSG00000137500.9	CCDC90B	-0.59	8.133162e-03	3.925469e-02	Down-regulated
ENSG00000160058.18	BSDC1	-0.60	8.473682e-03	4.034089e-02	Down-regulated
ENSG00000164961.15	KIAA0196	-0.58	8.662307e-03	4.085272e-02	Down-regulated
ENSG00000118181.10	RPS25	-0.76	8.791381e-03	4.123745e-02	Down-regulated
ENSG00000183624.13	HMCES	-0.33	8.916671e-03	4.163206e-02	Down-regulated
ENSG00000189266.11	PNRC2	-0.31	9.013615e-03	4.192722e-02	Down-regulated
ENSG00000085231.13	AK6	-0.73	9.292836e-03	4.269682e-02	Down-regulated
ENSG00000123179.13	EBPL	-0.44	9.575427e-03	4.357247e-02	Down-regulated
ENSG00000157538.13	DSCR3	-0.53	9.669187e-03	4.385864e-02	Down-regulated
ENSG00000185158.12	LRRC37B	-0.42	9.863310e-03	4.438077e-02	Down-regulated
ENSG00000096746.17	HNRNPH3	-0.66	9.890323e-03	4.446621e-02	Down-regulated
ENSG00000141644.17	MBD1	-0.37	9.921849e-03	4.454753e-02	Down-regulated
ENSG00000156875.13	MFSD14A	-0.53	1.000821e-02	4.481390e-02	Down-regulated
ENSG00000198815.8	FOXJ3	-0.70	1.003834e-02	4.488180e-02	Down-regulated
ENSG00000143742.12	SRP9	-0.89	1.039190e-02	4.579991e-02	Down-regulated
ENSG00000163584.17	RPL22L1	-0.86	1.042109e-02	4.586845e-02	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000183726.10	TMEM50A	-0.34	1.061291e-02	4.644785e-02	Down-regulated
ENSG00000140396.12	NCOA2	-0.52	1.102368e-02	4.754783e-02	Down-regulated
ENSG00000130699.17	TAF4	-0.43	1.108891e-02	4.768830e-02	Down-regulated
ENSG00000064313.11	TAF2	-0.30	1.117456e-02	4.787033e-02	Down-regulated
ENSG00000197323.11	TRIM33	-0.43	1.118237e-02	4.789347e-02	Down-regulated
ENSG00000143256.4	PFDN2	-0.32	1.149455e-02	4.879970e-02	Down-regulated
ENSG00000168672.3	FAM84B	-0.49	1.204325e-02	5.044016e-02	Down-regulated
ENSG00000115368.9	WDR75	-0.59	1.272068e-02	5.245994e-02	Down-regulated
ENSG00000198169.8	ZNF251	-0.62	1.329359e-02	5.408255e-02	Down-regulated
ENSG00000155090.14	KLF10	-0.86	1.354585e-02	5.476155e-02	Down-regulated
ENSG00000134758.13	RNF138	-0.73	1.359087e-02	5.491010e-02	Down-regulated
ENSG00000139323.13	POC1B	-0.58	1.379760e-02	5.548610e-02	Down-regulated
ENSG00000138190.16	EXOC6	-0.31	1.395335e-02	5.586396e-02	Down-regulated
ENSG00000165272.14	AQP3	-1.44	1.413112e-02	5.639405e-02	Down-regulated
ENSG00000173200.12	PARP15	0.79	1.456453e-02	5.750069e-02	Up-regulated
ENSG00000116209.11	TMEM59	-0.88	1.476356e-02	5.814797e-02	Down-regulated
ENSG00000132356.11	PRKAA1	-0.51	1.484789e-02	5.839917e-02	Down-regulated
ENSG00000263956.6	NBPF11	-0.75	1.505571e-02	5.893683e-02	Down-regulated
ENSG00000136450.12	SRSF1	-0.86	1.512874e-02	5.908185e-02	Down-regulated
ENSG00000213995.11	NAXD	-0.43	1.530821e-02	5.960852e-02	Down-regulated
ENSG00000144749.13	LRIG1	-0.68	1.539993e-02	5.973180e-02	Down-regulated
ENSG00000168291.12	PDHB	-0.37	1.555945e-02	6.023304e-02	Down-regulated
ENSG00000144476.5	ACKR3	-0.91	1.561987e-02	6.041993e-02	Down-regulated
ENSG00000138614.14	VWA9	-0.85	1.567848e-02	6.057595e-02	Down-regulated
ENSG00000152944.8	MED21	-0.59	1.575289e-02	6.069836e-02	Down-regulated
ENSG00000005893.15	LAMP2	-0.44	1.595619e-02	6.119720e-02	Down-regulated
ENSG00000188243.12	COMMD6	-0.88	1.613645e-02	6.160346e-02	Down-regulated
ENSG00000214194.8	LINC00998	-0.70	1.620656e-02	6.174074e-02	Down-regulated
ENSG00000141424.12	SLC39A6	-0.47	1.677259e-02	6.314329e-02	Down-regulated
ENSG00000116668.12	SWT1	-0.43	1.689640e-02	6.348215e-02	Down-regulated
ENSG00000152332.15	UHMK1	-0.31	1.689985e-02	6.348215e-02	Down-regulated
ENSG00000132432.13	SEC61G	-0.98	1.699258e-02	6.371017e-02	Down-regulated
ENSG00000169490.16	TM2D2	-0.46	1.700106e-02	6.371792e-02	Down-regulated
ENSG00000125686.11	MED1	-0.31	1.703447e-02	6.378299e-02	Down-regulated
ENSG00000165476.13	REEP3	-0.27	1.797536e-02	6.631977e-02	Down-regulated
ENSG00000089818.16	NECAP1	-0.71	1.807635e-02	6.662583e-02	Down-regulated
ENSG00000037474.14	NSUN2	-0.67	1.843763e-02	6.745121e-02	Down-regulated
ENSG00000153574.8	RPIA	-0.67	1.845671e-02	6.749477e-02	Down-regulated
ENSG00000063601.16	MTMR1	-0.44	1.892870e-02	6.845861e-02	Down-regulated
ENSG00000163743.13	RCHY1	-0.62	1.939326e-02	6.965089e-02	Down-regulated
ENSG00000115761.15	NOL10	-0.40	1.951307e-02	7.000632e-02	Down-regulated
ENSG00000153989.7	NUS1	-0.52	1.952313e-02	7.001715e-02	Down-regulated
ENSG00000115170.13	ACVR1	-0.71	1.964443e-02	7.035069e-02	Down-regulated
ENSG00000256060.2	TRAPPC2B	-0.52	1.971108e-02	7.049334e-02	Down-regulated
ENSG00000147592.8	LACTB2	-0.47	1.972726e-02	7.053303e-02	Down-regulated
ENSG00000198890.7	PRMT6	-0.53	1.984175e-02	7.073892e-02	Down-regulated
ENSG00000162736.15	NCSTN	-1.04	2.024487e-02	7.168780e-02	Down-regulated
ENSG00000136521.12	NDUFB5	-0.55	2.039845e-02	7.206487e-02	Down-regulated
ENSG00000114933.15	INO80D	-0.36	2.097167e-02	7.325720e-02	Down-regulated
ENSG00000158615.8	PPP1R15B	-0.27	2.099606e-02	7.331424e-02	Down-regulated
ENSG00000213625.8	LEPROT	-0.36	2.135076e-02	7.404767e-02	Down-regulated
ENSG00000198894.7	CIPC	-0.59	2.144818e-02	7.425661e-02	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000081154.11	PCNP	-0.43	2.164869e-02	7.474266e-02	Down-regulated
ENSG00000155508.13	CNOT8	-0.66	2.209000e-02	7.588429e-02	Down-regulated
ENSG00000115839.17	RAB3GAP1	-0.14	2.219438e-02	7.613768e-02	Down-regulated
ENSG00000197063.10	MAFG	-0.66	2.229690e-02	7.641150e-02	Down-regulated
ENSG00000115365.11	LANCL1	-0.48	2.233658e-02	7.642776e-02	Down-regulated
ENSG00000116752.5	BCAS2	-0.39	2.236789e-02	7.645548e-02	Down-regulated
ENSG00000120686.11	UFM1	-0.29	2.238868e-02	7.645548e-02	Down-regulated
ENSG00000137449.15	CPEB2	-0.55	2.262970e-02	7.701997e-02	Down-regulated
ENSG00000053900.10	ANAPC4	-0.32	2.314884e-02	7.814502e-02	Down-regulated
ENSG00000163902.11	RPN1	-0.56	2.354941e-02	7.913463e-02	Down-regulated
ENSG00000165832.5	TRUB1	-0.62	2.360182e-02	7.927056e-02	Down-regulated
ENSG00000164167.9	LSM6	-0.53	2.361238e-02	7.927924e-02	Down-regulated
ENSG00000083937.8	CHMP2B	-0.43	2.389188e-02	7.985635e-02	Down-regulated
ENSG00000085788.13	DDHD2	-0.42	2.399495e-02	8.006369e-02	Down-regulated
ENSG00000128654.13	MTX2	-0.73	2.424486e-02	8.070801e-02	Down-regulated
ENSG00000141428.16	C18orf21	-0.43	2.449717e-02	8.127586e-02	Down-regulated
ENSG00000086598.10	TMED2	-0.49	2.455606e-02	8.141952e-02	Down-regulated
ENSG00000145050.15	MANF	-0.58	2.500583e-02	8.259150e-02	Down-regulated
ENSG00000271601.3	LIX1L	-1.01	2.605701e-02	8.494901e-02	Down-regulated
ENSG00000145741.15	BTF3	-0.49	2.652136e-02	8.606784e-02	Down-regulated
ENSG00000113328.18	CCNG1	-0.59	2.660486e-02	8.624033e-02	Down-regulated
ENSG00000178573.6	MAF	-0.30	2.672453e-02	8.654360e-02	Down-regulated
ENSG00000157625.15	TAB3	-0.28	2.685285e-02	8.683194e-02	Down-regulated
ENSG00000038532.14	CLEC16A	-0.31	2.688680e-02	8.689934e-02	Down-regulated
ENSG00000113583.7	C5orf15	-1.00	2.693165e-02	8.701602e-02	Down-regulated
ENSG00000180228.12	PRKRA	-0.44	2.759270e-02	8.843358e-02	Down-regulated
ENSG00000151729.10	SLC25A4	-0.36	2.930655e-02	9.232475e-02	Down-regulated
ENSG00000166562.8	SEC11C	-0.45	2.968629e-02	9.310316e-02	Down-regulated
ENSG00000242247.10	ARFGAP3	-0.34	2.988642e-02	9.353908e-02	Down-regulated
ENSG00000028839.9	TBPL1	-0.43	3.041695e-02	9.466109e-02	Down-regulated
ENSG00000154719.13	MRPL39	-0.91	3.042015e-02	9.466109e-02	Down-regulated
ENSG00000198912.10	C1orf174	-0.94	3.104010e-02	9.592722e-02	Down-regulated
ENSG00000165678.20	GHITM	-0.36	3.129627e-02	9.649399e-02	Down-regulated
ENSG00000163412.12	EIF4E3	-0.47	3.138765e-02	9.670080e-02	Down-regulated
ENSG00000112941.13	PAPD7	-0.53	3.227713e-02	9.829921e-02	Down-regulated
ENSG00000065154.11	OAT	-0.91	3.253828e-02	9.887749e-02	Down-regulated
ENSG00000197037.10	ZSCAN25	-0.50	3.283295e-02	9.954991e-02	Down-regulated
ENSG00000139372.14	TDG	-0.34	3.291422e-02	9.963104e-02	Down-regulated
ENSG00000163320.10	CGGBP1	-0.28	3.465747e-02	1.031974e-01	Down-regulated
ENSG00000229487.1	ALG13-AS1	-0.81	3.467811e-02	1.032402e-01	Down-regulated
ENSG00000148110.15	MFSD14B	-0.65	3.474923e-02	1.033746e-01	Down-regulated
ENSG00000010219.13	DYRK4	-0.44	3.478483e-02	1.034477e-01	Down-regulated
ENSG00000120802.13	TMPO	-0.37	3.524867e-02	1.043566e-01	Down-regulated
ENSG00000070831.15	CDC42	-0.42	3.533847e-02	1.045022e-01	Down-regulated
ENSG00000148943.11	LIN7C	-0.49	3.700000e-02	1.078760e-01	Down-regulated
ENSG00000134970.13	TMED7	-0.49	3.726683e-02	1.083680e-01	Down-regulated
ENSG00000066583.11	ISOC1	-0.74	3.737639e-02	1.085121e-01	Down-regulated
ENSG00000152518.7	ZFP36L2	-0.53	3.764281e-02	1.091104e-01	Down-regulated
ENSG00000157800.17	SLC37A3	-0.41	3.802288e-02	1.098598e-01	Down-regulated
ENSG00000173113.6	TRMT112	-0.93	3.840702e-02	1.105886e-01	Down-regulated
ENSG00000259274.1	CTD-2501E16.2	0.64	3.898828e-02	1.117080e-01	Up-regulated
ENSG00000276293.4	PIP4K2B	-0.24	3.902879e-02	1.117734e-01	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000077713.18	SLC25A43	-0.52	3.908654e-02	1.118445e-01	Down-regulated
ENSG00000160190.13	SLC37A1	-0.38	3.954677e-02	1.127236e-01	Down-regulated
ENSG00000138050.14	THUMPD2	-0.50	4.092104e-02	1.152703e-01	Down-regulated
ENSG00000139687.13	RB1	-0.58	4.115423e-02	1.157299e-01	Down-regulated
ENSG00000102317.17	RBM3	-0.32	4.177811e-02	1.168512e-01	Down-regulated
ENSG00000182700.4	IGIP	-0.68	4.189560e-02	1.171028e-01	Down-regulated
ENSG00000074695.5	LMAN1	-0.26	4.201125e-02	1.173106e-01	Down-regulated
ENSG00000145414.8	NAF1	-0.26	4.306557e-02	1.192170e-01	Down-regulated
ENSG00000140632.16	GLYR1	-0.27	4.365188e-02	1.202709e-01	Down-regulated
ENSG00000128908.15	INO80	-0.30	4.372866e-02	1.203991e-01	Down-regulated
ENSG00000014123.9	UFL1	-0.19	4.420525e-02	1.212079e-01	Down-regulated
ENSG00000104613.11	INTS10	-0.34	4.484850e-02	1.223141e-01	Down-regulated
ENSG00000136156.12	ITM2B	-0.30	4.538513e-02	1.233858e-01	Down-regulated
ENSG00000138600.9	SPPL2A	-0.24	4.546309e-02	1.234731e-01	Down-regulated
ENSG00000101337.15	TM9SF4	-0.22	4.579233e-02	1.241731e-01	Down-regulated
ENSG00000115875.18	SRSF7	-0.43	4.661250e-02	1.257286e-01	Down-regulated
ENSG00000113966.9	ARL6	-0.38	4.692817e-02	1.262718e-01	Down-regulated
ENSG00000167912.5	RP11-25K19.1	-0.43	4.700391e-02	1.264243e-01	Down-regulated
ENSG00000159388.5	BTG2	-0.48	4.881724e-02	1.296881e-01	Down-regulated
ENSG00000177054.13	ZDHHC13	-0.32	4.888602e-02	1.298188e-01	Down-regulated
ENSG00000065518.7	NDUFB4	-0.59	4.988546e-02	1.318918e-01	Down-regulated
ENSG00000157426.13	AASDH	-0.49	5.018570e-02	1.323489e-01	Down-regulated
ENSG00000165672.6	PRDX3	-0.78	5.073254e-02	1.335013e-01	Down-regulated
ENSG00000062598.17	ELMO2	0.22	5.171604e-02	1.352881e-01	Up-regulated
ENSG00000145545.11	SRD5A1	-0.39	5.358309e-02	1.386996e-01	Down-regulated
ENSG00000155893.12	PXYLP1	-0.47	5.401039e-02	1.394246e-01	Down-regulated
ENSG00000137656.11	BUD13	-0.26	5.428386e-02	1.397945e-01	Down-regulated
ENSG00000139197.10	PEX5	-0.75	5.469889e-02	1.404727e-01	Down-regulated
ENSG00000268043.7	NBPF12	-0.41	5.548310e-02	1.419277e-01	Down-regulated
ENSG00000162923.14	WDR26	-0.36	5.588901e-02	1.426633e-01	Down-regulated
ENSG00000101166.15	PRELID3B	-0.46	5.591440e-02	1.426644e-01	Down-regulated
ENSG00000213281.4	NRAS	-0.83	5.632543e-02	1.434335e-01	Down-regulated
ENSG00000111300.9	NAA25	-0.26	5.683932e-02	1.442239e-01	Down-regulated
ENSG00000144597.13	EAF1	-0.66	5.690357e-02	1.443372e-01	Down-regulated
ENSG00000120889.12	TNFRSF10B	-0.55	5.696542e-02	1.444286e-01	Down-regulated
ENSG00000116977.18	LGALS8	0.22	5.764720e-02	1.456004e-01	Up-regulated
ENSG00000171988.17	JMJD1C	-0.20	6.137172e-02	1.524901e-01	Down-regulated
ENSG00000137414.5	FAM8A1	-0.42	6.231334e-02	1.541873e-01	Down-regulated
ENSG00000104219.12	ZDHHC2	-0.43	6.336236e-02	1.560522e-01	Down-regulated
ENSG00000089057.14	SLC23A2	-0.58	6.372338e-02	1.566503e-01	Down-regulated
ENSG00000213719.8	CLIC1	-0.67	6.570665e-02	1.600423e-01	Down-regulated
ENSG00000155760.2	FZD7	-0.55	6.675510e-02	1.618429e-01	Down-regulated
ENSG00000120742.10	SERP1	-0.25	6.693557e-02	1.621421e-01	Down-regulated
ENSG00000173041.11	ZNF680	-0.55	6.737108e-02	1.625438e-01	Down-regulated
ENSG00000143442.21	POGZ	-0.28	6.862033e-02	1.645994e-01	Down-regulated
ENSG00000077152.9	UBE2T	-0.67	6.892723e-02	1.651606e-01	Down-regulated
ENSG00000168826.15	ZBTB49	-0.48	7.281893e-02	1.718520e-01	Down-regulated
ENSG00000139496.15	NUP58	-0.18	7.445172e-02	1.742580e-01	Down-regulated
ENSG00000188785.11	ZNF548	-0.35	7.525844e-02	1.756764e-01	Down-regulated
ENSG00000146083.11	RNF44	-0.43	7.596879e-02	1.768515e-01	Down-regulated
ENSG00000110934.10	BIN2	-0.42	7.815174e-02	1.804130e-01	Down-regulated
ENSG00000156508.17	EEF1A1	-0.45	7.924892e-02	1.821004e-01	Down-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000177889.9	UBE2N	-0.38	7.972542e-02	1.828152e-01	Down-regulated
ENSG00000171044.10	XKR6	-0.45	8.043544e-02	1.839766e-01	Down-regulated
ENSG00000138092.10	CENPO	-0.32	8.414706e-02	1.897817e-01	Down-regulated
ENSG00000253276.2	CCDC71L	-0.46	8.460250e-02	1.905155e-01	Down-regulated
ENSG00000088387.18	DOCK9	-0.43	8.693429e-02	1.941962e-01	Down-regulated
ENSG00000144848.10	ATG3	-0.21	9.061211e-02	1.995433e-01	Down-regulated
ENSG00000096060.14	FKBP5	-0.21	9.186112e-02	2.012909e-01	Down-regulated
ENSG00000175895.3	PLEKHF2	-0.44	9.472060e-02	2.057210e-01	Down-regulated
ENSG00000186468.12	RPS23	-0.53	9.616687e-02	2.081348e-01	Down-regulated
ENSG00000074660.15	SCARF1	-0.65	9.633320e-02	2.083375e-01	Down-regulated
ENSG00000113273.15	ARSB	-0.49	9.715142e-02	2.095361e-01	Down-regulated
ENSG00000204176.13	SYT15	0.36	9.854061e-02	2.114090e-01	Up-regulated
ENSG00000170540.14	ARL6IP1	-0.53	9.909561e-02	2.123020e-01	Down-regulated
ENSG00000120278.15	PLEKHG1	-0.47	1.011601e-01	2.155641e-01	Down-regulated
ENSG00000112695.11	COX7A2	-0.29	1.026768e-01	2.176915e-01	Down-regulated
ENSG00000168175.14	MAPK1IP1L	-0.22	1.081799e-01	2.258798e-01	Down-regulated
ENSG00000118495.18	PLAGL1	-0.27	1.113589e-01	2.303378e-01	Down-regulated
ENSG00000176624.10	MEX3C	-0.45	1.115578e-01	2.305814e-01	Down-regulated
ENSG00000165661.16	QSOX2	-0.38	1.126673e-01	2.321268e-01	Down-regulated
ENSG00000123728.9	RAP2C	-0.32	1.205728e-01	2.430884e-01	Down-regulated
ENSG00000119523.9	ALG2	-0.26	1.240882e-01	2.477876e-01	Down-regulated
ENSG00000143493.12	INTS7	-0.26	1.363161e-01	2.643625e-01	Down-regulated
ENSG00000106829.18	TLE4	-0.17	1.410582e-01	2.707893e-01	Down-regulated
ENSG00000078237.6	TIGAR	-0.36	1.419947e-01	2.720620e-01	Down-regulated
ENSG00000135127.11	BICDL1	0.26	1.421758e-01	2.723040e-01	Up-regulated
ENSG00000173917.10	HOXB2	-0.63	1.424323e-01	2.726378e-01	Down-regulated
ENSG00000149532.15	CPSF7	-0.37	1.470286e-01	2.789279e-01	Down-regulated
ENSG00000153066.12	TXNDC11	-0.31	1.476791e-01	2.798130e-01	Down-regulated
ENSG00000172531.14	PPP1CA	-0.79	1.477119e-01	2.798353e-01	Down-regulated
ENSG00000185115.5	NSMCE3	-0.38	1.507397e-01	2.837711e-01	Down-regulated
ENSG00000272760.1	RP11-5C23.1	-0.47	1.514124e-01	2.844346e-01	Down-regulated
ENSG00000146757.13	ZNF92	-0.36	1.542533e-01	2.878141e-01	Down-regulated
ENSG00000171155.7	C1GALT1C1	-0.18	1.545343e-01	2.882302e-01	Down-regulated
ENSG00000168405.14	CMAHP	-0.33	1.558809e-01	2.898393e-01	Down-regulated
ENSG00000064102.14	ASUN	-0.23	1.567792e-01	2.909441e-01	Down-regulated
ENSG00000105829.11	BET1	-0.18	1.572496e-01	2.915722e-01	Down-regulated
ENSG00000052802.12	MSMO1	-0.40	1.591267e-01	2.939553e-01	Down-regulated
ENSG00000134198.9	TSPAN2	-0.26	1.606671e-01	2.959226e-01	Down-regulated
ENSG00000177917.10	ARL6IP6	-0.30	1.638263e-01	3.003783e-01	Down-regulated
ENSG00000174500.12	GCSAM	0.23	1.638964e-01	3.004240e-01	Up-regulated
ENSG00000166881.9	NEMP1	-0.36	1.670060e-01	3.042731e-01	Down-regulated
ENSG00000014641.17	MDH1	-0.30	1.709829e-01	3.093087e-01	Down-regulated
ENSG00000182952.4	HMGN4	-0.26	1.764128e-01	3.162266e-01	Down-regulated
ENSG00000106615.9	RHEB	-0.30	1.823916e-01	3.235613e-01	Down-regulated
ENSG00000133794.17	ARNTL	0.25	1.887198e-01	3.315054e-01	Up-regulated
ENSG00000126790.11	L3HYPDH	-0.49	1.890193e-01	3.318558e-01	Down-regulated
ENSG00000197976.11	AKAP17A	-0.21	1.891827e-01	3.320278e-01	Down-regulated
ENSG00000139620.12	KANSL2	-0.36	1.891841e-01	3.320278e-01	Down-regulated
ENSG00000100784.10	RPS6KA5	-0.20	1.917636e-01	3.349884e-01	Down-regulated
ENSG00000156482.10	RPL30	-0.46	1.920227e-01	3.352643e-01	Down-regulated
ENSG00000074842.7	MYDGF	-0.46	1.924835e-01	3.357447e-01	Down-regulated
ENSG00000124508.16	BTN2A2	0.34	1.943325e-01	3.381691e-01	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000198001.13	IRAK4	-0.17	2.007205e-01	3.456964e-01	Down-regulated
ENSG00000091317.7	CMTM6	-0.57	2.050531e-01	3.505980e-01	Down-regulated
ENSG00000014164.6	ZC3H3	0.32	2.211504e-01	3.700102e-01	Up-regulated
ENSG00000063169.10	GLTSCR1	-0.30	2.235819e-01	3.726052e-01	Down-regulated
ENSG00000164111.14	ANXA5	-0.26	2.289995e-01	3.790535e-01	Down-regulated
ENSG00000111711.9	GOLT1B	-0.27	2.297793e-01	3.798146e-01	Down-regulated
ENSG00000151498.11	ACAD8	-0.31	2.486611e-01	4.008972e-01	Down-regulated
ENSG00000234428.2	RP11-666F17.1	0.28	2.574560e-01	4.109791e-01	Up-regulated
ENSG00000112242.14	E2F3	-0.15	2.856132e-01	4.412994e-01	Down-regulated
ENSG00000146143.17	PRIM2	-0.20	2.858160e-01	4.414987e-01	Down-regulated
ENSG00000173706.12	HEG1	-0.19	2.871997e-01	4.428563e-01	Down-regulated
ENSG00000158711.13	ELK4	-0.13	2.887204e-01	4.445463e-01	Down-regulated
ENSG00000136111.12	TBC1D4	-0.19	2.926063e-01	4.488269e-01	Down-regulated
ENSG00000198805.11	PNP	-0.32	3.034590e-01	4.603615e-01	Down-regulated
ENSG00000128534.7	LSM8	-0.14	3.039795e-01	4.609401e-01	Down-regulated
ENSG00000072042.12	RDH11	0.16	3.163609e-01	4.733644e-01	Up-regulated
ENSG00000111729.12	CLEC4A	-0.28	3.172593e-01	4.744639e-01	Down-regulated
ENSG00000170571.11	EMB	0.21	3.264469e-01	4.843971e-01	Up-regulated
ENSG00000033178.12	UBA6	0.09	3.330252e-01	4.903900e-01	Up-regulated
ENSG00000103353.15	UBFD1	-0.15	3.369125e-01	4.943229e-01	Down-regulated
ENSG00000143590.13	EFNA3	-0.18	3.385251e-01	4.961143e-01	Down-regulated
ENSG00000068438.14	FTSJ1	0.15	3.391943e-01	4.966925e-01	Up-regulated
ENSG00000075884.12	ARHGAP15	0.18	3.425183e-01	4.997937e-01	Up-regulated
ENSG00000101574.14	METTL4	-0.14	3.454096e-01	5.024277e-01	Down-regulated
ENSG00000225205.5	AC093818.1	0.14	3.643865e-01	5.218555e-01	Up-regulated
ENSG00000173114.12	LRRN3	-0.23	3.659205e-01	5.234579e-01	Down-regulated
ENSG00000183735.9	TBK1	-0.11	3.699842e-01	5.277128e-01	Down-regulated
ENSG00000164307.12	ERAP1	0.12	3.762996e-01	5.332811e-01	Up-regulated
ENSG00000213186.7	TRIM59	-0.17	3.777329e-01	5.346266e-01	Down-regulated
ENSG00000178075.19	GRAMD1C	-0.21	3.867214e-01	5.435856e-01	Down-regulated
ENSG00000173083.14	HPSE	-0.16	3.883892e-01	5.451317e-01	Down-regulated
ENSG00000102531.16	FNDC3A	0.07	3.972929e-01	5.536436e-01	Up-regulated
ENSG00000079819.17	EPB41L2	-0.15	4.094450e-01	5.655402e-01	Down-regulated
ENSG00000104205.12	SGK3	-0.08	4.459549e-01	5.996906e-01	Down-regulated
ENSG00000184056.14	VPS33B	-0.09	4.684738e-01	6.200670e-01	Down-regulated
ENSG00000167965.17	MLST8	0.17	4.777728e-01	6.286234e-01	Up-regulated
ENSG00000138767.12	CNOT6L	0.07	4.805781e-01	6.314374e-01	Up-regulated
ENSG00000163577.7	EIF5A2	0.14	4.824155e-01	6.325474e-01	Up-regulated
ENSG00000196305.17	IARS	-0.12	4.854557e-01	6.350772e-01	Down-regulated
ENSG00000188343.12	FAM92A1	-0.15	4.903481e-01	6.397053e-01	Down-regulated
ENSG00000188452.13	CERKL	0.16	5.003996e-01	6.488232e-01	Up-regulated
ENSG00000105849.5	TWISTNB	0.08	5.007978e-01	6.492549e-01	Up-regulated
ENSG00000166479.9	TMX3	0.06	5.056860e-01	6.530837e-01	Up-regulated
ENSG00000139597.17	N4BP2L1	-0.13	5.181271e-01	6.633335e-01	Down-regulated
ENSG00000122432.16	SPATA1	0.11	5.195110e-01	6.644636e-01	Up-regulated
ENSG00000123505.15	AMD1	-0.09	5.251762e-01	6.696855e-01	Down-regulated
ENSG00000164398.12	ACSL6	-0.19	5.303566e-01	6.743028e-01	Down-regulated
ENSG00000100982.11	PCIF1	-0.11	5.371102e-01	6.807138e-01	Down-regulated
ENSG00000173757.9	STAT5B	-0.10	5.538785e-01	6.939977e-01	Down-regulated
ENSG00000132680.10	KIAA0907	0.10	5.618474e-01	7.011516e-01	Up-regulated
ENSG00000129566.12	TEP1	0.09	5.677453e-01	7.056902e-01	Up-regulated
ENSG00000151657.11	KIN	0.05	5.776369e-01	7.138365e-01	Up-regulated

Gene_ID	Symbol	Log2FoldChange	pvalue	padj	Direction
ENSG00000087157.18	PGS1	-0.09	5.968803e-01	7.290523e-01	Down-regulated
ENSG00000144802.11	NFKBIZ	-0.11	6.098607e-01	7.395970e-01	Down-regulated
ENSG00000156136.9	DCK	-0.08	6.171917e-01	7.452297e-01	Down-regulated
ENSG00000157020.17	SEC13	-0.08	6.216096e-01	7.486050e-01	Down-regulated
ENSG00000128604.18	IRF5	0.14	6.221206e-01	7.489396e-01	Up-regulated
ENSG00000107968.9	MAP3K8	0.07	6.279344e-01	7.539488e-01	Up-regulated
ENSG00000135205.14	CCDC146	-0.07	6.365993e-01	7.608436e-01	Down-regulated
ENSG00000164463.12	CREBRF	0.05	6.455209e-01	7.681371e-01	Up-regulated
ENSG00000064652.10	SNX24	-0.05	6.555352e-01	7.762283e-01	Down-regulated
ENSG00000164938.13	TP53INP1	-0.09	6.635836e-01	7.823293e-01	Down-regulated
ENSG00000091127.13	PUS7	-0.08	6.744305e-01	7.905583e-01	Down-regulated
ENSG00000271383.6	NBPF19	-0.07	6.783160e-01	7.932786e-01	Down-regulated
ENSG00000270562.1	RP11-154H23.3	-0.08	6.955398e-01	8.051113e-01	Down-regulated
ENSG00000205659.10	LIN52	-0.05	6.971424e-01	8.059264e-01	Down-regulated
ENSG00000174125.7	TLR1	0.08	7.049728e-01	8.120170e-01	Up-regulated
ENSG00000144655.14	CSRNP1	-0.08	7.096555e-01	8.154744e-01	Down-regulated
ENSG00000101003.9	GINS1	-0.06	7.184975e-01	8.215059e-01	Down-regulated
ENSG00000132952.11	USPL1	-0.04	7.536214e-01	8.470575e-01	Down-regulated
ENSG00000137478.14	FCHSD2	0.04	7.610542e-01	8.525213e-01	Up-regulated
ENSG00000163606.10	CD200R1	0.08	7.687729e-01	8.575936e-01	Up-regulated
ENSG00000198951.11	NAGA	0.03	7.692304e-01	8.578659e-01	Up-regulated
ENSG00000171621.13	SPSB1	0.04	7.810681e-01	8.649543e-01	Up-regulated
ENSG00000104320.13	NBN	-0.03	7.904946e-01	8.711734e-01	Down-regulated
ENSG00000148400.9	NOTCH1	-0.05	8.014287e-01	8.779696e-01	Down-regulated
ENSG00000137955.15	RABGGTB	-0.03	8.022163e-01	8.785905e-01	Down-regulated
ENSG00000155307.17	SAMSN1	-0.06	8.232200e-01	8.920646e-01	Down-regulated
ENSG00000104904.12	OAZ1	-0.02	8.635827e-01	9.177037e-01	Down-regulated
ENSG00000198604.10	BAZ1A	0.02	8.800841e-01	9.279444e-01	Up-regulated
ENSG00000116001.15	TIA1	-0.02	8.860140e-01	9.317834e-01	Down-regulated
ENSG00000196810.4	CTBP1-AS2	0.02	9.068594e-01	9.452812e-01	Up-regulated
ENSG00000162695.11	SLC30A7	0.01	9.416191e-01	9.668959e-01	Up-regulated
ENSG00000226067.6	LINC00623	-0.01	9.709913e-01	9.840240e-01	Down-regulated

```
## FDR 0.05 list
n.genesbeta.05 <- nrow(genesbeta.de[genesbeta.de$padj <= 0.05, ])
paste("Number of Core genesbeta with FDR less than or equal to 0.05", n.genesbeta.05)
```

```
## [1] "Number of Core genesbeta with FDR less than or equal to 0.05 137"
```

```
## volcano plot
rownames(genesbeta.de) <- genesbeta.de$Symbol.x

EnhancedVolcano(genesbeta.de,
        lab = rownames(genesbeta.de),
        x = "Log2FoldChange",
        y = "padj",
        pCutoff = 5e-2,
        FCcutoff = 1,
        pLabellingCutoff = 5e-2,
        ## select labels to show
        # selectLab = c("cg18587484","cg00803922", " cg19425295"),
        ## point and label size
```

```
transcriptPointSize = 2.0,
transcriptLabSize = 3.5,
xlab = bquote(~Log[2]~ "Fold Change"),
ylab = bquote(~-Log[10]~adjusted~italic(P)),
title = "Core genesbeta: HIV Infected vs Health Control",
#Modify border and remove gridlines
gridlines.major = FALSE,
gridlines.minor = FALSE,
border = "full",
borderWidth = 1.0,
borderColour = "black",
# the transparence of the dots
colAlpha = 0.8,
xlim = c(-3, 3),
ylim = c(0, -log10(10e-25)),
# adjust the legend
legend=c("NS","log2 Fold Change >= 1","adjusted p-value <= 0.05",
    "adjusted p-value <= 0.05 & log2 Fold Change >= 1"),
legendPosition = "bottom",
legendLabSize = 9,
legendIconSize = 3,
# connectors
DrawConnectors = TRUE,
#
widthConnectors = 0.3,
#
colConnectors = "grey40",
col = c("grey30", "forestgreen", "royalblue", "tomato")
)
```

Core genesbeta: HIV Infected vs Health Control
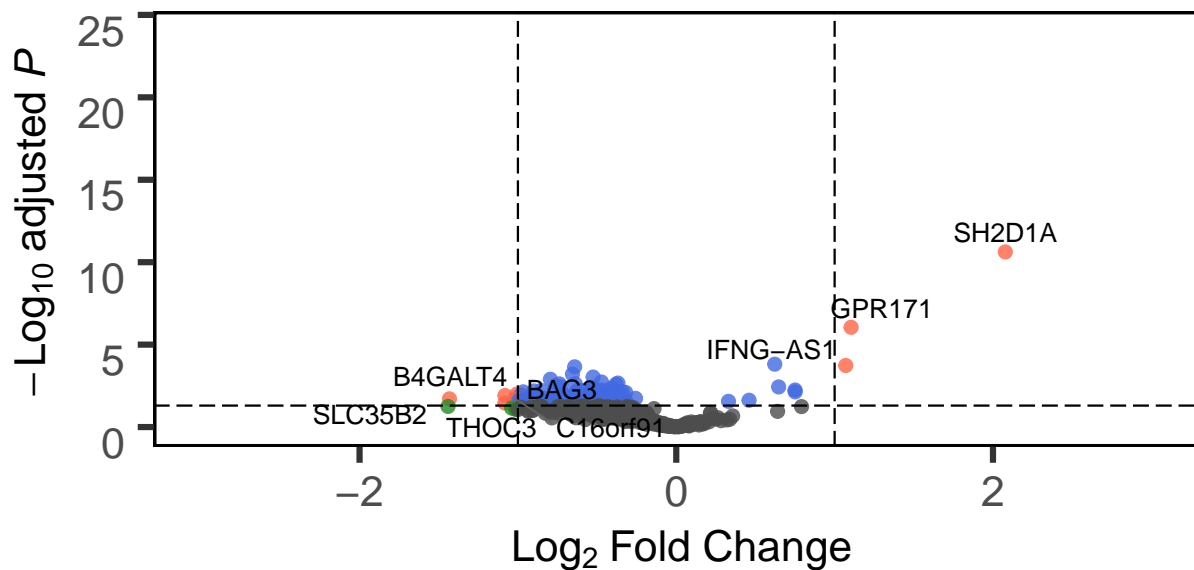
2.2.1 How many of them are significantly altered in the clinical gut biopsies? (Uninfected vs HIV infected).

For the Core ISGs list, there are 230genes, where 230 of them are in the differential expression list found by DESeq2 with FDR <= 0.1 and 124 of them are FDR <= 0.05.

For the IFN-Beta specific genes list, there are 423 genes, where 423 of them are FDR <=0.1, and 137 of them are FDR <= 0.05.

2.2.2 Association between genes and clinical outcomes

```
## check the counts of gene list
cnts.geneid <- rownames_to_column(data.frame(cnts.deseq2), var = "Gene_ID")
dim(cnts.geneid)
```

```
## [1] 19890    33
```

```
cnts.isgs <- base::merge(cnts.geneid, isgs, by = "Gene_ID") %>%
    select(-c("Gene_ID")) %>% column_to_rownames(var = "Symbol")
dim(cnts.isgs)
```

```
## [1] 230  32
```

```
cnts.isgs <- as.matrix(cnts.isgs)
## QC plots
EDASeq::plotRLE(cnts.isgs, outline = FALSE, col = c(rep("steelblue",
    13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (Core ISGs DESeq2 Normalization)",
    xlab = "Sample", ylab = "Relative Log Ratio")
```

Control vs. HIV RLE Plot (Core ISGs DESeq2 Normalization)


```
EDASeq::plotPCA(cnts.isgs, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (Core ISGs DESeq2 Normalization)")
```

Control vs. HIV PCA Plot (Core ISGs DESeq2 Normalization)


```r
EDASeq::plotPCA(cnts.isgs, col = c(rep("steelblue", 13), rep("tomato",
    19)), main = "Control vs. HIV PCA Plot (Core ISGs DESeq2 Normalization)",
    k = 3)
```
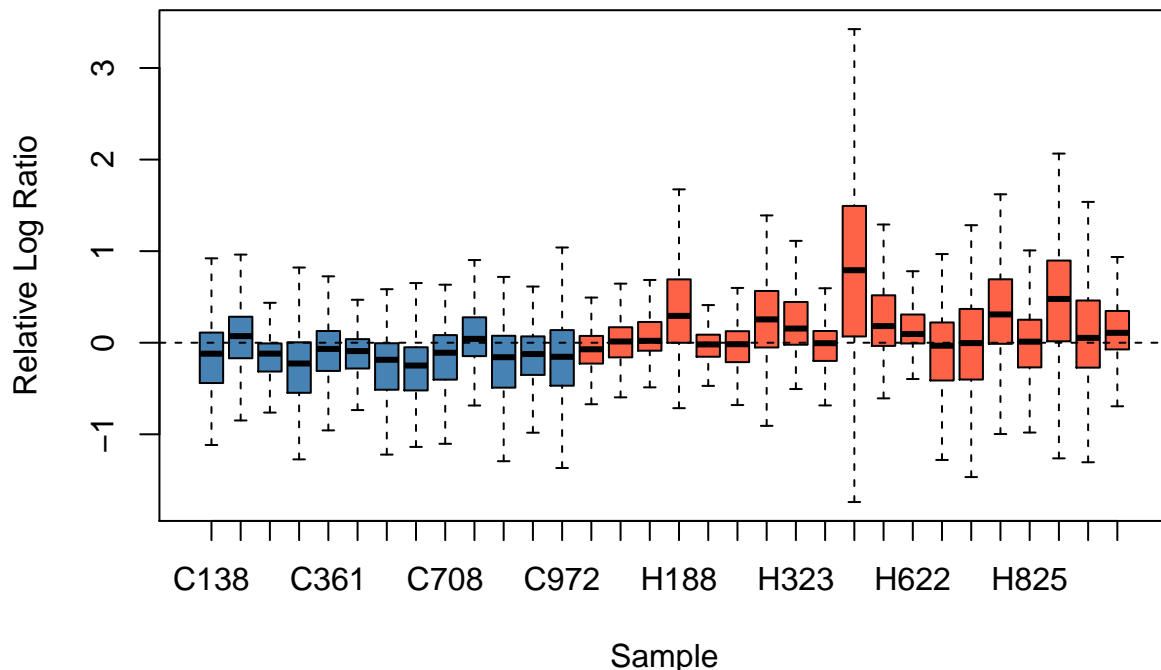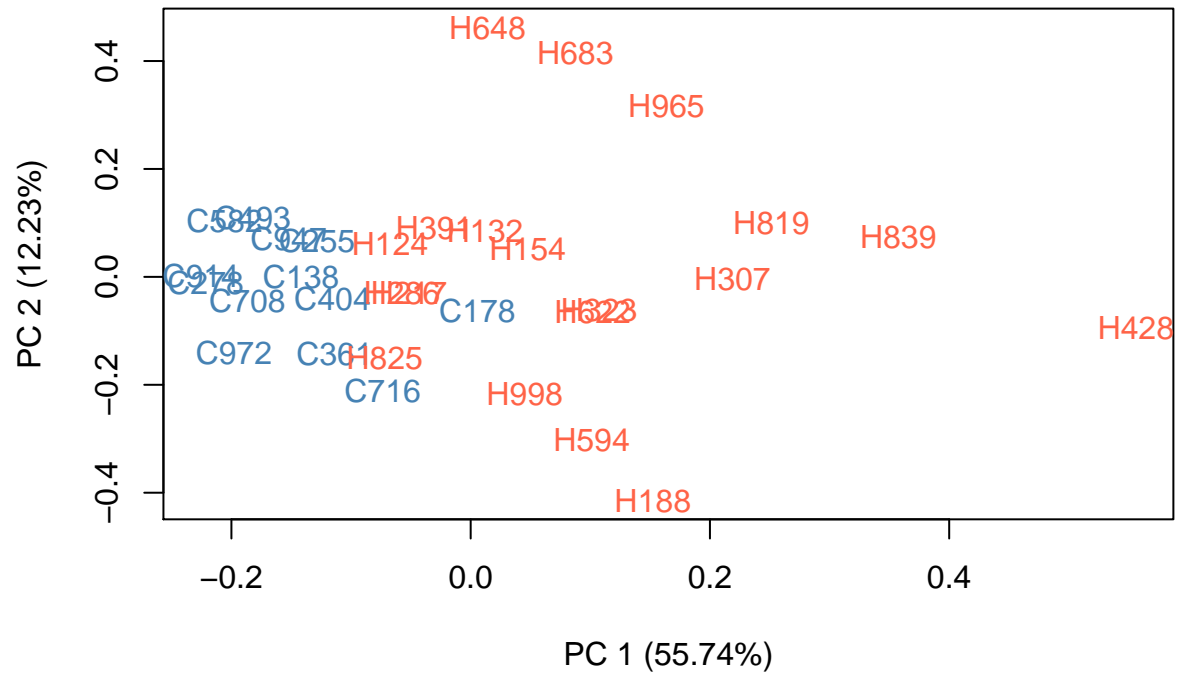
Control vs. HIV PCA Plot (Core ISGs DESeq2 Normalization)

```
boxplot(log2(cnts.isgs), main = "Control vs. HIV Boxplot (Core ISGs DESeq2 Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

Control vs. HIV Boxplot (Core ISGs DESeq2 Normalization)
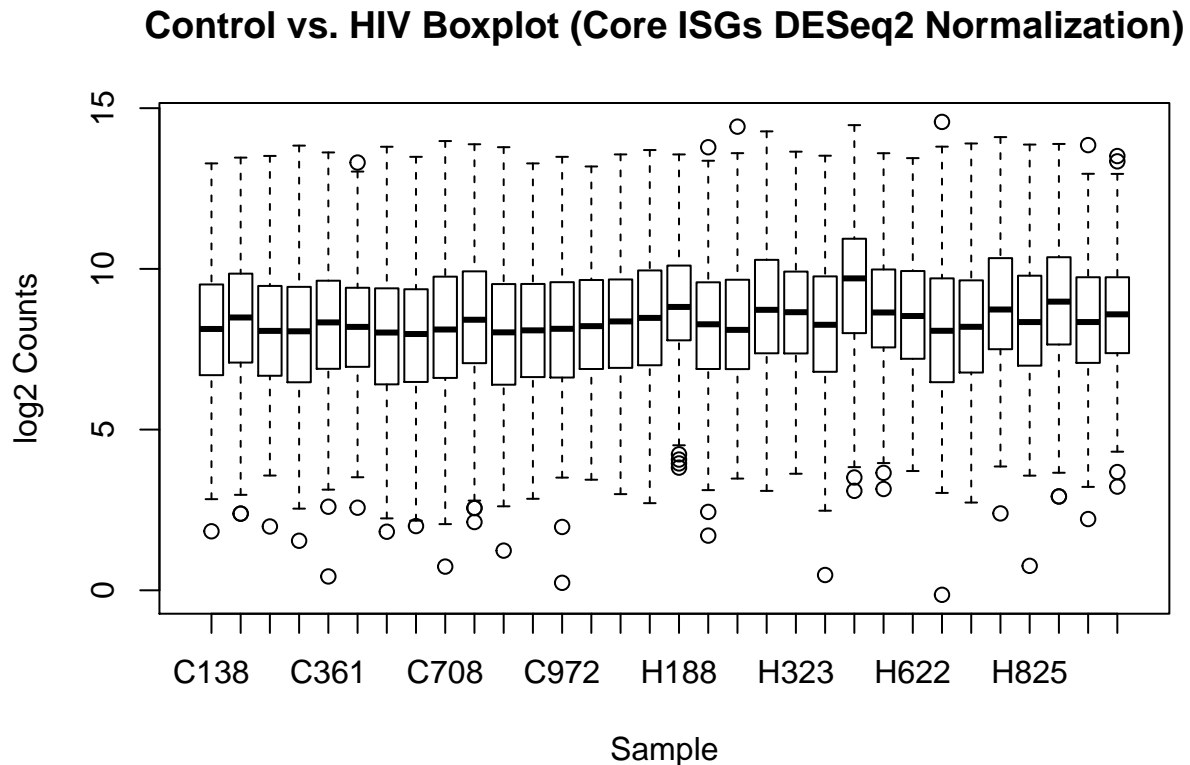

```
## beta specific genesbeta
cnts.genesbeta <- base::merge(cnts.geneid, genesbeta, by = "Gene_ID") %>%
    select(-c("Gene_ID")) %>% column_to_rownames(var = "Symbol")
dim(cnts.genesbeta)
```

```
## [1] 423  32
```

```
cnts.genesbeta <- as.matrix(cnts.genesbeta)
## QC plots
EDASeq::plotRLE(cnts.genesbeta, outline = FALSE, col = c(rep("steelblue",
    13), rep("tomato", 19)), main = "Control vs. HIV RLE Plot (IFN-beta Genes DESeq2 Normalization)",
    xlab = "Sample", ylab = "Relative Log Ratio")
```

Control vs. HIV RLE Plot (IFN–beta Genes DESeq2 Normalization)


```
EDASeq::plotPCA(cnts.genesbeta, col = c(rep("steelblue", 13),
    rep("tomato", 19)), main = "Control vs. HIV PCA Plot (IFN-beta Genes DESeq2 Normalization)")
```

Control vs. HIV PCA Plot (IFN–beta Genes DESeq2 Normalization)


```
EDASeq::plotPCA(cnts.genesbeta, col = c(rep("steelblue", 13),
    rep("tomato", 19)), main = "Control vs. HIV PCA Plot (IFN-beta Genes DESeq2 Normalization)",
```

```
    k = 3)
```

Control vs. HIV PCA Plot (IFN−beta Genes DESeq2 Normalization)


```
boxplot(log2(cnts.genesbeta), main = "Control vs. HIV Boxplot (IFN-beta Genes DESeq2 Normalization)",
    xlab = "Sample", ylab = "log2 Counts")
```

Control vs. HIV Boxplot (IFN−beta Genes DESeq2 Normalization)
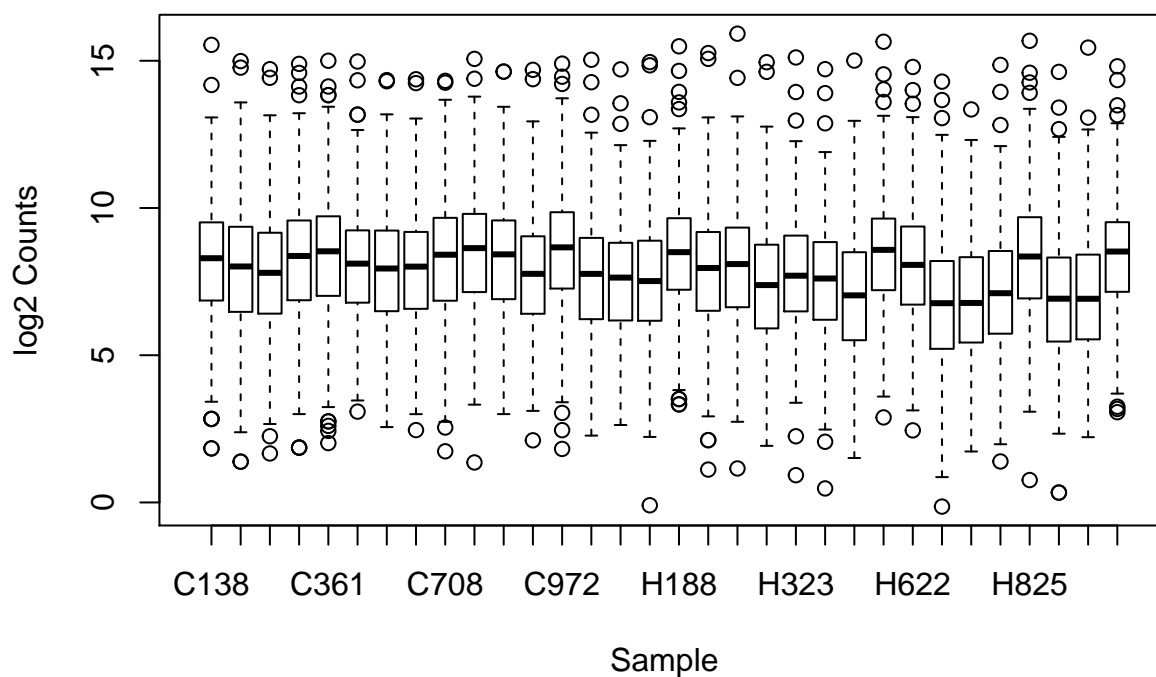
```
# ## Voom transformation ## The voom method estimates the
# mean-variance relationship of the log-counts, ## generates
# a precision weight for each observation and enters these
# into the limma empirical Bayes analysis pipeline.  ## two
# group design design <- model.matrix(~0 + pheno$txt) v <-
# voom(cnts.isgs, design, plot=TRUE) v voom is more suitable
# for edgeR


########################## VST Transformation ##################### DESeq2 has VST,
########################## yielding a matrix of values which are now approximately
########################## homoskedastic (having constant variance along the range of
########################## mean values).  are useful when checking for outliers or as
########################## input for machine learning techniques such as clustering or
######################### linear discriminant analysis.

## check size factors
dds$sizeFactor
```

```
##       C138      C178      C255      C278      C361      C404      C493
## 0.2801477 0.3829072 1.2625914 1.3744154 1.4832384 2.3577403 0.8480453
##       C582      C708      C716      C914      C947      C972      H124
## 2.0025479 1.1997877 3.9008838 2.1250832 0.6948343 2.5525922 0.8290624
##       H132      H154      H188      H217      H286      H307      H323
## 1.1309331 1.0691897 1.4909671 0.9222770 0.4492812 1.0551965 1.0524649
##       H391      H428      H594      H622      H648      H683      H819
## 0.7188160 0.3511746 4.0518366 0.9162538 1.1020128 0.3013386 0.7619062
##       H825      H839      H965      H998
## 0.5903655 0.7926637 0.2150957 6.0910728
```

```
paste("The size factors vary a lot.")
```

```
## [1] "The size factors vary a lot."
```

```
# ## vst transformation dds <-
# varianceStabilizingTransformation(dds, blind = FALSE,
# fitType = 'parametric') getVarianceStabilizedData(object)
# If many of genes have large differences in counts due to
# the experimental design, it is important to set blind=FALSE
# for downstream analysis.  The more the size factors differ,
# the more residual dependence of the variance on the mean
# will be found in the transformed data. rlog is a
# transformation which can perform better in these cases.
rld <- rlog(dds, blind = FALSE, fitType = "parametric")
var.cnts.rld <- assay(rld)
## get linear model ready cnts for core isgs and beta specific
var.rld <- rownames_to_column(data.frame(var.cnts.rld))
colnames(var.rld)[1] <- c("Gene_ID")

## gene level dataset
var.isgs <- base::merge(var.rld, isgs.de, by = "Gene_ID") %>%
    dplyr::mutate(Symbol = Symbol.x) %>% select(-c(Symbol.x,
    Symbol.y))
dim(var.isgs)
```

```
## [1] 230  38
```

```
var.genesbeta <- base::merge(var.rld, genesbeta.de, by = "Gene_ID") %>%
    dplyr::mutate(Symbol = Symbol.x) %>% select(-c(Symbol.x,
    Symbol.y))
dim(var.genesbeta)
```

```
## [1] 423  38
```

```
## clustering core isgs
dist.isgs <- dist(t(var.isgs[, 2:33]))
plot(hclust(dist.isgs, method = "complete"), main = "Cluster Dendrogram by Core ISGs")
```

Cluster Dendrogram by Core ISGs

dist.isgs
hclust (*, "complete")
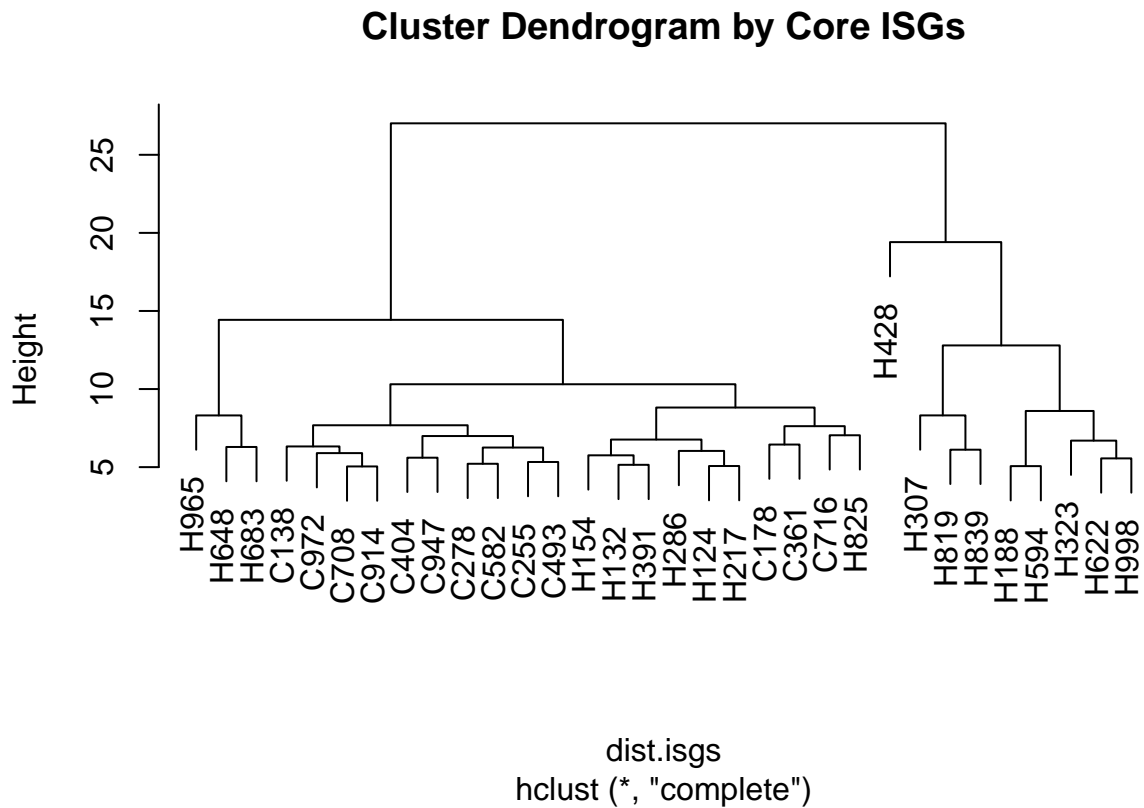
```
## beta specific
dist.genesbeta <- dist(t(var.genesbeta[, 2:33]))
plot(hclust(dist.genesbeta, method = "complete"), main = "Cluster Dendrogram by IFN-beta Genes")
```

Cluster Dendrogram by IFN–beta Genes
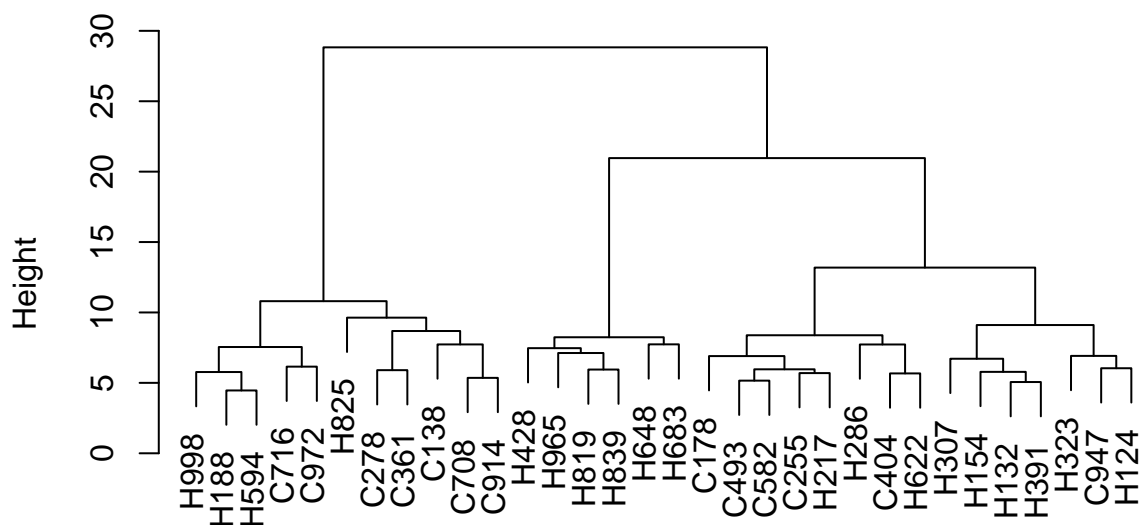
dist.genesbeta
hclust (*, "complete")

```
## kmeans cluster

## kmeans and try k
maxk <- 7
k_c <- 1:maxk
k_sws <- NULL

k_wsm <- NULL
for (i in k_c) {
    km <- kmeans(t(var.isgs[, 2:33]), i, iter.max = 10)
    k_sws[i] <- sum(km$withinss)
    if (i == 1) {
        k_wsm <- c(km$withinss)
    } else {
        k_wsm <- c(k_wsm, km$withinss)
    }
}
plot(k_c, k_sws, type = "o", xlab = "Number of Clusters by Core ISGs",
    ylab = "Sum of Within cluster sum of squares")
```

Number of Clusters by Core ISGs
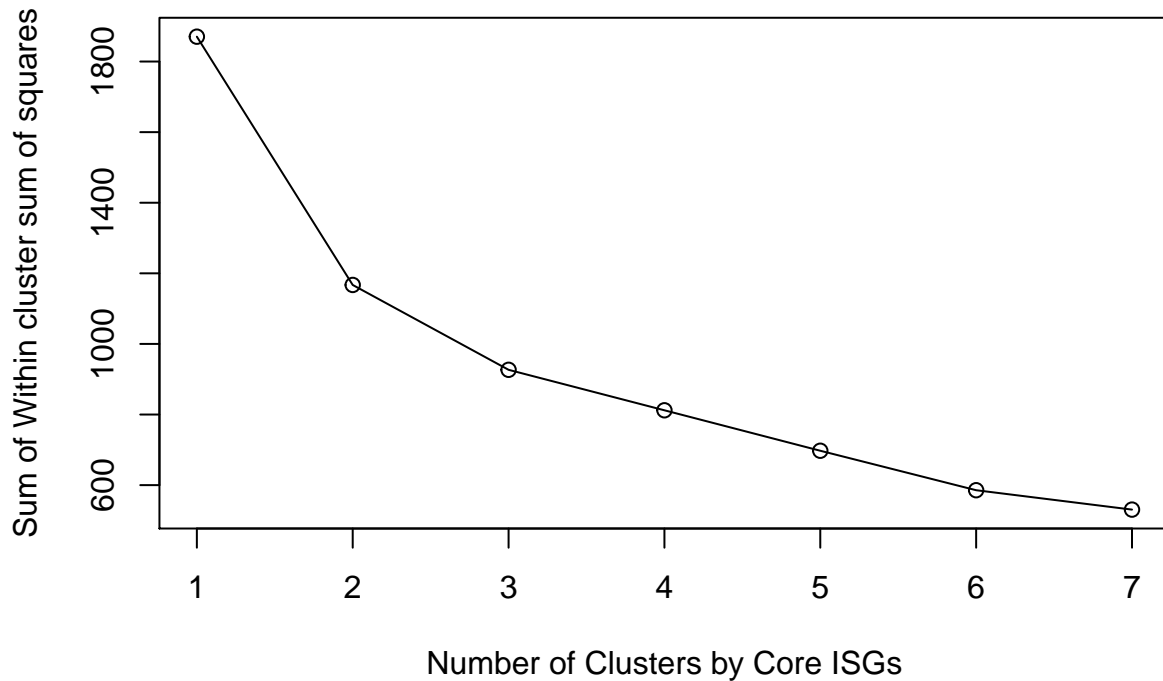
```
## kmeans for isgs
kisgs6 <- kmeans(t(var.isgs[, 2:33]), 6, iter.max = 10)
kisgs6$cluster
```

```
## C138 C178 C255 C278 C361 C404 C493 C582 C708 C716 C914 C947 C972 H124 H132
##    5    3    5    5    3    5    5    5    5    3    5    5    5    2    2
## H154 H188 H217 H286 H307 H323 H391 H428 H594 H622 H648 H683 H819 H825 H839
##    2    4    2    2    1    4    2    1    4    4    6    6    1    3    1
## H965 H998
##    6    4
```

```
## beta
for (i in k_c) {
    km <- kmeans(t(var.genesbeta[, 2:33]), i, iter.max = 10)
    k_sws[i] <- sum(km$withinss)
    if (i == 1) {
        k_wsm <- c(km$withinss)
    } else {
        k_wsm <- c(k_wsm, km$withinss)
    }
}
plot(k_c, k_sws, type = "o", xlab = "Number of Clusters by IFN-Beta Genes",
    ylab = "Sum of Within cluster sum of squares")
```

Number of Clusters by IFN–Beta Genes
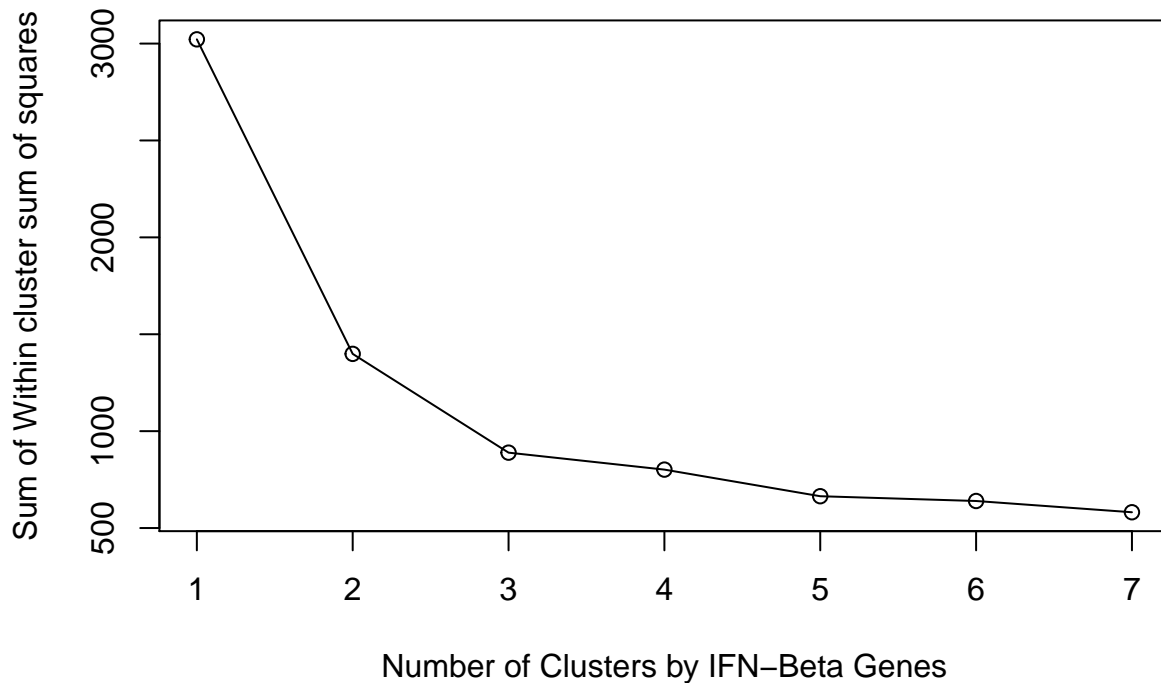
```
## kmeans for beta
kgbeta3 <- kmeans(t(var.genesbeta[, 2:33]), 3, iter.max = 10)
kgbeta3$cluster
```

```
## C138 C178 C255 C278 C361 C404 C493 C582 C708 C716 C914 C947 C972 H124 H132
##    3    1    1    3    3    1    1    1    3    3    3    1    3    1    1
## H154 H188 H217 H286 H307 H323 H391 H428 H594 H622 H648 H683 H819 H825 H839
##    1    3    1    1    1    1    1    2    3    3    2    2    2    3    2
## H965 H998
##    2    3
```

```
################## linear regression ################ import age, gender and
################## clinical outcomes by pid basic clinical data
basic_cli_CH <- read.delim("Basic_clinical_control_infected_untreated")
colnames(basic_cli_CH) <- c("pid", "sex", "age", "CD4_Counts",
    "Plasma_Viral_Load")

#### sample level dataset isgs
isgs.rld.raw <- as.matrix(t(var.isgs[, 2:33]))
colnames(isgs.rld.raw) <- var.isgs$Symbol
## row id to column pid
isgs.rld.raw <- data.frame(isgs.rld.raw)
isgs.rld.raw$pid <- rownames(isgs.rld.raw)
rownames(isgs.rld.raw) <- NULL
## combine gene counts and clinical data
isgs.rld.lin <- base::merge(isgs.rld.raw, basic_cli_CH, by = "pid")
dim(isgs.rld.lin)
```

```
## [1]  32 235
```

```
##### sample level dataset genesbeta
genesbeta.rld.raw <- as.matrix(t(var.genesbeta[, 2:33]))
colnames(genesbeta.rld.raw) <- var.genesbeta$Symbol
```

```
## row id to column pid
genesbeta.rld.raw <- data.frame(genesbeta.rld.raw)
genesbeta.rld.raw$pid <- rownames(genesbeta.rld.raw)
rownames(genesbeta.rld.raw) <- NULL
## combine gene counts and clinical data
genesbeta.rld.lin <- base::merge(genesbeta.rld.raw, basic_cli_CH,
    by = "pid")
dim(genesbeta.rld.lin)
```

```
## [1]  32 428
```

```
## check same pid
sum(isgs.rld.lin$pid == genesbeta.rld.lin$pid)
```

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

```
# the same order of pid

########################## linear regression ############################ equal
########################### length of outcomes and covariates
gene_FunReg <- function(gene_matrix, clinical_variable, genelistname,
    clin_var_name) {
    ## number of gene to test, also the number of multiple test
    n_gene = ncol(gene_matrix)
    ## outcome lm
    outcome_lm = lapply(1:n_gene, function(i) {
        lm = lm(gene_matrix[, i] ~ clinical_variable + isgs.rld.lin$age +
            isgs.rld.lin$sex)
        coef = summary(lm)$coefficients[2, ]
        return(coef)
    })
    outcome_lm = data.frame(matrix(unlist(outcome_lm), ncol = 4,
        byrow = TRUE, dimnames = list(c(colnames(gene_matrix)),
            c("Estimate", "Std.Error", "t.statistic", "p.value"))))

    # adjusted p-value
    outcome_lm = outcome_lm %>% dplyr::mutate(FDR = p.adjust(p.value,
        "BH", n_gene), names = colnames(gene_matrix)) %>% dplyr::mutate(Estimate = round(Estimate,
        10), Std.Error = round(Std.Error, 10), t.statistic = round(t.statistic,
        4)) %>% select(names, everything())
    # sort by p.value
    outcome_lm = outcome_lm[order(outcome_lm$p.value), ]

    ## sample size
    size = length(clinical_variable) - sum(clinical_variable)

    ## summary table
    kable(outcome_lm, caption = paste("Top Genes from ", genelistname,
        " Associated with Outcome: ", clin_var_name, " by p.value",
        " (Sample Size = ", size, ") ", sep = "", collapse = ""),
        digits = c(2, 10, 10, 4, 20, 20))
}

############## viral load ################### after rlog the count data
############## to the log2 scale whole isgs
```

```
gene_FunReg(as.matrix(isgs.rld.lin[, 2:231]), isgs.rld.lin[,
    235], "Core ISGs", "Plasma Viral Load")
```

Table 4: Top Genes from Core ISGs Associated with Outcome: Plasma Viral Load by p.value (Sample Size = NA)

	names	Estimate	Std.Error	t.statistic	p.value	FDR
30	SMCHD1	-1.7840e-06	4.5940e-07	-3.8831	0.001471060	0.2136266
84	SNX6	-2.6289e-06	6.9750e-07	-3.7689	0.001857623	0.2136266
214	ASAH2B	7.9078e-06	2.2198e-06	3.5624	0.002836082	0.2174330
210	CD2AP	-2.3665e-06	7.3750e-07	-3.2086	0.005859761	0.3369363
99	TRAFD1	5.3036e-06	1.7176e-06	3.0879	0.007500727	0.3450334
165	TLR3	4.9896e-06	1.7056e-06	2.9254	0.010443083	0.4003182
32	FMR1	-2.3666e-06	8.5150e-07	-2.7794	0.014030289	0.4289824
178	SNTB1	4.6487e-06	1.6912e-06	2.7488	0.014921127	0.4289824
39	GIMAP2	5.5667e-06	2.3089e-06	2.4110	0.029192260	0.7460244
203	TDRD7	6.9213e-06	3.0309e-06	2.2836	0.037390883	0.7913862
52	TRIM38	-1.9743e-06	8.6700e-07	-2.2773	0.037848904	0.7913862
116	PARP9	6.7003e-06	3.0046e-06	2.2300	0.041449447	0.7925806
124	ZCCHC2	-2.3946e-06	1.0937e-06	-2.1893	0.044798033	0.7925806
143	SLC25A28	3.6153e-06	1.6889e-06	2.1407	0.049133916	0.8072000
213	RNY4P34	-3.3733e-06	1.8026e-06	-1.8714	0.080923296	0.9694104
180	AFF1	4.0322e-06	2.1918e-06	1.8396	0.085697477	0.9694104
137	IFIT5	3.6948e-06	2.0378e-06	1.8132	0.089864720	0.9694104
11	TBC1D1	-1.2962e-06	7.2910e-07	-1.7778	0.095713985	0.9694104
177	PRKCE	-2.4329e-06	1.3723e-06	-1.7729	0.096552260	0.9694104
158	GPR155	-3.0475e-06	1.7681e-06	-1.7235	0.105335663	0.9694104
222	TRIM26	-3.1203e-06	1.8195e-06	-1.7150	0.106928741	0.9694104
53	CCND3	-2.6477e-06	1.5666e-06	-1.6901	0.111678367	0.9694104
181	MYD88	4.2295e-06	2.5028e-06	1.6900	0.111706778	0.9694104
126	MVB12A	-3.1735e-06	1.8911e-06	-1.6781	0.114026753	0.9694104
110	CMTR1	1.5366e-06	9.4860e-07	1.6200	0.126064659	0.9694104
100	CD164	4.7499e-06	2.9417e-06	1.6147	0.127210627	0.9694104
18	CHMP5	5.4749e-06	3.4212e-06	1.6003	0.130377932	0.9694104
130	DYNLT1	5.7765e-06	3.6808e-06	1.5694	0.137412305	0.9694104
133	ENDOD1	-2.0503e-06	1.3317e-06	-1.5396	0.144474012	0.9694104
211	TMEM229B	-3.4447e-06	2.2731e-06	-1.5154	0.150457288	0.9694104
106	RTP4	3.8892e-06	2.5955e-06	1.4985	0.154763127	0.9694104
7	TMSB10	3.2836e-06	2.2023e-06	1.4910	0.156697863	0.9694104
73	ODF2L	1.2424e-06	8.4210e-07	1.4755	0.160764883	0.9694104
70	KIAA1217	-1.2459e-06	8.4820e-07	-1.4688	0.162532511	0.9694104
142	TTC39B	-1.6511e-06	1.1313e-06	-1.4595	0.165044535	0.9694104
131	TMEM140	2.3106e-06	1.6644e-06	1.3883	0.185330593	0.9694104
164	YEATS2	1.7103e-06	1.2380e-06	1.3815	0.187362243	0.9694104
227	CTD.2047H16.2	4.8039e-06	3.5068e-06	1.3699	0.190884033	0.9694104
19	OAS1	2.7651e-06	2.0212e-06	1.3681	0.191434312	0.9694104
89	TRIM21	1.9801e-06	1.4553e-06	1.3606	0.193737686	0.9694104
145	MOV10	-1.8118e-06	1.3541e-06	-1.3380	0.200838528	0.9694104
171	LGALS9	-3.0486e-06	2.3050e-06	-1.3226	0.205776781	0.9694104
119	SCARB2	2.3239e-06	1.7767e-06	1.3080	0.210569468	0.9694104
215	CARD16	2.8097e-06	2.1505e-06	1.3065	0.211063124	0.9694104
157	CTSS	-1.6600e-06	1.2775e-06	-1.2994	0.213410706	0.9694104
90	TRIM5	-2.2210e-06	1.7094e-06	-1.2993	0.213451856	0.9694104

	names	Estimate	Std.Error	t.statistic	p.value	FDR
228	RP3.508I15.21	-2.9880e-06	2.3086e-06	-1.2943	0.215144121	0.9694104
31	MYL12A	2.4404e-06	1.8899e-06	1.2913	0.216140875	0.9694104
91	TRIM22	3.4477e-06	2.7726e-06	1.2435	0.232771521	0.9694104
94	EPSTI1	3.2421e-06	2.6198e-06	1.2375	0.234909719	0.9694104
58	GCA	2.2824e-06	1.8728e-06	1.2187	0.241772396	0.9694104
109	STX17	-8.7470e-07	7.2210e-07	-1.2112	0.244556584	0.9694104
135	RASGRP3	2.0003e-06	1.6582e-06	1.2063	0.246387400	0.9694104
138	UTRN	-1.3329e-06	1.1087e-06	-1.2022	0.247919584	0.9694104
196	ANKFY1	-1.7091e-06	1.4311e-06	-1.1942	0.250940977	0.9694104
69	MASTL	-1.2759e-06	1.0769e-06	-1.1848	0.254516667	0.9694104
144	USP25	1.3552e-06	1.1661e-06	1.1622	0.263315242	0.9694104
64	ECE1	-2.1483e-06	1.8540e-06	-1.1587	0.264679757	0.9694104
5	SLC38A5	-2.7131e-06	2.3545e-06	-1.1523	0.267225821	0.9694104
118	HERC5	3.6168e-06	3.1919e-06	1.1331	0.274952710	0.9694104
4	NUB1	-1.2674e-06	1.1373e-06	-1.1144	0.282642236	0.9694104
105	CHST12	-1.7359e-06	1.5975e-06	-1.0866	0.294350779	0.9694104
141	SLFN13	-2.0915e-06	1.9457e-06	-1.0749	0.299400059	0.9694104
223	APOBEC3G	2.3236e-06	2.1834e-06	1.0642	0.304060607	0.9694104
163	DTX3L	-2.0650e-06	1.9452e-06	-1.0616	0.305221078	0.9694104
161	AIM2	3.2349e-06	3.0661e-06	1.0551	0.308090233	0.9694104
95	C14orf159	5.9700e-07	5.6850e-07	1.0502	0.310267094	0.9694104
40	TRIM14	-1.2050e-06	1.1524e-06	-1.0456	0.312296006	0.9694104
82	HELB	-2.4039e-06	2.3295e-06	-1.0319	0.318469673	0.9694104
190	UBA7	-1.7696e-06	1.7173e-06	-1.0304	0.319138057	0.9694104
48	MDK	-1.5921e-06	1.5499e-06	-1.0272	0.320606604	0.9694104
123	SECTM1	-2.6281e-06	2.5628e-06	-1.0255	0.321377661	0.9694104
44	KPNB1	-1.3842e-06	1.3533e-06	-1.0228	0.322622537	0.9694104
27	REC8	2.3933e-06	2.3763e-06	1.0071	0.329834433	0.9694104
146	UBE2L6	2.6362e-06	2.6227e-06	1.0052	0.330764136	0.9694104
125	PMAIP1	2.1055e-06	2.1193e-06	0.9935	0.336218007	0.9694104
148	ADPGK	1.5633e-06	1.5855e-06	0.9860	0.339770004	0.9694104
35	N4BP1	-8.9720e-07	9.1840e-07	-0.9769	0.344116771	0.9694104
136	GPR180	1.6060e-06	1.6473e-06	0.9749	0.345061688	0.9694104
169	TRANK1	1.4388e-06	1.5409e-06	0.9337	0.365243291	0.9694104
167	SLFN5	3.2431e-06	3.5031e-06	0.9258	0.369215229	0.9694104
221	AC074338.4	1.6504e-06	1.7870e-06	0.9236	0.370336663	0.9694104
37	PRKD2	-1.6626e-06	1.8073e-06	-0.9199	0.372169663	0.9694104
45	LGALS3BP	-1.3853e-06	1.5537e-06	-0.8916	0.386695942	0.9694104
46	DHX58	1.7813e-06	2.0180e-06	0.8827	0.391330703	0.9694104
108	CBWD2	-1.2238e-06	1.3914e-06	-0.8796	0.392972774	0.9694104
3	ETV7	3.2521e-06	3.7676e-06	0.8632	0.401631887	0.9694104
80	RBCK1	-1.7221e-06	2.0195e-06	-0.8527	0.407220386	0.9694104
10	TNK2	1.1807e-06	1.3860e-06	0.8519	0.407682210	0.9694104
14	DAPP1	2.1261e-06	2.4999e-06	0.8505	0.408427392	0.9694104
38	C1GALT1	1.2931e-06	1.5583e-06	0.8298	0.419663460	0.9694104
83	APOL2	2.6330e-06	3.1761e-06	0.8290	0.420100564	0.9694104
212	CARD11	2.2907e-06	2.7742e-06	0.8257	0.421887710	0.9694104
220	AC009950.2	-3.0621e-06	3.7182e-06	-0.8235	0.423110108	0.9694104
151	DBF4B	-1.7741e-06	2.1615e-06	-0.8207	0.424640836	0.9694104
56	FRMD4B	-1.2140e-06	1.4940e-06	-0.8126	0.429175893	0.9694104
127	IFITM3	-3.2773e-06	4.0599e-06	-0.8072	0.432153198	0.9694104
55	XRN1	-9.3110e-07	1.1550e-06	-0.8061	0.432763063	0.9694104

	names	Estimate	Std.Error	t.statistic	p.value	FDR
155	GBP4	2.9504e-06	3.7469e-06	0.7874	0.443290879	0.9694104
29	LPIN2	8.9260e-07	1.1507e-06	0.7757	0.449994061	0.9694104
193	USP18	-3.8446e-06	5.0005e-06	-0.7688	0.453918801	0.9694104
54	FAM46A	-8.5110e-07	1.1231e-06	-0.7578	0.460314057	0.9694104
202	PLSCR1	1.1267e-06	1.4878e-06	0.7573	0.460589602	0.9694104
207	PGAP1	1.3407e-06	1.8041e-06	0.7431	0.468879462	0.9694104
67	IFIT2	2.7442e-06	3.7111e-06	0.7395	0.471041407	0.9694104
74	NT5C3A	1.3953e-06	1.9226e-06	0.7257	0.479192879	0.9694104
86	BST2	-2.6535e-06	3.7922e-06	-0.6997	0.494807090	0.9694104
175	STAT2	-1.4173e-06	2.0471e-06	-0.6923	0.499312036	0.9694104
201	FANCA	-1.2527e-06	1.8332e-06	-0.6834	0.504801843	0.9694104
230	RP11.640L9.2	-6.6100e-07	9.7140e-07	-0.6805	0.506585191	0.9694104
1	LAP3	-1.7551e-06	2.5923e-06	-0.6771	0.508675322	0.9694104
23	NANS	-5.2490e-07	7.8290e-07	-0.6704	0.512799022	0.9694104
22	PSME1	-8.1840e-07	1.2211e-06	-0.6702	0.512891066	0.9694104
77	ZNFX1	-2.0604e-06	3.1460e-06	-0.6549	0.522423491	0.9694104
194	IFITM2	-2.1620e-06	3.3253e-06	-0.6502	0.525408478	0.9694104
183	CNP	-7.8560e-07	1.2109e-06	-0.6488	0.526290851	0.9694104
92	XAF1	-2.3243e-06	3.5980e-06	-0.6460	0.528047992	0.9694104
21	RGS1	2.0129e-06	3.1895e-06	0.6311	0.537466754	0.9694104
68	CD274	2.3761e-06	3.8925e-06	0.6104	0.550716176	0.9694104
170	TTC21A	-8.7300e-07	1.4427e-06	-0.6051	0.554151171	0.9694104
174	TRIM56	-1.0130e-06	1.6896e-06	-0.5996	0.557746348	0.9694104
87	HELZ2	1.4088e-06	2.3689e-06	0.5947	0.560896273	0.9694104
188	PARP10	-1.5040e-06	2.5737e-06	-0.5844	0.567647135	0.9694104
205	HSH2D	1.1528e-06	1.9760e-06	0.5834	0.568299401	0.9694104
60	IL18R1	6.6870e-07	1.1789e-06	0.5672	0.578978094	0.9694104
112	CASP1	1.4077e-06	2.4939e-06	0.5644	0.580798434	0.9694104
26	PSME2	-1.3640e-06	2.4560e-06	-0.5554	0.586824348	0.9694104
218	APOL6	9.1320e-07	1.6826e-06	0.5427	0.595293184	0.9694104
226	RP11.468E2.4	-1.4127e-06	2.6595e-06	-0.5312	0.603071179	0.9694104
120	BRCA2	-8.7090e-07	1.6447e-06	-0.5295	0.604175931	0.9694104
71	TRIM25	1.2013e-06	2.2854e-06	0.5256	0.606823271	0.9694104
47	UNC93B1	-9.8950e-07	1.8829e-06	-0.5255	0.606905546	0.9694104
98	OASL	1.4809e-06	2.8675e-06	0.5164	0.613074479	0.9694104
209	C5orf56	1.0472e-06	2.0649e-06	0.5071	0.619428053	0.9694104
176	GIMAP8	8.6130e-07	1.7145e-06	0.5024	0.622708582	0.9694104
9	PARP12	6.0400e-07	1.2115e-06	0.4985	0.625347956	0.9694104
79	MT2A	1.3086e-06	2.6557e-06	0.4928	0.629312953	0.9694104
134	SCLT1	4.9980e-07	1.0188e-06	0.4906	0.630796979	0.9694104
208	GTF2E2	-2.9010e-07	5.9320e-07	-0.4890	0.631893236	0.9694104
66	IFIT3	2.7502e-06	5.6960e-06	0.4828	0.636189331	0.9694104
147	MX1	-2.3317e-06	4.8445e-06	-0.4813	0.637236308	0.9694104
173	BUB1	8.3300e-07	1.7533e-06	0.4751	0.641548517	0.9694104
229	AC008079.10	1.2308e-06	2.6187e-06	0.4700	0.645109888	0.9694104
36	EHD4	-5.3770e-07	1.1584e-06	-0.4641	0.649221959	0.9694104
198	TRIM69	-9.1700e-07	1.9863e-06	-0.4617	0.650955688	0.9694104
117	HERC6	-1.6512e-06	3.5801e-06	-0.4612	0.651262664	0.9694104
179	ISG20	1.1154e-06	2.4509e-06	0.4551	0.655548741	0.9694104
33	TNFSF13B	-1.0552e-06	2.3196e-06	-0.4549	0.655700284	0.9694104
41	DDX58	1.3575e-06	3.0115e-06	0.4508	0.658606508	0.9694104
128	MCL1	1.0790e-06	2.4384e-06	0.4425	0.664457971	0.9694104

	names	Estimate	Std.Error	t.statistic	p.value	FDR
162	PPM1K	8.3700e-07	1.8935e-06	0.4420	0.664766919	0.9694104
156	CAPN2	-4.7850e-07	1.0842e-06	-0.4414	0.665239879	0.9694104
85	SAT1	3.8890e-07	9.0730e-07	0.4287	0.674256982	0.9694104
107	TANK	4.6280e-07	1.0951e-06	0.4226	0.678572548	0.9694104
17	DNAJA1	5.9000e-07	1.4161e-06	0.4166	0.682847117	0.9694104
103	PHF11	4.7870e-07	1.1547e-06	0.4145	0.684346068	0.9694104
160	IFI16	9.6740e-07	2.3361e-06	0.4141	0.684652245	0.9694104
129	SLC18B1	3.0450e-07	7.7780e-07	0.3914	0.700984714	0.9694104
200	ISG15	-1.9897e-06	5.1164e-06	-0.3889	0.702824378	0.9694104
225	RP11.81H14.2	7.4410e-07	1.9163e-06	0.3883	0.703251960	0.9694104
61	FBXO6	-1.0422e-06	2.7657e-06	-0.3768	0.711575057	0.9694104
216	SAMD9	-6.6170e-07	1.8261e-06	-0.3624	0.722130410	0.9694104
81	IFI6	-2.1696e-06	6.1312e-06	-0.3539	0.728361522	0.9694104
192	RBM43	4.6250e-07	1.3098e-06	0.3531	0.728903223	0.9694104
204	SPATS2L	-2.1390e-07	6.1170e-07	-0.3498	0.731381088	0.9694104
12	SP100	-5.4410e-07	1.5630e-06	-0.3481	0.732612113	0.9694104
206	CASP4	-5.8400e-07	1.7454e-06	-0.3346	0.742563833	0.9694104
65	BLZF1	-3.4590e-07	1.0601e-06	-0.3263	0.748691388	0.9694104
101	USP15	-2.6290e-07	8.1550e-07	-0.3224	0.751631140	0.9694104
59	STAT1	7.4490e-07	2.3435e-06	0.3179	0.754965125	0.9694104
96	RSAD2	-1.4066e-06	4.4812e-06	-0.3139	0.757930266	0.9694104
76	NMI	4.9110e-07	1.6022e-06	0.3065	0.763419411	0.9694104
2	CD38	8.4820e-07	2.7992e-06	0.3030	0.766036072	0.9694104
20	LAG3	-1.1289e-06	3.7963e-06	-0.2974	0.770266807	0.9694104
115	PNPT1	-6.7720e-07	2.3121e-06	-0.2929	0.773608600	0.9694104
24	JAK2	-3.8440e-07	1.3149e-06	-0.2924	0.774019928	0.9694104
168	NOD2	5.0660e-07	1.7702e-06	0.2862	0.778651265	0.9694104
8	EIF2AK2	4.5270e-07	1.6533e-06	0.2738	0.787978946	0.9694104
50	OAS3	9.9180e-07	3.7190e-06	0.2667	0.793345866	0.9694104
153	RAVER2	4.8430e-07	1.9111e-06	0.2534	0.803409849	0.9694104
197	IFIT1	1.2816e-06	5.1241e-06	0.2501	0.805886347	0.9694104
104	SETDB2	-1.5500e-07	6.2500e-07	-0.2480	0.807459944	0.9694104
132	STOM	-5.5460e-07	2.2855e-06	-0.2427	0.811561758	0.9694104
63	GBP1	9.8060e-07	4.0482e-06	0.2422	0.811883750	0.9694104
43	LIPA	6.3400e-07	2.6834e-06	0.2363	0.816409077	0.9694104
186	SAMD9L	7.0160e-07	2.9882e-06	0.2348	0.817551119	0.9694104
195	IRF7	7.5780e-07	3.2401e-06	0.2339	0.818240146	0.9694104
102	SP110	4.8750e-07	2.1070e-06	0.2314	0.820155357	0.9694104
28	SAMHD1	-5.9420e-07	2.6938e-06	-0.2206	0.828403397	0.9694104
166	IFI27	-5.7200e-07	2.5978e-06	-0.2202	0.828694211	0.9694104
113	IFI44L	-1.3133e-06	6.1210e-06	-0.2146	0.833006194	0.9694104
111	DDX60	-4.4100e-07	2.1145e-06	-0.2086	0.837591422	0.9694104
159	AZI2	1.5960e-07	7.7360e-07	0.2063	0.839326357	0.9694104
13	IFI35	4.9950e-07	2.5552e-06	0.1955	0.847625713	0.9694104
184	RNF213	4.6010e-07	2.4371e-06	0.1888	0.852797528	0.9694104
149	ADAR	2.0180e-07	1.0810e-06	0.1867	0.854421647	0.9694104
78	ZBP1	-6.2410e-07	3.4306e-06	-0.1819	0.858087399	0.9694104
88	C19orf66	-3.1910e-07	1.7546e-06	-0.1818	0.858147129	0.9694104
93	ALOX5AP	3.0180e-07	1.6759e-06	0.1801	0.859476794	0.9694104
224	PSMB9	-5.4380e-07	3.0432e-06	-0.1787	0.860563274	0.9694104
114	IFI44	8.4100e-07	4.9857e-06	0.1687	0.868302678	0.9694104
152	AK4	1.3550e-07	8.0550e-07	0.1682	0.868655172	0.9694104

	names	Estimate	Std.Error	t.statistic	p.value	FDR
72	TNFSF10	-3.8940e-07	2.3434e-06	-0.1662	0.870256630	0.9694104
187	ODF3B	-4.5140e-07	2.8756e-06	-0.1570	0.877358650	0.9694104
49	PARP11	1.6990e-07	1.0900e-06	0.1559	0.878191334	0.9694104
154	NEXN	1.9680e-07	1.2678e-06	0.1552	0.878698052	0.9694104
121	PML	-3.9640e-07	2.6247e-06	-0.1510	0.881971075	0.9694104
150	LY6E	-5.3990e-07	3.7327e-06	-0.1446	0.886922801	0.9694104
16	SP140	-4.5080e-07	3.1182e-06	-0.1446	0.886963785	0.9694104
189	DDX60L	-3.9040e-07	2.7210e-06	-0.1435	0.887813732	0.9694104
219	GBP1P1	-6.7910e-07	4.8186e-06	-0.1409	0.889797353	0.9694104
185	DRAP1	1.8170e-07	1.3847e-06	0.1312	0.897362378	0.9694104
97	CMPK2	4.6970e-07	3.7269e-06	0.1260	0.901388972	0.9694104
34	PARP4	7.8600e-08	6.9290e-07	0.1135	0.911176290	0.9694104
51	OAS2	-4.9310e-07	4.3628e-06	-0.1130	0.911510354	0.9694104
15	IPCEF1	1.4280e-07	1.3441e-06	0.1062	0.916803485	0.9694104
57	IFIH1	2.8460e-07	2.6836e-06	0.1061	0.916936647	0.9694104
139	MCOLN2	-2.9550e-07	2.8516e-06	-0.1036	0.918832481	0.9694104
199	C11orf96	-2.5320e-07	2.7645e-06	-0.0916	0.928224353	0.9748475
42	SETX	6.0700e-08	7.0800e-07	0.0857	0.932848565	0.9752508
75	ACO1	-4.5600e-08	9.1840e-07	-0.0496	0.961081034	0.9901315
182	PARP14	1.1940e-07	2.5983e-06	0.0459	0.963960516	0.9901315
62	GBP3	1.1040e-07	2.4958e-06	0.0442	0.965302868	0.9901315
217	IRF9	1.1640e-07	2.8617e-06	0.0407	0.968083427	0.9901315
172	IRS1	-4.5500e-08	1.1367e-06	-0.0400	0.968606948	0.9901315
6	TYMP	-7.0100e-08	3.9543e-06	-0.0177	0.986079935	0.9970929
140	GBP5	6.0100e-08	4.7043e-06	0.0128	0.989979569	0.9970929
25	APOL1	-3.0900e-08	3.2844e-06	-0.0094	0.992617645	0.9970929
191	MX2	-1.8100e-08	4.6008e-06	-0.0039	0.996906239	0.9970929
122	NLRC5	9.0000e-09	2.4308e-06	0.0037	0.997092893	0.9970929

```
## betas
gene_FunReg(as.matrix(genesbeta.rld.lin[, 2:424]), genesbeta.rld.lin[,
    428], "IFN-beta Genes", "Plasma Viral Load")
```

Table 5: Top Genes from IFN-beta Genes Associated with Outcome:
Plasma Viral Load by p.value (Sample Size = NA)

	names	Estimate	Std.Error	t.statistic	p.value	FDR
15	THOC3	8.16970e-06	2.1273e-06	3.8404	0.001604998	0.2120574
146	INO80	3.95000e-06	1.0703e-06	3.6905	0.002180955	0.2120574
64	CCNB1IP1	4.38260e-06	1.2289e-06	3.5664	0.002813188	0.2120574
256	RPL30	8.95710e-06	2.6573e-06	3.3707	0.004202861	0.2120574
234	SLC25A4	3.38200e-06	1.0124e-06	3.3404	0.004472326	0.2120574
181	CENPO	4.77840e-06	1.4430e-06	3.3115	0.004746018	0.2120574
420	LIX1L	1.01495e-05	3.1354e-06	3.2371	0.005527284	0.2120574
253	PXYLP1	5.85940e-06	1.8224e-06	3.2152	0.005781029	0.2120574
407	ALG13.AS1	7.63880e-06	2.3837e-06	3.2045	0.005908588	0.2120574
123	PLEKHG1	7.57930e-06	2.4263e-06	3.1238	0.006970559	0.2120574
252	FZD7	6.67650e-06	2.1498e-06	3.1056	0.007233850	0.2120574
292	AQP3	1.34789e-05	4.3732e-06	3.0821	0.007589009	0.2120574
149	ZNF227	8.43510e-06	2.7846e-06	3.0292	0.008454548	0.2120574
194	KANSL2	6.04800e-06	2.0325e-06	2.9757	0.009427176	0.2120574

	names	Estimate	Std.Error	t.statistic	p.value	FDR
175	CCDC90B	5.34980e-06	1.8182e-06	2.9424	0.010088503	0.2120574
148	TAF4	3.26670e-06	1.1609e-06	2.8139	0.013088513	0.2120574
364	RPS23	7.86390e-06	2.8050e-06	2.8035	0.013363791	0.2120574
119	RPS25	7.27780e-06	2.6190e-06	2.7788	0.014047395	0.2120574
193	N4BP2L1	4.71760e-06	1.7211e-06	2.7411	0.015156148	0.2120574
214	LRIG1	5.07810e-06	1.8589e-06	2.7317	0.015443272	0.2120574
4	UFL1	1.45140e-06	5.3280e-07	2.7244	0.015671760	0.2120574
10	GRN	-3.55480e-06	1.3096e-06	-2.7145	0.015986286	0.2120574
406	LINC00623	5.92900e-06	2.2075e-06	2.6859	0.016931359	0.2120574
136	BTN2A2	4.98510e-06	1.8799e-06	2.6518	0.018126835	0.2120574
55	SLC23A2	7.19130e-06	2.7409e-06	2.6237	0.019173505	0.2120574
262	SLC35B2	9.36520e-06	3.5971e-06	2.6035	0.019957500	0.2120574
322	PPP1CA	1.09779e-05	4.2179e-06	2.6027	0.019990849	0.2120574
60	HNRNPH3	5.85750e-06	2.2539e-06	2.5988	0.020147286	0.2120574
127	SERP1	2.41280e-06	9.2920e-07	2.5967	0.020230307	0.2120574
341	C8orf59	3.03300e-06	1.1766e-06	2.5777	0.021012088	0.2120574
359	CSF1	5.06860e-06	1.9843e-06	2.5544	0.022006146	0.2120574
8	IFNGR1	6.57860e-06	2.5888e-06	2.5411	0.022591048	0.2120574
141	SHFM1	7.10040e-06	2.8023e-06	2.5338	0.022921277	0.2120574
366	GTF2F2	3.17900e-06	1.2569e-06	2.5293	0.023125894	0.2120574
370	PNRC2	1.91890e-06	7.6230e-07	2.5174	0.023679204	0.2120574
54	DOCK9	6.01100e-06	2.3993e-06	2.5053	0.024249274	0.2120574
101	C5orf15	1.10474e-05	4.4171e-06	2.5011	0.024454105	0.2120574
332	HOXB2	6.04270e-06	2.4288e-06	2.4879	0.025095663	0.2120574
74	TMEM87A	7.00950e-06	2.8292e-06	2.4776	0.025612899	0.2120574
421	GTF2H5	4.82680e-06	1.9488e-06	2.4768	0.025651107	0.2120574
327	TRMT112	1.07278e-05	4.3492e-06	2.4666	0.026172011	0.2120574
31	ARFGEF1	3.95820e-06	1.6067e-06	2.4635	0.026333254	0.2120574
110	KDM3A	2.80060e-06	1.1438e-06	2.4485	0.027122151	0.2120574
245	MRPL39	6.88330e-06	2.8209e-06	2.4401	0.027572118	0.2120574
20	ATG5	5.19560e-06	2.1300e-06	2.4392	0.027620701	0.2120574
270	BSDC1	4.14290e-06	1.7033e-06	2.4323	0.027999339	0.2120574
69	POFUT1	4.12320e-06	1.6996e-06	2.4260	0.028346229	0.2120574
416	NBPF11	6.32000e-06	2.6114e-06	2.4201	0.028674028	0.2120574
189	PEX5	8.02040e-06	3.3575e-06	2.3888	0.030483764	0.2120574
226	EBAG9	1.35210e-06	5.6920e-07	2.3755	0.031283332	0.2120574
188	KIF21A	3.53700e-06	1.4958e-06	2.3647	0.031950968	0.2120574
216	ATG3	2.13250e-06	9.0500e-07	2.3562	0.032482342	0.2120574
79	INTS10	3.55660e-06	1.5120e-06	2.3522	0.032735615	0.2120574
381	UCKL1	7.11860e-06	3.0321e-06	2.3478	0.033020643	0.2120574
244	TCEB1	4.09510e-06	1.7516e-06	2.3379	0.033662550	0.2120574
99	ARSB	5.44070e-06	2.3346e-06	2.3305	0.034150077	0.2120574
58	CMTM6	1.00451e-05	4.3110e-06	2.3301	0.034172309	0.2120574
124	PROSER1	5.39580e-06	2.3235e-06	2.3223	0.034695553	0.2120574
325	ZNF680	5.46040e-06	2.3532e-06	2.3204	0.034823068	0.2120574
282	RPN1	5.41080e-06	2.3343e-06	2.3179	0.034990110	0.2120574
333	C16orf91	7.46410e-06	3.2224e-06	2.3164	0.035096214	0.2120574
277	EIF4E3	4.66260e-06	2.0211e-06	2.3069	0.035742405	0.2120574
365	COMMD6	9.51670e-06	4.1315e-06	2.3035	0.035983200	0.2120574
142	LSM8	2.11480e-06	9.2020e-07	2.2981	0.036355989	0.2120574
68	TM9SF4	1.92770e-06	8.3900e-07	2.2976	0.036394413	0.2120574
116	SWT1	3.54120e-06	1.5427e-06	2.2955	0.036541927	0.2120574

	names	Estimate	Std.Error	t.statistic	p.value	FDR
392	C1orf174	9.45660e-06	4.1261e-06	2.2919	0.036795000	0.2120574
240	TXNDC11	4.74030e-06	2.0720e-06	2.2878	0.037088550	0.2120574
24	MTMR1	4.33670e-06	1.8959e-06	2.2874	0.037119155	0.2120574
345	ARL6IP6	2.74320e-06	1.2023e-06	2.2817	0.037529831	0.2120574
268	UBR1	3.58950e-06	1.5804e-06	2.2712	0.038293995	0.2120574
138	L3HYPDH	6.95920e-06	3.0684e-06	2.2680	0.038531549	0.2120574
402	CLIC1	7.52420e-06	3.3277e-06	2.2611	0.039048893	0.2120574
274	NCSTN	9.31290e-06	4.1291e-06	2.2555	0.039472249	0.2120574
225	LACTB2	3.98180e-06	1.7685e-06	2.2515	0.039776073	0.2120574
338	EIF1AD	6.78850e-06	3.0307e-06	2.2399	0.040670109	0.2120574
38	SCARF1	7.10820e-06	3.1781e-06	2.2366	0.040923345	0.2120574
30	ISOC1	8.57770e-06	3.8447e-06	2.2311	0.041364205	0.2120574
207	INTS7	3.47530e-06	1.5652e-06	2.2204	0.042220727	0.2120574
130	B4GALT4	8.30830e-06	3.7523e-06	2.2142	0.042722876	0.2120574
152	SEC61G	8.97380e-06	4.0636e-06	2.2084	0.043200591	0.2120574
2	RANBP9	4.45960e-06	2.0199e-06	2.2078	0.043247731	0.2120574
305	NUDT21	6.87410e-06	3.1310e-06	2.1955	0.044276264	0.2120574
158	CYP2J2	6.23680e-06	2.8448e-06	2.1923	0.044543195	0.2120574
314	TM2D2	3.83080e-06	1.7528e-06	2.1856	0.045119984	0.2120574
198	GLYR1	2.29470e-06	1.0553e-06	2.1744	0.046090247	0.2120574
209	SRP9	7.85510e-06	3.6170e-06	2.1717	0.046325242	0.2120574
241	RPIA	6.34740e-06	2.9249e-06	2.1702	0.046463426	0.2120574
399	NRAS	9.52140e-06	4.4041e-06	2.1619	0.047194925	0.2120574
51	DDHD2	3.32130e-06	1.5393e-06	2.1577	0.047572634	0.2120574
404	LINC00998	5.56520e-06	2.5859e-06	2.1522	0.048077434	0.2120574
202	SMAD4	4.08460e-06	1.9064e-06	2.1426	0.048958866	0.2120574
351	IGIP	7.19510e-06	3.3586e-06	2.1423	0.048987203	0.2120574
403	NAXD	3.39640e-06	1.5885e-06	2.1381	0.049377704	0.2120574
143	IRF5	4.64790e-06	2.1772e-06	2.1348	0.049683781	0.2120574
291	KIAA0196	4.05850e-06	1.9210e-06	2.1127	0.051797504	0.2120574
296	QSOX2	4.09490e-06	1.9403e-06	2.1105	0.052019021	0.2120574
283	ANXA5	3.65880e-06	1.7350e-06	2.1088	0.052184865	0.2120574
199	SLC39A6	3.86670e-06	1.8351e-06	2.1071	0.052350204	0.2120574
289	SUN1	6.98530e-06	3.3226e-06	2.1023	0.052824245	0.2120574
284	FBXO8	4.55440e-06	2.1704e-06	2.0984	0.053215036	0.2120574
115	TMEM59	8.33060e-06	3.9742e-06	2.0961	0.053441814	0.2120574
367	FAM92A1	3.88360e-06	1.8570e-06	2.0913	0.053928611	0.2120574
89	BIN2	4.55310e-06	2.1849e-06	2.0839	0.054688556	0.2120574
97	COX7A2	3.25710e-06	1.5631e-06	2.0838	0.054696027	0.2120574
400	LEPROT	2.29440e-06	1.1077e-06	2.0712	0.055998797	0.2120574
185	NUP54	2.90160e-06	1.4079e-06	2.0609	0.057094532	0.2120574
96	SMAP1	4.08070e-06	1.9852e-06	2.0556	0.057658829	0.2120574
227	MFSD14B	6.82320e-06	3.3450e-06	2.0398	0.059382297	0.2120574
94	RWDD1	4.69750e-06	2.3057e-06	2.0374	0.059656236	0.2120574
47	PCNP	3.52180e-06	1.7288e-06	2.0371	0.059689623	0.2120574
121	MYL12B	5.06790e-06	2.4882e-06	2.0368	0.059723424	0.2120574
378	AKAP17A	3.21980e-06	1.5860e-06	2.0301	0.060465476	0.2120574
323	MUS81	5.27190e-06	2.6010e-06	2.0269	0.060833835	0.2120574
260	AASDH	4.86860e-06	2.4033e-06	2.0259	0.060949514	0.2120574
363	ZBTB6	3.34140e-06	1.6537e-06	2.0205	0.061553313	0.2120574
129	TNFRSF10B	6.23720e-06	3.0950e-06	2.0153	0.062159058	0.2120574
261	DSCR3	3.82740e-06	1.9049e-06	2.0092	0.062859198	0.2120574

	names	Estimate	Std.Error	t.statistic	p.value	FDR
21	ALDH18A1	7.13270e-06	3.5609e-06	2.0031	0.063581362	0.2120574
28	OAT	8.41770e-06	4.2113e-06	1.9988	0.064084776	0.2120574
221	BTF3	4.03970e-06	2.0213e-06	1.9986	0.064110950	0.2120574
187	USO1	2.11550e-06	1.0595e-06	1.9968	0.064329048	0.2120574
251	FAM126B	6.30420e-06	3.1574e-06	1.9967	0.064341779	0.2120574
285	LSM6	4.19180e-06	2.1037e-06	1.9926	0.064827067	0.2120574
156	EMC7	5.48180e-06	2.7561e-06	1.9889	0.065268537	0.2120574
203	CREG1	4.36170e-06	2.1969e-06	1.9854	0.065697339	0.2120574
87	NDUFC1	6.40980e-06	3.2288e-06	1.9852	0.065723335	0.2120574
293	GTF2A1	6.11600e-06	3.0814e-06	1.9848	0.065766727	0.2120574
220	SRD5A1	3.64950e-06	1.8442e-06	1.9789	0.066483143	0.2120574
272	JAK1	1.93230e-06	9.7670e-07	1.9783	0.066560207	0.2120574
374	ZSCAN25	3.14790e-06	1.5962e-06	1.9722	0.067319898	0.2120574
165	CAB39	5.49780e-06	2.7880e-06	1.9720	0.067344155	0.2120574
369	ZNF548	3.73460e-06	1.8948e-06	1.9710	0.067460429	0.2120574
105	SF3B6	5.72200e-06	2.9031e-06	1.9710	0.067461820	0.2120574
84	EIF4H	3.02740e-06	1.5373e-06	1.9693	0.067677898	0.2120574
107	LANCL1	3.88530e-06	1.9887e-06	1.9536	0.069654945	0.2155898
318	XKR6	4.92210e-06	2.5212e-06	1.9523	0.069824597	0.2155898
106	ACVR1	5.94100e-06	3.0529e-06	1.9461	0.070629741	0.2164955
184	VWA9	6.87480e-06	3.5507e-06	1.9362	0.071918901	0.2184966
316	ARL6IP1	6.26090e-06	3.2387e-06	1.9332	0.072315656	0.2184966
232	ACAD8	4.63080e-06	2.4055e-06	1.9251	0.073394168	0.2201825
195	RB1	5.82640e-06	3.0372e-06	1.9184	0.074301170	0.2213338
204	RFWD2	3.72150e-06	1.9506e-06	1.9079	0.075739303	0.2239953
81	BET1	1.53460e-06	8.0590e-07	1.9041	0.076253725	0.2239953
299	TRUB1	5.56770e-06	2.9376e-06	1.8953	0.077489460	0.2256728
267	BTG2	4.59830e-06	2.4305e-06	1.8919	0.077975559	0.2256728
19	HPF1	5.16820e-06	2.7400e-06	1.8862	0.078781446	0.2256728
391	CAPZA2	2.46000e-06	1.3084e-06	1.8802	0.079642215	0.2256728
145	PSMG2	4.46960e-06	2.3778e-06	1.8797	0.079709443	0.2256728
160	TMED7	4.10580e-06	2.1868e-06	1.8776	0.080025828	0.2256728
279	RPL22L1	7.14090e-06	3.8132e-06	1.8727	0.080736912	0.2261703
103	INO80D	2.60980e-06	1.4009e-06	1.8629	0.082171886	0.2277222
144	MTX2	5.98250e-06	3.2196e-06	1.8582	0.082881387	0.2277222
306	GLOD4	2.31390e-06	1.2466e-06	1.8561	0.083185326	0.2277222
313	ZBTB49	4.57230e-06	2.4656e-06	1.8544	0.083444287	0.2277222
159	RNF138	5.85760e-06	3.1739e-06	1.8456	0.084783174	0.2277418
151	PRKAA1	3.84540e-06	2.0841e-06	1.8451	0.084851199	0.2277418
297	PRDX3	7.37400e-06	4.0233e-06	1.8328	0.086755511	0.2277418
250	CNOT8	5.58520e-06	3.0478e-06	1.8326	0.086792413	0.2277418
361	NSMCE3	4.40330e-06	2.4033e-06	1.8322	0.086847715	0.2277418
330	HEG1	2.81890e-06	1.5454e-06	1.8240	0.088140761	0.2277418
200	C18orf21	2.76400e-06	1.5156e-06	1.8237	0.088184171	0.2277418
71	RBM3	2.11160e-06	1.1580e-06	1.8234	0.088224910	0.2277418
303	SEC11C	3.93570e-06	2.1626e-06	1.8199	0.088788892	0.2277418
371	IARS	2.80550e-06	1.5460e-06	1.8147	0.089618225	0.2277418
210	CALM2	4.46570e-06	2.4631e-06	1.8130	0.089883328	0.2277418
422	RP11.5C23.1	3.40530e-06	1.8784e-06	1.8129	0.089912262	0.2277418
42	UBE2T	6.17580e-06	3.4138e-06	1.8091	0.090518580	0.2279129
380	ZNF251	3.80510e-06	2.1203e-06	1.7946	0.092890807	0.2315996
133	EBPL	2.84730e-06	1.5876e-06	1.7935	0.093077858	0.2315996

	names	Estimate	Std.Error	t.statistic	p.value	FDR
239	MED21	4.01810e-06	2.2543e-06	1.7824	0.094926764	0.2331687
17	ANAPC4	2.25540e-06	1.2657e-06	1.7820	0.095002997	0.2331687
117	BCAS2	2.83660e-06	1.5967e-06	1.7766	0.095921164	0.2331687
169	SRSF1	7.60040e-06	4.2973e-06	1.7686	0.097281687	0.2331687
196	DCAF5	3.62870e-06	2.0518e-06	1.7685	0.097295614	0.2331687
205	PFDN2	1.75540e-06	9.9700e-07	1.7606	0.098670037	0.2331687
352	HMGN4	2.40660e-06	1.3683e-06	1.7588	0.098990464	0.2331687
118	LGALS8	-2.02210e-06	1.1502e-06	-1.7580	0.099123799	0.2331687
206	POGZ	2.30670e-06	1.3134e-06	1.7563	0.099421628	0.2331687
301	CUL5	2.55780e-06	1.4569e-06	1.7557	0.099540731	0.2331687
340	MEX3C	4.68940e-06	2.6809e-06	1.7492	0.100680017	0.2331687
222	RNF44	4.25310e-06	2.4357e-06	1.7461	0.101225992	0.2331687
405	AC093818.1	-2.13550e-06	1.2237e-06	-1.7452	0.101396069	0.2331687
90	NAA25	2.08240e-06	1.1933e-06	1.7450	0.101425625	0.2331687
78	DECR1	4.27000e-06	2.4532e-06	1.7406	0.102221577	0.2332328
317	EMB	3.08040e-06	1.7716e-06	1.7387	0.102556273	0.2332328
212	EAF1	6.27630e-06	3.6198e-06	1.7339	0.103441274	0.2333097
137	MED1	2.12890e-06	1.2288e-06	1.7325	0.103693216	0.2333097
376	TRIM33	3.22370e-06	1.8677e-06	1.7261	0.104864297	0.2337877
398	TRIM59	2.50090e-06	1.4498e-06	1.7250	0.105066368	0.2337877
360	AP3M1	3.38730e-06	1.9667e-06	1.7223	0.105563698	0.2337877
140	SLC10A3	4.18740e-06	2.4544e-06	1.7061	0.108600395	0.2389931
248	PTPRN2	4.59840e-06	2.6989e-06	1.7038	0.109044126	0.2389931
12	NSUN2	5.19410e-06	3.0760e-06	1.6886	0.111974871	0.2418219
348	PRKRA	3.44240e-06	2.0402e-06	1.6873	0.112224304	0.2418219
177	ADAM10	2.83980e-06	1.6898e-06	1.6806	0.113545975	0.2418219
26	TAF2	1.75630e-06	1.0461e-06	1.6789	0.113880603	0.2418219
249	SAMSN1	4.32780e-06	2.5837e-06	1.6750	0.114647752	0.2418219
331	STAT5B	1.95790e-06	1.1711e-06	1.6718	0.115283963	0.2418219
395	TRIQK	3.50970e-06	2.1003e-06	1.6711	0.115428677	0.2418219
387	FOXJ3	4.96330e-06	2.9708e-06	1.6707	0.115503445	0.2418219
92	CLEC4A	3.55190e-06	2.1285e-06	1.6688	0.115896522	0.2418219
362	LRRC37B	2.55610e-06	1.5324e-06	1.6680	0.116051663	0.2418219
111	NOL10	2.91470e-06	1.7512e-06	1.6644	0.116783059	0.2421531
236	BAG3	5.08620e-06	3.0723e-06	1.6555	0.118590878	0.2437394
176	BUD13	1.43590e-06	8.6840e-07	1.6534	0.119024851	0.2437394
278	EIF5A2	2.05800e-06	1.2457e-06	1.6522	0.119276723	0.2437394
37	TSG101	3.13600e-06	1.9072e-06	1.6443	0.120902234	0.2449844
88	GTF2H1	2.99150e-06	1.8218e-06	1.6420	0.121380654	0.2449844
390	CIPC	4.06480e-06	2.4777e-06	1.6406	0.121681751	0.2449844
43	SLC25A43	3.40730e-06	2.0800e-06	1.6381	0.122202612	0.2449844
275	WDR26	3.11080e-06	1.9085e-06	1.6300	0.123925125	0.2462548
46	EPB41L2	2.71150e-06	1.6641e-06	1.6294	0.124039425	0.2462548
339	PLEKHF2	4.26450e-06	2.6244e-06	1.6249	0.124995556	0.2462548
9	TBPL1	3.11940e-06	1.9206e-06	1.6242	0.125164974	0.2462548
269	EFCAB14	2.98850e-06	1.8530e-06	1.6128	0.127631633	0.2491234
191	TDG	2.58600e-06	1.6076e-06	1.6086	0.128547284	0.2491234
171	HS6ST1	4.42760e-06	2.7564e-06	1.6063	0.129054179	0.2491234
23	GLTSCR1	3.37770e-06	2.1050e-06	1.6046	0.129430116	0.2491234
300	CCT2	3.25670e-06	2.0304e-06	1.6040	0.129567729	0.2491234
73	UBFD1	2.39320e-06	1.4958e-06	1.5999	0.130457815	0.2496998
102	ARL6	2.44470e-06	1.5449e-06	1.5824	0.134406297	0.2526953

	names	Estimate	Std.Error	t.statistic	p.value	FDR
49	AK6	4.02520e-06	2.5448e-06	1.5817	0.134565504	0.2526953
377	S100A10	3.44730e-06	2.1808e-06	1.5807	0.134793224	0.2526953
44	UBE2A	4.47820e-06	2.8346e-06	1.5798	0.134995916	0.2526953
100	CCNG1	4.48800e-06	2.8419e-06	1.5792	0.135137621	0.2526953
353	X15.Sep	4.56290e-06	2.8931e-06	1.5772	0.135607185	0.2526953
197	NCOA2	3.47770e-06	2.2205e-06	1.5662	0.138154347	0.2563127
238	ZFP36L2	4.37900e-06	2.8049e-06	1.5612	0.139318640	0.2573440
63	RPS6KA5	2.22400e-06	1.4408e-06	1.5436	0.143524983	0.2637747
56	NECAP1	5.04130e-06	3.2706e-06	1.5414	0.144047150	0.2637747
423	PIP4K2B	1.58300e-06	1.0304e-06	1.5362	0.145302017	0.2649257
157	TSPAN2	2.60440e-06	1.7006e-06	1.5314	0.146474241	0.2659168
401	PPP1CB	3.03230e-06	1.9932e-06	1.5213	0.148978935	0.2693081
229	LIN7C	3.95340e-06	2.6056e-06	1.5173	0.149979350	0.2699628
125	UFM1	1.63190e-06	1.0788e-06	1.5127	0.151129514	0.2708804
397	HLA.A	2.59910e-06	1.7216e-06	1.5097	0.151891337	0.2710972
298	GHITM	2.25030e-06	1.4981e-06	1.5021	0.153823675	0.2721962
224	ZNF92	3.62740e-06	2.4172e-06	1.5007	0.154195422	0.2721962
36	AFF4	1.77720e-06	1.1859e-06	1.4986	0.154726933	0.2721962
25	ASUN	2.06200e-06	1.3786e-06	1.4958	0.155459551	0.2721962
409	ARFGAP3	1.87170e-06	1.2537e-06	1.4929	0.156198309	0.2721962
164	DHX9	1.59860e-06	1.0713e-06	1.4922	0.156368026	0.2721962
62	TIMM9	2.07130e-06	1.3917e-06	1.4883	0.157395486	0.2728618
3	DYRK4	3.06070e-06	2.0704e-06	1.4783	0.160011685	0.2762651
170	NDUFB5	3.59890e-06	2.4512e-06	1.4682	0.162704516	0.2764408
302	TMX3	1.09570e-06	7.4650e-07	1.4678	0.162810886	0.2764408
7	DERA	5.47730e-06	3.7479e-06	1.4614	0.164530978	0.2764408
231	PTS	4.16260e-06	2.8493e-06	1.4609	0.164665948	0.2764408
39	LMAN1	1.55240e-06	1.0635e-06	1.4597	0.164996215	0.2764408
276	CGGBP1	1.80900e-06	1.2403e-06	1.4586	0.165299939	0.2764408
180	THUMPD2	3.28450e-06	2.2521e-06	1.4584	0.165338860	0.2764408
308	MLST8	2.19560e-06	1.5074e-06	1.4565	0.165855688	0.2764408
190	POC1B	3.75130e-06	2.5772e-06	1.4556	0.166125063	0.2764408
113	SRSF7	3.48800e-06	2.3995e-06	1.4536	0.166648707	0.2764408
211	ACKR3	4.85660e-06	3.3514e-06	1.4491	0.167883244	0.2774008
29	NDUFB4	4.94960e-06	3.4267e-06	1.4444	0.169181834	0.2784588
1	LAMP2	2.88940e-06	2.0038e-06	1.4419	0.169875710	0.2785172
109	UNC50	3.17820e-06	2.2177e-06	1.4331	0.172337829	0.2814629
346	GRAMD1C	1.63250e-06	1.1493e-06	1.4204	0.175947431	0.2856602
218	OCIAD2	4.39500e-06	3.0966e-06	1.4193	0.176258392	0.2856602
34	CDC42	2.79870e-06	1.9861e-06	1.4091	0.179194074	0.2870135
167	TBC1D4	2.65570e-06	1.8883e-06	1.4064	0.179986175	0.2870135
335	GCSAM	-1.45850e-06	1.0376e-06	-1.4056	0.180217011	0.2870135
230	CPSF7	4.01630e-06	2.8621e-06	1.4033	0.180900632	0.2870135
108	WDR75	3.67760e-06	2.6208e-06	1.4032	0.180906647	0.2870135
18	TAB2	2.00410e-06	1.4296e-06	1.4018	0.181323520	0.2870135
147	TEP1	1.63760e-06	1.1716e-06	1.3978	0.182497373	0.2870135
281	RCHY1	3.95030e-06	2.8262e-06	1.3977	0.182521556	0.2870135
75	SGK3	-1.37900e-06	9.8840e-07	-1.3952	0.183260019	0.2871074
315	PDCD6IP	2.56370e-06	1.8498e-06	1.3859	0.186034860	0.2903791
307	RP11.25K19.1	2.30330e-06	1.6652e-06	1.3832	0.186859745	0.2905944
410	CCDC71L	3.85640e-06	2.7933e-06	1.3806	0.187623289	0.2907130
53	PGS1	2.37300e-06	1.7308e-06	1.3711	0.190521898	0.2941269

	names	Estimate	Std.Error	t.statistic	p.value	FDR
178	GTF2B	2.21940e-06	1.6328e-06	1.3593	0.194145858	0.2986316
13	CLEC16A	1.66550e-06	1.2314e-06	1.3526	0.196226200	0.2999954
415	INAFM2	4.53300e-06	3.3531e-06	1.3519	0.196450913	0.2999954
396	LIN52	1.29620e-06	9.6300e-07	1.3461	0.198262482	0.3016728
319	C1GALT1C1	1.64830e-06	1.2447e-06	1.3243	0.205243988	0.3111764
247	KLF10	4.89020e-06	3.7181e-06	1.3152	0.208182406	0.3145041
57	PUS7	2.21110e-06	1.6858e-06	1.3116	0.209370471	0.3151733
155	ARNTL	2.20600e-06	1.6870e-06	1.3077	0.210666212	0.3153092
98	PAPD7	3.57400e-06	2.7349e-06	1.3068	0.210951553	0.3153092
389	PRMT6	3.05770e-06	2.3741e-06	1.2879	0.217282245	0.3236281
329	PARP15	2.78290e-06	2.1747e-06	1.2797	0.220094652	0.3266668
408	RP11.666F17.1	2.37370e-06	1.8624e-06	1.2746	0.221854017	0.3281267
310	PDHB	1.67100e-06	1.3240e-06	1.2621	0.226182621	0.3333632
217	MANF	3.43600e-06	2.7723e-06	1.2394	0.234251975	0.3440576
344	UBE2N	2.86410e-06	2.3363e-06	1.2259	0.239128719	0.3500050
41	ARHGAP15	1.69160e-06	1.3845e-06	1.2218	0.240640372	0.3510030
50	SLC25A24	2.78980e-06	2.3062e-06	1.2097	0.245124759	0.3563154
163	RNASEL	1.34790e-06	1.1185e-06	1.2051	0.246827220	0.3575379
14	YTHDC2	1.89060e-06	1.5717e-06	1.2029	0.247656249	0.3575379
45	TIGAR	3.00730e-06	2.5058e-06	1.2001	0.248698551	0.3578214
286	ERAP1	1.44070e-06	1.2057e-06	1.1949	0.250670512	0.3594360
342	FAM91A1	2.83560e-06	2.4189e-06	1.1722	0.259384060	0.3702244
321	JMJD1C	-1.10480e-06	9.4360e-07	-1.1708	0.259944799	0.3702244
35	RDH11	1.85660e-06	1.6008e-06	1.1599	0.264239072	0.3750776
304	NEMP1	2.20750e-06	1.9225e-06	1.1482	0.268849670	0.3803459
290	TP53INP1	2.07190e-06	1.8131e-06	1.1427	0.271070317	0.3822091
59	FKBP5	1.21310e-06	1.0682e-06	1.1357	0.273915763	0.3849381
312	FAM84B	2.40810e-06	2.1436e-06	1.1233	0.278948535	0.3907127
355	TMEM50A	1.05420e-06	9.4400e-07	1.1167	0.281694800	0.3932571
386	PNP	2.52290e-06	2.2800e-06	1.1065	0.285926965	0.3978523
412	TRAPPC2B	1.80360e-06	1.6344e-06	1.1035	0.287195687	0.3983075
179	RABGGTB	-1.07500e-06	9.7800e-07	-1.0992	0.289007125	0.3983943
122	ALG2	1.94160e-06	1.7669e-06	1.0989	0.289141966	0.3983943
337	ZNF654	1.15670e-06	1.0566e-06	1.0947	0.290895239	0.3995087
343	ZDHHC13	1.56840e-06	1.4359e-06	1.0923	0.291941393	0.3996479
52	TMED2	2.63390e-06	2.4228e-06	1.0871	0.294151264	0.4001288
263	TAB3	1.19310e-06	1.0976e-06	1.0870	0.294184530	0.4001288
91	GOLT1B	2.48020e-06	2.3227e-06	1.0678	0.302491398	0.4099161
172	FAM8A1	2.19760e-06	2.0617e-06	1.0659	0.303318569	0.4099161
280	CD200R1	2.03470e-06	1.9158e-06	1.0621	0.305003377	0.4108803
349	SIAH2	3.04190e-06	2.8714e-06	1.0594	0.306177516	0.4111527
61	ASCC2	1.24790e-06	1.1824e-06	1.0554	0.307945913	0.4122187
128	TMPO	2.01320e-06	1.9264e-06	1.0451	0.312546743	0.4170576
265	PPP1R15B	-9.63600e-07	9.3060e-07	-1.0355	0.316857814	0.4214807
243	NUS1	2.52400e-06	2.4770e-06	1.0190	0.324370341	0.4290081
153	KIAA0907	1.53040e-06	1.5025e-06	1.0186	0.324545108	0.4290081
326	HPSE	1.62180e-06	1.6033e-06	1.0115	0.327802856	0.4319645
150	VIMP	1.59470e-06	1.5866e-06	1.0051	0.330788227	0.4345448
67	PRELID3B	2.41230e-06	2.4245e-06	0.9950	0.335519188	0.4393951
383	TXNRD1	1.22950e-06	1.2613e-06	0.9748	0.345115688	0.4494189
120	PLAGL1	1.59590e-06	1.6378e-06	0.9744	0.345298222	0.4494189
368	CERKL	2.32480e-06	2.4042e-06	0.9670	0.348877787	0.4526850

	names	Estimate	Std.Error	t.statistic	p.value	FDR
254	FAM161B	1.10630e-06	1.1586e-06	0.9549	0.354762226	0.4589126
246	ATP5J	1.51480e-06	1.6082e-06	0.9419	0.361167328	0.4657737
168	ITM2B	1.41630e-06	1.5263e-06	0.9279	0.368153491	0.4724136
357	SH2D1A	2.33770e-06	2.5215e-06	0.9271	0.368549633	0.4724136
228	NOTCH1	1.96880e-06	2.1395e-06	0.9202	0.372030706	0.4740088
76	ZDHHC2	2.40420e-06	2.6127e-06	0.9202	0.372035260	0.4740088
72	FNDC3A	-7.58700e-07	8.2700e-07	-0.9175	0.373414653	0.4743375
354	HMCES	1.04770e-06	1.1514e-06	0.9100	0.377220979	0.4777379
258	MFSD14A	1.94500e-06	2.1432e-06	0.9075	0.378495518	0.4779212
350	FAM89A	1.45810e-06	1.6280e-06	0.8956	0.384608672	0.4841948
375	MAFG	3.12940e-06	3.5275e-06	0.8871	0.389004020	0.4882751
311	CMAHP	1.86040e-06	2.1299e-06	0.8735	0.396166981	0.4957948
173	CPEB2	1.92080e-06	2.2072e-06	0.8703	0.397872751	0.4964607
183	SPPL2A	7.48100e-07	8.6600e-07	0.8639	0.401261530	0.4992166
309	MAPK1IP1L	-1.17290e-06	1.3696e-06	-0.8564	0.405241713	0.5026899
70	METTL4	9.44600e-07	1.1081e-06	0.8524	0.407400939	0.5038906
347	MAF	-1.01330e-06	1.1932e-06	-0.8492	0.409121506	0.5045434
379	IRAK4	1.06720e-06	1.2625e-06	0.8453	0.411236212	0.5056771
16	MSMO1	2.35500e-06	2.8228e-06	0.8343	0.417200020	0.5115235
112	RAB3GAP1	3.75300e-07	4.5340e-07	0.8276	0.420854958	0.5145134
83	RHEB	1.96610e-06	2.4022e-06	0.8185	0.425905475	0.5191874
139	FAM78A	-1.41850e-06	1.7598e-06	-0.8061	0.432794767	0.5260695
418	RP11.154H23.3	1.13640e-06	1.4175e-06	0.8017	0.435223151	0.5275054
417	NBPF12	1.09770e-06	1.3848e-06	0.7927	0.440311028	0.5321473
182	EXOC6	9.33000e-07	1.1902e-06	0.7839	0.445280317	0.5366199
264	SLC37A3	1.74150e-06	2.2312e-06	0.7805	0.447231193	0.5374398
77	NBN	9.03700e-07	1.1681e-06	0.7737	0.451151170	0.5406146
48	CHMP2B	1.59320e-06	2.1009e-06	0.7583	0.460007192	0.5496696
126	ELF1	-5.36500e-07	7.1280e-07	-0.7528	0.463240730	0.5519742
394	SYT15	-1.12130e-06	1.5046e-06	-0.7453	0.467632040	0.5556414
414	CTD.2501E16.2	1.22470e-06	1.6546e-06	0.7402	0.470610346	0.5576139
271	SLC37A1	1.37450e-06	1.8652e-06	0.7369	0.472539336	0.5583356
166	SCYL2	7.52200e-07	1.0533e-06	0.7141	0.486120592	0.5727828
114	TIA1	5.62400e-07	8.0220e-07	0.7011	0.493976523	0.5790126
192	NUP58	-4.98900e-07	7.1190e-07	-0.7008	0.494145466	0.5790126
32	FTSJ1	-8.74100e-07	1.3350e-06	-0.6547	0.522549850	0.6106038
223	PRIM2	1.08070e-06	1.6864e-06	0.6408	0.531291748	0.6180032
324	OXSR1	1.03510e-06	1.6173e-06	0.6400	0.531804200	0.6180032
6	MDH1	1.40240e-06	2.3887e-06	0.5871	0.565873727	0.6546316
174	FCHSD2	6.83000e-07	1.1650e-06	0.5863	0.566418799	0.6546316
213	CSRNP1	-1.28150e-06	2.2096e-06	-0.5800	0.570547034	0.6566089
242	CEBPG	-5.07000e-07	8.7570e-07	-0.5789	0.571234188	0.6566089
294	REEP3	6.80800e-07	1.1832e-06	0.5754	0.573566461	0.6567126
135	RAP2C	1.11050e-06	1.9345e-06	0.5741	0.574429481	0.6567126
273	SLC30A7	7.22500e-07	1.2724e-06	0.5678	0.578577016	0.6596714
411	IFNG.AS1	-8.24800e-07	1.5321e-06	-0.5383	0.598237610	0.6798211
235	PARP8	-5.16700e-07	9.6310e-07	-0.5365	0.599463980	0.6798211
287	ACSL6	6.71200e-07	1.2757e-06	0.5262	0.606457183	0.6859128
66	GINS1	7.31500e-07	1.3973e-06	0.5235	0.608282013	0.6861421
257	EEF1A1	-1.42030e-06	2.7998e-06	-0.5073	0.619314404	0.6967287
413	KIAA1147	6.69900e-07	1.3276e-06	0.5046	0.621139124	0.6969280
358	VPS33B	5.70900e-07	1.1391e-06	0.5012	0.623514666	0.6977426

	names	Estimate	Std.Error	t.statistic	p.value	FDR
201	MBD1	7.87800e-07	1.6014e-06	0.4919	0.629876300	0.7030018
27	SNX24	-5.35200e-07	1.1159e-06	-0.4796	0.638409472	0.7106505
334	TLR1	7.23100e-07	1.5551e-06	0.4650	0.648623574	0.7176970
393	NAGA	-4.90400e-07	1.0562e-06	-0.4643	0.649080019	0.7176970
11	UBA6	-4.46300e-07	9.6330e-07	-0.4633	0.649829658	0.7176970
208	EFNA3	8.02200e-07	1.7586e-06	0.4561	0.654824480	0.7213301
134	AMD1	-5.35300e-07	1.1855e-06	-0.4516	0.658032413	0.7229811
33	CLEC2D	7.10000e-07	1.5964e-06	0.4447	0.662856197	0.7263942
385	TTC37	3.76900e-07	8.5440e-07	0.4411	0.665439455	0.7273408
85	TLE4	4.52400e-07	1.0453e-06	0.4328	0.671317164	0.7318741
161	BICDL1	-7.45200e-07	1.7348e-06	-0.4295	0.673632389	0.7319654
328	LRRN3	-8.84800e-07	2.0682e-06	-0.4278	0.674861755	0.7319654
382	GFPT1	4.14400e-07	1.0089e-06	0.4108	0.687020650	0.7429051
356	TBK1	-3.63500e-07	8.8920e-07	-0.4088	0.688460477	0.7429051
104	EPB41L5	6.98300e-07	1.7204e-06	0.4059	0.690571913	0.7432873
388	SFMBT2	6.38600e-07	1.5893e-06	0.4018	0.693481055	0.7445241
132	SPATA1	6.67700e-07	1.7325e-06	0.3854	0.705365758	0.7553664
40	MYDGF	1.69130e-06	4.5079e-06	0.3752	0.712771399	0.7613694
259	SEC13	-6.57700e-07	1.7809e-06	-0.3693	0.717055964	0.7640168
82	TWISTNB	4.33100e-07	1.1850e-06	0.3655	0.719874545	0.7650928
237	UHMK1	4.32600e-07	1.2471e-06	0.3469	0.733498249	0.7776184
372	CTBP1.AS2	3.93800e-07	1.1626e-06	0.3387	0.739501628	0.7809241
86	MAP3K8	4.56900e-07	1.3576e-06	0.3365	0.741134221	0.7809241
419	NBPF19	3.95200e-07	1.1792e-06	0.3351	0.742154803	0.7809241
384	BAZ1A	-4.53200e-07	1.3795e-06	-0.3286	0.747036984	0.7841108
255	DCK	4.74800e-07	1.4663e-06	0.3238	0.750544387	0.7858423
215	NFKBIZ	-6.38600e-07	2.2198e-06	-0.2877	0.777514307	0.8120705
233	KIN	-2.01500e-07	7.2780e-07	-0.2769	0.785639001	0.8185352
154	USPL1	3.47900e-07	1.3003e-06	0.2675	0.792718681	0.8238821
131	KHDRBS1	2.29900e-07	8.9040e-07	0.2582	0.799739716	0.8291419
373	PPTC7	3.60900e-07	1.4152e-06	0.2550	0.802158380	0.8296161
80	OAZ1	2.34000e-07	9.6000e-07	0.2438	0.810695386	0.8364004
266	ELK4	1.91800e-07	8.6710e-07	0.2212	0.827929089	0.8521022
95	E2F3	-2.88400e-07	1.5608e-06	-0.1848	0.855897051	0.8787487
320	SPSB1	-2.15200e-07	1.3364e-06	-0.1611	0.874195150	0.8939597
186	CNOT6L	-1.30800e-07	8.1720e-07	-0.1601	0.874939287	0.8939597
219	NAF1	1.53700e-07	1.1579e-06	0.1328	0.896127932	0.9134027
65	PCIF1	-1.64400e-07	1.5256e-06	-0.1078	0.915594410	0.9310010
288	CREBRF	9.08000e-08	8.6700e-07	0.1047	0.917968802	0.9311770
5	ZC3H3	-7.78000e-08	1.4195e-06	-0.0548	0.957021257	0.9684689
336	GPR171	6.20000e-08	1.6431e-06	0.0377	0.970390054	0.9773498
295	MICU2	3.21000e-08	8.5110e-07	0.0377	0.970418277	0.9773498
162	CCDC146	-4.60000e-08	1.4513e-06	-0.0317	0.975145805	0.9797783
93	C2CD5	3.64000e-08	1.3149e-06	0.0277	0.978264119	0.9805823
22	ELMO2	-1.03000e-08	8.8670e-07	-0.0116	0.990910940	0.9909109

```
################# CD4 Counts ################# whole isgs
gene_FunReg(as.matrix(isgs.rld.lin[, 2:231]), isgs.rld.lin[,
    234], "Core ISGs", "CD4 Counts")
```

Table 6: Top Genes from Core ISGs Associated with Outcome: CD4
Counts by p.value (Sample Size = -18801)

	names	Estimate	Std.Error	t.statistic	p.value	FDR
172	IRS1	0.0007610715	0.0001482952	5.1321	1.932496e-05	0.004444741
126	MVB12A	-0.0010835714	0.0002476611	-4.3752	1.525605e-04	0.017544461
187	ODF3B	-0.0015686938	0.0004039165	-3.8837	5.734632e-04	0.029788242
45	LGALS3BP	-0.0007490935	0.0001939187	-3.8629	6.061176e-04	0.029788242
190	UBA7	-0.0010256825	0.0002672392	-3.8381	6.475705e-04	0.029788242
181	MYD88	0.0012700210	0.0003375633	3.7623	7.917648e-04	0.030350986
20	LAG3	-0.0022022688	0.0006142794	-3.5851	1.262499e-03	0.041351330
214	ASAH2B	0.0014553747	0.0004129725	3.5241	1.480444e-03	0.041351330
203	TDRD7	0.0017143951	0.0004915349	3.4878	1.627094e-03	0.041351330
220	AC009950.2	-0.0018182819	0.0005287117	-3.4391	1.846379e-03	0.041351330
38	C1GALT1	0.0006697419	0.0001962611	3.4125	1.977672e-03	0.041351330
145	MOV10	-0.0006626383	0.0001967015	-3.3688	2.213713e-03	0.042429506
47	UNC93B1	-0.0009141223	0.0002743428	-3.3320	2.432518e-03	0.043036866
224	PSMB9	-0.0017736404	0.0005453889	-3.2521	2.983743e-03	0.048429186
26	PSME2	-0.0011765994	0.0003643089	-3.2297	3.158425e-03	0.048429186
180	AFF1	0.0011163424	0.0003504499	3.1855	3.532698e-03	0.050782536
122	NLRC5	-0.0014858749	0.0004831703	-3.0753	4.659137e-03	0.061185867
183	CNP	-0.0006228970	0.0002043938	-3.0475	4.992483e-03	0.061185867
198	TRIM69	-0.0010965476	0.0003655343	-2.9998	5.619499e-03	0.061185867
65	BLZF1	0.0004353983	0.0001454242	2.9940	5.701552e-03	0.061185867
37	PRKD2	-0.0007526942	0.0002529494	-2.9757	5.965341e-03	0.061185867
53	CCND3	-0.0006605088	0.0002224638	-2.9691	6.063350e-03	0.061185867
211	TMEM229B	-0.0011605751	0.0003957111	-2.9329	6.627422e-03	0.061185867
228	RP3.508I15.21	-0.0010991850	0.0003755405	-2.9269	6.724723e-03	0.061185867
200	ISG15	-0.0022389112	0.0007678216	-2.9159	6.908636e-03	0.061185867
34	PARP4	0.0004448793	0.0001542342	2.8844	7.460929e-03	0.061185867
17	DNAJA1	0.0005798897	0.0002015356	2.8774	7.590822e-03	0.061185867
105	CHST12	-0.0007499669	0.0002607437	-2.8763	7.611105e-03	0.061185867
144	USP25	0.0004981413	0.0001735259	2.8707	7.714740e-03	0.061185867
222	TRIM26	-0.0007458627	0.0002620257	-2.8465	8.181397e-03	0.062724044
58	GCA	0.0007218355	0.0002567134	2.8118	8.897597e-03	0.066014432
157	CTSS	-0.0005079175	0.0001830009	-2.7755	9.710942e-03	0.067890427
99	TRAFD1	0.0008270641	0.0002981757	2.7737	9.751691e-03	0.067890427
5	SLC38A5	-0.0009863791	0.0003573311	-2.7604	1.006865e-02	0.067890427
18	CHMP5	0.0013876928	0.0005075771	2.7340	1.072590e-02	0.067890427
129	SLC18B1	-0.0003059680	0.0001120516	-2.7306	1.081211e-02	0.067890427
6	TYMP	-0.0018290393	0.0006708685	-2.7264	1.092150e-02	0.067890427
107	TANK	0.0004418309	0.0001637848	2.6976	1.169407e-02	0.070779925
174	TRIM56	-0.0006656211	0.0002493138	-2.6698	1.249017e-02	0.073039913
31	MYL12A	0.0008372688	0.0003144472	2.6627	1.270259e-02	0.073039913
77	ZNFX1	-0.0011380574	0.0004322759	-2.6327	1.363073e-02	0.074283093
171	LGALS9	-0.0008269940	0.0003146165	-2.6286	1.376361e-02	0.074283093
93	ALOX5AP	-0.0006109527	0.0002334813	-2.6167	1.415195e-02	0.074283093
84	SNX6	-0.0003112336	0.0001190212	-2.6149	1.421068e-02	0.074283093
188	PARP10	-0.0012017546	0.0004682792	-2.5663	1.591682e-02	0.081350628
163	DTX3L	-0.0007715865	0.0003028539	-2.5477	1.661839e-02	0.081350628
175	STAT2	-0.0007711986	0.0003029924	-2.5453	1.671270e-02	0.081350628
194	IFITM2	-0.0011643989	0.0004587001	-2.5385	1.697752e-02	0.081350628
11	TBC1D1	-0.0002869006	0.0001141313	-2.5138	1.797272e-02	0.082687505

	names	Estimate	Std.Error	t.statistic	p.value	FDR
219	GBP1P1	-0.0019834924	0.0007890704	-2.5137	1.797554e-02	0.082687505
16	SP140	-0.0012043479	0.0004818170	-2.4996	1.856813e-02	0.082945231
42	SETX	0.0003291428	0.0001319060	2.4953	1.875283e-02	0.082945231
25	APOL1	-0.0012276064	0.0004965735	-2.4722	1.977233e-02	0.085804453
130	DYNLT1	0.0012720611	0.0005230313	2.4321	2.165968e-02	0.091075581
226	RP11.468E2.4	-0.0012305421	0.0005064644	-2.4297	2.177894e-02	0.091075581
21	RGS1	0.0010924890	0.0004515582	2.4194	2.229256e-02	0.091283372
185	DRAP1	0.0004545708	0.0001888560	2.4070	2.292621e-02	0.091283372
217	IRF9	-0.0013114588	0.0005462964	-2.4006	2.325603e-02	0.091283372
7	TMSB10	0.0007495510	0.0003126268	2.3976	2.341617e-02	0.091283372
119	SCARB2	0.0006480421	0.0002729194	2.3745	2.466445e-02	0.093876717
92	XAF1	-0.0013356020	0.0005634782	-2.3703	2.489774e-02	0.093876717
100	CD164	0.0010169943	0.0004310393	2.3594	2.551152e-02	0.094639511
81	IFI6	-0.0020600915	0.0008773353	-2.3481	2.616220e-02	0.095512807
159	AZI2	0.0003076636	0.0001329935	2.3134	2.826334e-02	0.101571381
1	LAP3	-0.0008583774	0.0003728348	-2.3023	2.896444e-02	0.102489556
121	PML	-0.0009161003	0.0004000079	-2.2902	2.974817e-02	0.103667853
140	GBP5	-0.0017522554	0.0007691946	-2.2780	3.055587e-02	0.104148350
127	IFITM3	-0.0013126885	0.0005792681	-2.2661	3.136666e-02	0.104148350
71	TRIM25	0.0006835689	0.0003022142	2.2619	3.166008e-02	0.104148350
170	TTC21A	-0.0006297596	0.0002784904	-2.2613	3.169732e-02	0.104148350
109	STX17	-0.0002800037	0.0001271598	-2.2020	3.607044e-02	0.116847913
86	BST2	-0.0012477134	0.0005739157	-2.1740	3.831165e-02	0.122384428
196	ANKFY1	-0.0004304835	0.0001989244	-2.1641	3.914175e-02	0.123323316
128	MCL1	0.0006756275	0.0003161542	2.1370	4.147204e-02	0.128899578
13	IFI35	-0.0007241745	0.0003418864	-2.1182	4.316883e-02	0.130682655
184	RNF213	-0.0007705242	0.0003644015	-2.1145	4.350727e-02	0.130682655
59	STAT1	-0.0008216114	0.0003890452	-2.1119	4.375028e-02	0.130682655
182	PARP14	-0.0008285693	0.0003940227	-2.1028	4.459394e-02	0.131494963
147	MX1	-0.0016062367	0.0007677195	-2.0922	4.560670e-02	0.132778996
33	TNFSF13B	-0.0008091647	0.0003901229	-2.0741	4.737746e-02	0.134859651
123	SECTM1	-0.0007527260	0.0003645223	-2.0650	4.829736e-02	0.134859651
28	SAMHD1	-0.0007488932	0.0003637907	-2.0586	4.894751e-02	0.134859651
22	PSME1	-0.0003503192	0.0001704750	-2.0550	4.932001e-02	0.134859651
164	YEATS2	0.0003398593	0.0001657758	2.0501	4.982209e-02	0.134859651
72	TNFSF10	-0.0006528738	0.0003184832	-2.0499	4.983944e-02	0.134859651
51	OAS2	-0.0013845240	0.0006792521	-2.0383	5.106444e-02	0.136567699
80	RBCK1	-0.0006773025	0.0003339869	-2.0279	5.217865e-02	0.137943569
63	GBP1	-0.0013166857	0.0006578202	-2.0016	5.510425e-02	0.144022465
158	GPR155	-0.0006551093	0.0003369670	-1.9441	6.198925e-02	0.158862169
61	FBXO6	-0.0007765893	0.0003997361	-1.9428	6.216346e-02	0.158862169
150	LY6E	-0.0011344815	0.0005858161	-1.9366	6.294790e-02	0.159099076
56	FRMD4B	0.0004272985	0.0002266786	1.8850	6.984181e-02	0.174604527
64	ECE1	-0.0004698165	0.0002520027	-1.8643	7.279076e-02	0.176809178
125	PMAIP1	0.0005020337	0.0002693866	1.8636	7.289425e-02	0.176809178
151	DBF4B	-0.0006437485	0.0003467951	-1.8563	7.396595e-02	0.176809178
9	PARP12	-0.0003298893	0.0001782812	-1.8504	7.483626e-02	0.176809178
178	SNTB1	0.0005552807	0.0003003350	1.8489	7.506164e-02	0.176809178
27	REC8	-0.0006815416	0.0003695830	-1.8441	7.577723e-02	0.176809178
206	CASP4	-0.0004499502	0.0002448097	-1.8380	7.670086e-02	0.176809178
193	USP18	-0.0013205160	0.0007189137	-1.8368	7.687356e-02	0.176809178
2	CD38	-0.0008002076	0.0004381767	-1.8262	7.849846e-02	0.178639499

	names	Estimate	Std.Error	t.statistic	p.value	FDR
229	AC008079.10	-0.0010397941	0.0005708271	-1.8216	7.922273e-02	0.178639499
82	HELB	-0.0006320468	0.0003479417	-1.8165	8.000962e-02	0.178662261
176	GIMAP8	-0.0004810982	0.0002656509	-1.8110	8.088049e-02	0.178870308
113	IFI44L	-0.0017371281	0.0009961360	-1.7439	9.215368e-02	0.199999575
46	DHX58	-0.0005475066	0.0003143600	-1.7417	9.254652e-02	0.199999575
88	C19orf66	-0.0005726334	0.0003293135	-1.7389	9.304328e-02	0.199999575
101	USP15	0.0001939374	0.0001136891	1.7059	9.910531e-02	0.209784690
35	N4BP1	-0.0002020519	0.0001185616	-1.7042	9.941970e-02	0.209784690
4	NUB1	-0.0002879501	0.0001694957	-1.6989	1.004314e-01	0.209992984
201	FANCA	-0.0004993951	0.0002967748	-1.6827	1.035454e-01	0.213324235
66	IFIT3	-0.0014041452	0.0008374730	-1.6766	1.047436e-01	0.213324235
155	GBP4	-0.0010553067	0.0006295364	-1.6763	1.048071e-01	0.213324235
132	STOM	-0.0006184140	0.0003747379	-1.6503	1.100651e-01	0.222061169
166	IFI27	-0.0006615508	0.0004042347	-1.6366	1.129168e-01	0.225833525
97	CMPK2	-0.0009360359	0.0005795471	-1.6151	1.174995e-01	0.231518420
44	KPNB1	-0.0003212761	0.0001996016	-1.6096	1.187063e-01	0.231518420
136	GPR180	0.0003779430	0.0002352209	1.6068	1.193278e-01	0.231518420
117	HERC6	-0.0007946757	0.0004957958	-1.6028	1.201952e-01	0.231518420
177	PRKCE	-0.0003554282	0.0002221235	-1.6001	1.207922e-01	0.231518420
73	ODF2L	0.0002198147	0.0001391722	1.5794	1.254664e-01	0.238160344
111	DDX60	-0.0005266962	0.0003342625	-1.5757	1.263285e-01	0.238160344
161	AIM2	-0.0008317045	0.0005311319	-1.5659	1.286030e-01	0.240477124
24	JAK2	0.0002721690	0.0001795980	1.5154	1.408712e-01	0.261293379
76	NMI	-0.0003771831	0.0002512363	-1.5013	1.444698e-01	0.265824377
52	TRIM38	-0.0002753587	0.0001842454	-1.4945	1.462249e-01	0.266918470
102	SP110	-0.0005008878	0.0003373691	-1.4847	1.487985e-01	0.269477550
36	EHD4	0.0003000116	0.0002031638	1.4767	1.509161e-01	0.271177359
23	NANS	-0.0001880331	0.0001279356	-1.4697	1.527780e-01	0.272394828
104	SETDB2	0.0001644406	0.0001123929	1.4631	1.545795e-01	0.273469850
143	SLC25A28	0.0003617081	0.0002480193	1.4584	1.558610e-01	0.273469850
204	SPATS2L	0.0001866083	0.0001283039	1.4544	1.569479e-01	0.273469850
218	APOL6	-0.0003971945	0.0002837236	-1.3999	1.725161e-01	0.298336038
213	RNY4P34	-0.0004467537	0.0003291947	-1.3571	1.855859e-01	0.318542919
48	MDK	-0.0003322205	0.0002488517	-1.3350	1.926254e-01	0.328176662
230	RP11.640L9.2	-0.0002663434	0.0002008389	-1.3262	1.955054e-01	0.330634079
202	PLSCR1	0.0002772896	0.0002124856	1.3050	2.025228e-01	0.340001759
89	TRIM21	0.0002919197	0.0002277272	1.2819	2.103967e-01	0.350661168
74	NT5C3A	0.0003403664	0.0002765914	1.2306	2.287201e-01	0.378457701
50	OAS3	-0.0007388047	0.0006031963	-1.2248	2.308491e-01	0.379252173
149	ADAR	-0.0002123488	0.0001765533	-1.2027	2.391468e-01	0.387012071
191	MX2	-0.0007961528	0.0006619744	-1.2027	2.391665e-01	0.387012071
12	SP100	-0.0002806605	0.0002342943	-1.1979	2.409992e-01	0.387012071
62	GBP3	-0.0004182899	0.0003501798	-1.1945	2.423032e-01	0.387012071
114	IFI44	-0.0008705497	0.0007393347	-1.1775	2.489171e-01	0.394833983
40	TRIM14	-0.0001965567	0.0001707255	-1.1513	2.593445e-01	0.407330663
78	ZBP1	-0.0005711729	0.0004971689	-1.1489	2.603374e-01	0.407330663
154	NEXN	-0.0002590988	0.0002279416	-1.1367	2.653031e-01	0.410676552
142	TTC39B	-0.0002404309	0.0002118554	-1.1349	2.660470e-01	0.410676552
138	UTRN	-0.0002160575	0.0001920908	-1.1248	2.702375e-01	0.414364159
210	CD2AP	0.0001858361	0.0001683513	1.1039	2.790508e-01	0.421323216
153	RAVER2	0.0002913897	0.0002645854	1.1013	2.801406e-01	0.421323216
221	AC074338.4	0.0002976281	0.0002713651	1.0968	2.820806e-01	0.421323216

	names	Estimate	Std.Error	t.statistic	p.value	FDR
173	BUB1	0.0002610895	0.0002380622	1.0967	2.821034e-01	0.421323216
75	ACO1	-0.0001425985	0.0001305941	-1.0919	2.841743e-01	0.421677978
186	SAMD9L	-0.0005163570	0.0004747990	-1.0875	2.860769e-01	0.421780044
223	APOBEC3G	-0.0004163575	0.0003917897	-1.0627	2.969951e-01	0.432602404
146	UBE2L6	-0.0004551060	0.0004287841	-1.0614	2.975835e-01	0.432602404
32	FMR1	-0.0001436355	0.0001360826	-1.0555	3.002183e-01	0.432602404
3	ETV7	-0.0005754739	0.0005461695	-1.0537	3.010491e-01	0.432602404
55	XRN1	-0.0001860079	0.0001771970	-1.0497	3.028217e-01	0.432602404
43	LIPA	0.0003754451	0.0003609755	1.0401	3.071989e-01	0.434000780
69	MASTL	0.0001821137	0.0001752336	1.0393	3.075745e-01	0.434000780
156	CAPN2	0.0001705960	0.0001653477	1.0317	3.110236e-01	0.436191572
205	HSH2D	-0.0002937619	0.0002927050	-1.0036	3.241611e-01	0.451860877
152	AK4	0.0001891084	0.0001907800	0.9912	3.300588e-01	0.457310356
49	PARP11	0.0001810996	0.0001946039	0.9306	3.600120e-01	0.495824849
10	TNK2	0.0001797142	0.0001949392	0.9219	3.644572e-01	0.496857220
95	C14orf159	0.0000939275	0.0001020196	0.9207	3.650820e-01	0.496857220
197	IFIT1	-0.0006999014	0.0007681111	-0.9112	3.699693e-01	0.500546740
195	IRF7	-0.0003838911	0.0004305019	-0.8917	3.801376e-01	0.509558766
216	SAMD9	-0.0002779836	0.0003126883	-0.8890	3.815710e-01	0.509558766
96	RSAD2	-0.0007050539	0.0007959634	-0.8858	3.832768e-01	0.509558766
167	SLFN5	-0.0004263116	0.0004879869	-0.8736	3.897604e-01	0.515200558
68	CD274	-0.0004819840	0.0005543755	-0.8694	3.920107e-01	0.515214095
137	IFIT5	0.0002542196	0.0003099705	0.8201	4.190629e-01	0.547639065
39	GIMAP2	0.0002951071	0.0003686242	0.8006	4.301251e-01	0.556513455
165	TLR3	0.0002572856	0.0003217812	0.7996	4.306930e-01	0.556513455
98	OASL	-0.0003461253	0.0004436228	-0.7802	4.418050e-01	0.567682457
124	ZCCHC2	-0.0001293547	0.0001699393	-0.7612	4.529119e-01	0.578720706
103	PHF11	-0.0001167939	0.0001549250	-0.7539	4.572184e-01	0.580995775
192	RBM43	-0.0001380180	0.0001969051	-0.7009	4.891273e-01	0.618127847
91	TRIM22	-0.0003274848	0.0004712422	-0.6949	4.928203e-01	0.619391691
85	SAT1	-0.0001094232	0.0001586548	-0.6897	4.960640e-01	0.620079998
57	IFIH1	0.0002394268	0.0003525777	0.6791	5.026653e-01	0.624935233
108	CBWD2	0.0001306369	0.0002066798	0.6321	5.324661e-01	0.658425830
15	IPCEF1	-0.0001629183	0.0002647238	-0.6154	5.432429e-01	0.664563515
135	RASGRP3	0.0001561543	0.0002549821	0.6124	5.452065e-01	0.664563515
189	DDX60L	-0.0002188625	0.0003581766	-0.6110	5.460978e-01	0.664563515
160	IFI16	0.0001802521	0.0003063049	0.5885	5.609325e-01	0.675895321
199	C11orf96	0.0002315298	0.0003938003	0.5879	5.612870e-01	0.675895321
179	ISG20	-0.0002050044	0.0003601742	-0.5692	5.737710e-01	0.687329900
131	TMEM140	-0.0001493054	0.0002769039	-0.5392	5.940136e-01	0.707891835
141	SLFN13	-0.0001798190	0.0003451547	-0.5210	6.064762e-01	0.719018197
116	PARP9	0.0002518720	0.0004979640	0.5058	6.169537e-01	0.726728785
67	IFIT2	-0.0002721925	0.0005417605	-0.5024	6.192993e-01	0.726728785
209	C5orf56	-0.0001604796	0.0003261495	-0.4920	6.265246e-01	0.731475407
30	SMCHD1	0.0000544629	0.0001118558	0.4869	6.301172e-01	0.731954308
83	APOL2	-0.0001970901	0.0004190840	-0.4703	6.417921e-01	0.741769743
148	ADPGK	0.0001049760	0.0002315466	0.4534	6.537774e-01	0.751843954
118	HERC5	0.0001939221	0.0004681977	0.4142	6.818920e-01	0.780274402
134	SCLT1	-0.0000616191	0.0001584014	-0.3890	7.002143e-01	0.797273666
90	TRIM5	0.0000909090	0.0002569921	0.3537	7.261816e-01	0.822767336
8	EIF2AK2	0.0000777300	0.0002247737	0.3458	7.320671e-01	0.824457874
162	PPM1K	-0.0000913271	0.0002669735	-0.3421	7.348429e-01	0.824457874

	names	Estimate	Std.Error	t.statistic	p.value	FDR
208	GTF2E2	0.0000360135	0.0001114558	0.3231	7.490057e-01	0.836268493
60	IL18R1	-0.0000709687	0.0002320564	-0.3058	7.620000e-01	0.840957032
70	KIAA1217	0.0000539773	0.0001765185	0.3058	7.620279e-01	0.840957032
115	PNPT1	-0.0000949803	0.0003135271	-0.3029	7.641740e-01	0.840957032
169	TRANK1	-0.0000858467	0.0002885286	-0.2975	7.682563e-01	0.841423568
29	LPIN2	-0.0000521516	0.0001844055	-0.2828	7.794033e-01	0.849351121
212	CARD11	0.0001267209	0.0004583383	0.2765	7.842109e-01	0.849351121
54	FAM46A	-0.0000517620	0.0001893458	-0.2734	7.865730e-01	0.849351121
87	HELZ2	-0.0000820111	0.0003401001	-0.2411	8.112052e-01	0.870790097
94	EPSTI1	-0.0001027516	0.0004335831	-0.2370	8.143957e-01	0.870790097
225	RP11.81H14.2	0.0000694511	0.0002986219	0.2326	8.177855e-01	0.870790097
133	ENDOD1	0.0000436403	0.0002200146	0.1984	8.442028e-01	0.894777188
79	MT2A	-0.0000871077	0.0004661015	-0.1869	8.530978e-01	0.900057297
112	CASP1	-0.0000608492	0.0003408820	-0.1785	8.596115e-01	0.902788372
215	CARD16	0.0000525331	0.0003170108	0.1657	8.695728e-01	0.907122960
227	CTD.2047H16.2	0.0000854897	0.0005242195	0.1631	8.716268e-01	0.907122960
110	CMTR1	-0.0000198796	0.0001552333	-0.1281	8.990149e-01	0.929151274
139	MCOLN2	0.0000500376	0.0003980920	0.1257	9.008728e-01	0.929151274
41	DDX58	-0.0000460855	0.0003999647	-0.1152	9.090900e-01	0.933440589
14	DAPP1	0.0000298705	0.0003724669	0.0802	9.366515e-01	0.957465936
120	BRCA2	-0.0000158849	0.0002427739	-0.0654	9.482958e-01	0.965079844
168	NOD2	-0.0000142652	0.0002693233	-0.0530	9.581344e-01	0.970796983
207	PGAP1	0.0000070111	0.0002446822	0.0287	9.773439e-01	0.981739434
19	OAS1	-0.0000096169	0.0003375169	-0.0285	9.774710e-01	0.981739434
106	RTP4	-0.0000018121	0.0003808971	-0.0048	9.962378e-01	0.996237768

```
## betas
gene_FunReg(as.matrix(genesbeta.rld.lin[, 2:424]), genesbeta.rld.lin[,
    427], "IFN-beta Genes", "CD4 Counts")
```

Table 7: Top Genes from IFN-beta Genes Associated with Outcome:
CD4 Counts by p.value (Sample Size = -18801)

	names	Estimate	Std.Error	t.statistic	p.value	FDR
85	TLE4	0.0005509871	0.0001202219	4.5831	8.663944e-05	0.01523938
385	TTC37	0.0005358599	0.0001287513	4.1620	2.717791e-04	0.01523938
359	CSF1	0.0012696458	0.0003114021	4.0772	3.415301e-04	0.01523938
131	KHDRBS1	0.0005601869	0.0001381998	4.0535	3.640346e-04	0.01523938
49	AK6	0.0014059302	0.0003525805	3.9875	4.344734e-04	0.01523938
350	FAM89A	0.0009533171	0.0002401430	3.9698	4.556344e-04	0.01523938
307	RP11.25K19.1	0.0008657358	0.0002211048	3.9155	5.268229e-04	0.01523938
12	NSUN2	0.0015618595	0.0004038578	3.8674	5.990158e-04	0.01523938
412	TRAPPC2B	0.0008937526	0.0002337691	3.8232	6.736309e-04	0.01523938
323	MUS81	0.0014277403	0.0003748157	3.8092	6.992467e-04	0.01523938
395	TRIQK	0.0011726172	0.0003082922	3.8036	7.096999e-04	0.01523938
244	TCEB1	0.0010812639	0.0002848620	3.7957	7.246280e-04	0.01523938
10	GRN	-0.0007831818	0.0002065103	-3.7925	7.309762e-04	0.01523938
187	USO1	0.0006495708	0.0001721166	3.7740	7.676093e-04	0.01523938
108	WDR75	0.0012639237	0.0003357579	3.7644	7.874356e-04	0.01523938
332	HOXB2	0.0013944974	0.0003721015	3.7476	8.231656e-04	0.01523938
285	LSM6	0.0011365405	0.0003062908	3.7107	9.076464e-04	0.01523938

	names	Estimate	Std.Error	t.statistic	p.value	FDR
415	INAFM2	0.0017077905	0.0004622833	3.6943	9.477999e-04	0.01523938
149	ZNF227	0.0016888185	0.0004607800	3.6651	1.023375e-03	0.01523938
185	NUP54	0.0007504855	0.0002054745	3.6525	1.058087e-03	0.01523938
62	TIMM9	0.0007878312	0.0002158457	3.6500	1.064998e-03	0.01523938
381	UCKL1	0.0016633265	0.0004585912	3.6270	1.131153e-03	0.01523938
169	SRSF1	0.0020739328	0.0005791145	3.5812	1.275491e-03	0.01523938
268	UBR1	0.0009275473	0.0002595275	3.5740	1.299839e-03	0.01523938
196	DCAF5	0.0011141710	0.0003121599	3.5692	1.316097e-03	0.01523938
109	UNC50	0.0012140825	0.0003409622	3.5608	1.345580e-03	0.01523938
389	PRMT6	0.0011019953	0.0003098296	3.5568	1.359628e-03	0.01523938
338	EIF1AD	0.0017723645	0.0004984594	3.5557	1.363517e-03	0.01523938
182	EXOC6	0.0005968732	0.0001678907	3.5551	1.365496e-03	0.01523938
164	DHX9	0.0006371057	0.0001795923	3.5475	1.392927e-03	0.01523938
347	MAF	0.0006288920	0.0001774002	3.5450	1.401914e-03	0.01523938
293	GTF2A1	0.0015621043	0.0004424363	3.5307	1.455412e-03	0.01523938
251	FAM126B	0.0016794616	0.0004804588	3.4955	1.594871e-03	0.01523938
19	HPF1	0.0014028773	0.0004018056	3.4914	1.611976e-03	0.01523938
14	YTHDC2	0.0007766616	0.0002229816	3.4831	1.647364e-03	0.01523938
96	SMAP1	0.0011067563	0.0003182918	3.4772	1.672792e-03	0.01523938
204	RFWD2	0.0011060594	0.0003184453	3.4733	1.689652e-03	0.01523938
101	C5orf15	0.0023466261	0.0006764048	3.4693	1.707490e-03	0.01523938
18	TAB2	0.0007931006	0.0002298693	3.4502	1.793870e-03	0.01523938
74	TMEM87A	0.0015804243	0.0004587707	3.4449	1.818721e-03	0.01523938
141	SHFM1	0.0015444091	0.0004490664	3.4392	1.846019e-03	0.01523938
209	SRP9	0.0018337032	0.0005342287	3.4324	1.878414e-03	0.01523938
410	CCDC71L	0.0012392697	0.0003616280	3.4269	1.905381e-03	0.01523938
211	ACKR3	0.0016209200	0.0004732109	3.4254	1.913048e-03	0.01523938
125	UFM1	0.0005521568	0.0001612035	3.4252	1.913785e-03	0.01523938
36	AFF4	0.0006706892	0.0001960334	3.4213	1.933250e-03	0.01523938
333	C16orf91	0.0017175196	0.0005027810	3.4160	1.959702e-03	0.01523938
156	EMC7	0.0013912402	0.0004078755	3.4109	1.985660e-03	0.01523938
137	MED1	0.0005996231	0.0001758581	3.4097	1.992051e-03	0.01523938
327	TRMT112	0.0022603274	0.0006632656	3.4079	2.001437e-03	0.01523938
289	SUN1	0.0017101931	0.0005034365	3.3970	2.058187e-03	0.01523938
305	NUDT21	0.0016457420	0.0004861225	3.3854	2.120597e-03	0.01523938
17	ANAPC4	0.0006206811	0.0001834687	3.3830	2.133806e-03	0.01523938
314	TM2D2	0.0008956957	0.0002651008	3.3787	2.157768e-03	0.01523938
243	NUS1	0.0010718193	0.0003178390	3.3722	2.194113e-03	0.01523938
119	RPS25	0.0015106862	0.0004484341	3.3688	2.213417e-03	0.01523938
392	C1orf174	0.0020781184	0.0006171776	3.3671	2.222953e-03	0.01523938
387	FOXJ3	0.0013808418	0.0004102588	3.3658	2.230679e-03	0.01523938
94	RWDD1	0.0011509067	0.0003435451	3.3501	2.322472e-03	0.01523938
247	KLF10	0.0017230728	0.0005145131	3.3489	2.329339e-03	0.01523938
60	HNRNPH3	0.0012647372	0.0003776976	3.3485	2.331696e-03	0.01523938
30	ISOC1	0.0018346516	0.0005484091	3.3454	2.350554e-03	0.01523938
231	PTS	0.0014024193	0.0004198042	3.3407	2.379418e-03	0.01523938
301	CUL5	0.0007362499	0.0002207817	3.3347	2.415750e-03	0.01523938
150	VIMP	0.0008271301	0.0002495984	3.3138	2.548601e-03	0.01523938
313	ZBTB49	0.0011136255	0.0003364800	3.3096	2.576203e-03	0.01523938
151	PRKAA1	0.0009691372	0.0002938474	3.2981	2.653326e-03	0.01523938
353	X15.Sep	0.0014147154	0.0004289789	3.2979	2.654883e-03	0.01523938
341	C8orf59	0.0006719449	0.0002038512	3.2963	2.665864e-03	0.01523938

	names	Estimate	Std.Error	t.statistic	p.value	FDR
88	GTF2H1	0.0008914960	0.0002704685	3.2961	2.666776e-03	0.01523938
90	NAA25	0.0005421613	0.0001646802	3.2922	2.693546e-03	0.01523938
217	MANF	0.0012190842	0.0003703170	3.2920	2.694961e-03	0.01523938
24	MTMR1	0.0008711950	0.0002646723	3.2916	2.697734e-03	0.01523938
376	TRIM33	0.0008202596	0.0002493568	3.2895	2.712223e-03	0.01523938
250	CNOT8	0.0014254054	0.0004341254	3.2834	2.754824e-03	0.01523938
180	THUMPD2	0.0009646625	0.0002940902	3.2802	2.777669e-03	0.01523938
212	EAF1	0.0016338107	0.0004987928	3.2755	2.810651e-03	0.01523938
299	TRUB1	0.0013293937	0.0004059108	3.2751	2.813820e-03	0.01523938
31	ARFGEF1	0.0008873710	0.0002727469	3.2535	2.973176e-03	0.01523938
248	PTPRN2	0.0012859617	0.0003954155	3.2522	2.982887e-03	0.01523938
258	MFSD14A	0.0009360301	0.0002878697	3.2516	2.987465e-03	0.01523938
152	SEC61G	0.0020590384	0.0006333877	3.2508	2.993099e-03	0.01523938
262	SLC35B2	0.0021351364	0.0006575850	3.2469	3.022921e-03	0.01523938
340	MEX3C	0.0011805756	0.0003636831	3.2462	3.028851e-03	0.01523938
375	MAFG	0.0014387699	0.0004442684	3.2385	3.088315e-03	0.01523938
106	ACVR1	0.0013603959	0.0004207132	3.2335	3.127532e-03	0.01523938
227	MFSD14B	0.0015164252	0.0004705336	3.2228	3.214189e-03	0.01523938
175	CCDC90B	0.0010242649	0.0003179770	3.2212	3.227145e-03	0.01523938
8	IFNGR1	0.0014060444	0.0004367476	3.2194	3.242234e-03	0.01523938
145	PSMG2	0.0011941514	0.0003712043	3.2170	3.261912e-03	0.01523938
342	FAM91A1	0.0010357615	0.0003224243	3.2124	3.299726e-03	0.01523938
124	PROSER1	0.0011413673	0.0003557079	3.2087	3.330773e-03	0.01523938
325	ZNF680	0.0011950861	0.0003727203	3.2064	3.350501e-03	0.01523938
158	CYP2J2	0.0014743566	0.0004618841	3.1920	3.474306e-03	0.01553088
421	GTF2H5	0.0011014230	0.0003452210	3.1905	3.488059e-03	0.01553088
133	EBPL	0.0007688893	0.0002420693	3.1763	3.615157e-03	0.01553088
195	RB1	0.0013292562	0.0004189996	3.1725	3.650600e-03	0.01553088
87	NDUFC1	0.0015680501	0.0004967129	3.1569	3.797027e-03	0.01553088
366	GTF2F2	0.0006693549	0.0002121712	3.1548	3.816842e-03	0.01553088
38	SCARF1	0.0014814375	0.0004696206	3.1545	3.819211e-03	0.01553088
383	TXNRD1	0.0007296310	0.0002314590	3.1523	3.840710e-03	0.01553088
50	SLC25A24	0.0010227851	0.0003250847	3.1462	3.900144e-03	0.01553088
297	PRDX3	0.0018207059	0.0005790791	3.1441	3.920511e-03	0.01553088
377	S100A10	0.0010558993	0.0003358958	3.1435	3.926508e-03	0.01553088
166	SCYL2	0.0004753143	0.0001513106	3.1413	3.948456e-03	0.01553088
373	PPTC7	0.0006609633	0.0002104917	3.1401	3.960633e-03	0.01553088
3	DYRK4	0.0008905403	0.0002836823	3.1392	3.969352e-03	0.01553088
202	SMAD4	0.0009160672	0.0002919420	3.1378	3.983123e-03	0.01553088
42	UBE2T	0.0015601886	0.0004983782	3.1305	4.056945e-03	0.01553088
165	CAB39	0.0014119311	0.0004512431	3.1290	4.072774e-03	0.01553088
380	ZNF251	0.0009688300	0.0003106621	3.1186	4.180316e-03	0.01553088
105	SF3B6	0.0013678870	0.0004390451	3.1156	4.211910e-03	0.01553088
274	NCSTN	0.0020092480	0.0006449629	3.1153	4.215107e-03	0.01553088
184	VWA9	0.0016196039	0.0005201712	3.1136	4.233056e-03	0.01553088
210	CALM2	0.0012007113	0.0003858570	3.1118	4.252140e-03	0.01553088
236	BAG3	0.0015235464	0.0004904106	3.1067	4.307136e-03	0.01553088
409	ARFGAP3	0.0006602537	0.0002126433	3.1050	4.325440e-03	0.01553088
399	NRAS	0.0020393811	0.0006573334	3.1025	4.352340e-03	0.01553088
315	PDCD6IP	0.0009606885	0.0003098034	3.1010	4.369207e-03	0.01553088
351	IGIP	0.0014864750	0.0004813413	3.0882	4.511031e-03	0.01590138
188	KIF21A	0.0008225421	0.0002668000	3.0830	4.570055e-03	0.01594970

	names	Estimate	Std.Error	t.statistic	p.value	FDR
173	CPEB2	0.0009758515	0.0003167975	3.0804	4.600150e-03	0.01594970
199	SLC39A6	0.0008420206	0.0002741051	3.0719	4.698511e-03	0.01614344
404	LINC00998	0.0012653174	0.0004122881	3.0690	4.732356e-03	0.01614344
413	KIAA1147	0.0005963581	0.0001948689	3.0603	4.836231e-03	0.01631843
241	RPIA	0.0013338088	0.0004361319	3.0583	4.860810e-03	0.01631843
229	LIN7C	0.0010573735	0.0003469251	3.0478	4.988630e-03	0.01661567
129	TNFRSF10B	0.0012773843	0.0004209555	3.0345	5.157071e-03	0.01704251
45	TIGAR	0.0010053362	0.0003328995	3.0199	5.346700e-03	0.01713558
28	OAT	0.0019111001	0.0006332720	3.0178	5.374885e-03	0.01713558
203	CREG1	0.0010308321	0.0003421173	3.0131	5.438186e-03	0.01713558
144	MTX2	0.0014420886	0.0004787614	3.0121	5.451289e-03	0.01713558
391	CAPZA2	0.0006620910	0.0002198170	3.0120	5.452839e-03	0.01713558
47	PCNP	0.0007909625	0.0002627273	3.0106	5.472129e-03	0.01713558
123	PLEKHG1	0.0012053269	0.0004006892	3.0081	5.505435e-03	0.01713558
61	ASCC2	0.0005699803	0.0001894976	3.0078	5.509310e-03	0.01713558
300	CCT2	0.0009046769	0.0003019182	2.9964	5.667217e-03	0.01740464
269	EFCAB14	0.0008540047	0.0002850813	2.9957	5.678111e-03	0.01740464
292	AQP3	0.0024864677	0.0008311654	2.9915	5.736091e-03	0.01742595
130	B4GALT4	0.0017972457	0.0006012187	2.9893	5.767453e-03	0.01742595
260	AASDH	0.0010521169	0.0003530848	2.9798	5.905099e-03	0.01766583
349	SIAH2	0.0012350764	0.0004147259	2.9781	5.930372e-03	0.01766583
310	PDHB	0.0006331924	0.0002133770	2.9675	6.087009e-03	0.01797551
98	PAPD7	0.0010828292	0.0003651628	2.9653	6.119321e-03	0.01797551
69	POFUT1	0.0008892187	0.0003004084	2.9600	6.199715e-03	0.01808606
365	COMMD6	0.0018464027	0.0006249340	2.9546	6.283824e-03	0.01820587
272	JAK1	0.0004771416	0.0001619528	2.9462	6.414628e-03	0.01845842
257	EEF1A1	0.0010993766	0.0003741478	2.9383	6.539155e-03	0.01868961
159	RNF138	0.0013564009	0.0004627028	2.9315	6.650410e-03	0.01888002
239	MED21	0.0010091901	0.0003450439	2.9248	6.759829e-03	0.01888272
306	GLOD4	0.0005854801	0.0002003545	2.9222	6.802964e-03	0.01888272
205	PFDN2	0.0005112322	0.0001749813	2.9216	6.812661e-03	0.01888272
2	RANBP9	0.0009830117	0.0003367879	2.9188	6.860434e-03	0.01888272
276	CGGBP1	0.0005220411	0.0001790398	2.9158	6.911080e-03	0.01888272
284	FBXO8	0.0010488456	0.0003597726	2.9153	6.919202e-03	0.01888272
191	TDG	0.0006282354	0.0002162190	2.9056	7.086209e-03	0.01921453
281	RCHY1	0.0011626251	0.0004012663	2.8974	7.228896e-03	0.01947658
138	L3HYPDH	0.0012341812	0.0004272335	2.8888	7.382509e-03	0.01967307
20	ATG5	0.0010437581	0.0003614008	2.8881	7.394842e-03	0.01967307
420	LIX1L	0.0017478761	0.0006061773	2.8834	7.479139e-03	0.01971243
52	TMED2	0.0009425678	0.0003270372	2.8821	7.502842e-03	0.01971243
348	PRKRA	0.0008246032	0.0002867553	2.8756	7.622728e-03	0.01990379
25	ASUN	0.0005893108	0.0002053001	2.8705	7.718861e-03	0.02003115
84	EIF4H	0.0007529396	0.0002629158	2.8638	7.845261e-03	0.02023503
37	TSG101	0.0008556847	0.0002999327	2.8529	8.055401e-03	0.02054157
142	LSM8	0.0004747220	0.0001665490	2.8503	8.105944e-03	0.02054157
324	OXSR1	0.0006607591	0.0002318332	2.8501	8.109791e-03	0.02054157
295	MICU2	0.0004281525	0.0001503710	2.8473	8.165881e-03	0.02056052
279	RPL22L1	0.0016009073	0.0005654542	2.8312	8.491058e-03	0.02117421
56	NECAP1	0.0012772309	0.0004512736	2.8303	8.509731e-03	0.02117421
1	LAMP2	0.0007791179	0.0002762508	2.8203	8.716982e-03	0.02144240
253	PXYLP1	0.0008543575	0.0003029382	2.8202	8.718895e-03	0.02144240
312	FAM84B	0.0008070957	0.0002866056	2.8160	8.807526e-03	0.02153516

	names	Estimate	Std.Error	t.statistic	p.value	FDR
252	FZD7	0.0010797161	0.0003847655	2.8062	9.020077e-03	0.02187080
360	AP3M1	0.0008247862	0.0002943417	2.8021	9.108086e-03	0.02187080
7	DERA	0.0015372657	0.0005487559	2.8014	9.125084e-03	0.02187080
107	LANCL1	0.0008229414	0.0002941692	2.7975	9.210199e-03	0.02187080
270	BSDC1	0.0009443511	0.0003376053	2.7972	9.216987e-03	0.02187080
378	AKAP17A	0.0006211350	0.0002221915	2.7955	9.255020e-03	0.02187080
55	SLC23A2	0.0012708198	0.0004551888	2.7919	9.336520e-03	0.02188528
21	ALDH18A1	0.0015523029	0.0005566590	2.7886	9.409701e-03	0.02188528
363	ZBTB6	0.0007549784	0.0002707654	2.7883	9.416364e-03	0.02188528
121	MYL12B	0.0013006496	0.0004678226	2.7802	9.601320e-03	0.02219322
230	CPSF7	0.0010242681	0.0003695566	2.7716	9.801747e-03	0.02244758
104	EPB41L5	0.0006186529	0.0002233299	2.7701	9.836697e-03	0.02244758
330	HEG1	0.0006345267	0.0002291788	2.7687	9.870567e-03	0.02244758
369	ZNF548	0.0007221371	0.0002618061	2.7583	1.011983e-02	0.02283202
283	ANXA5	0.0007469359	0.0002709090	2.7571	1.014756e-02	0.02283202
178	GTF2B	0.0007137483	0.0002601489	2.7436	1.048136e-02	0.02345827
303	SEC11C	0.0008469506	0.0003104019	2.7286	1.086474e-02	0.02418834
78	DECR1	0.0010005443	0.0003670581	2.7258	1.093526e-02	0.02421787
89	BIN2	0.0009252361	0.0003398357	2.7226	1.102022e-02	0.02427892
128	TMPO	0.0007027689	0.0002597862	2.7052	1.148632e-02	0.02507713
115	TMEM59	0.0016856853	0.0006232566	2.7046	1.150110e-02	0.02507713
113	SRSF7	0.0008765040	0.0003246208	2.7001	1.162617e-02	0.02521985
282	RPN1	0.0010121517	0.0003756030	2.6947	1.177460e-02	0.02541152
374	ZSCAN25	0.0008008030	0.0002975731	2.6911	1.187622e-02	0.02550071
44	UBE2A	0.0011436891	0.0004286749	2.6680	1.254483e-02	0.02680031
423	PIP4K2B	0.0004148197	0.0001557941	2.6626	1.270423e-02	0.02690036
13	CLEC16A	0.0005080311	0.0001908365	2.6621	1.271884e-02	0.02690036
344	UBE2N	0.0008192498	0.0003085062	2.6555	1.291804e-02	0.02718572
15	THOC3	0.0013730551	0.0005187582	2.6468	1.318628e-02	0.02761285
135	RAP2C	0.0006917094	0.0002625785	2.6343	1.358008e-02	0.02817289
354	HMCES	0.0004771956	0.0001811621	2.6341	1.358693e-02	0.02817289
371	IARS	0.0005890273	0.0002241224	2.6281	1.377745e-02	0.02842860
177	ADAM10	0.0007009500	0.0002669702	2.6256	1.386095e-02	0.02846204
249	SAMSN1	0.0008947513	0.0003411306	2.6229	1.394817e-02	0.02850278
214	LRIG1	0.0009280812	0.0003544493	2.6184	1.409686e-02	0.02866813
170	NDUFB5	0.0009413787	0.0003616017	2.6034	1.460098e-02	0.02955127
382	GFPT1	0.0004352290	0.0001681985	2.5876	1.514827e-02	0.03051294
54	DOCK9	0.0009181845	0.0003552886	2.5843	1.526369e-02	0.03059971
337	ZNF654	0.0004372436	0.0001699650	2.5726	1.568806e-02	0.03130211
171	HS6ST1	0.0011616253	0.0004526650	2.5662	1.592158e-02	0.03161892
245	MRPL39	0.0013391300	0.0005223661	2.5636	1.601823e-02	0.03166219
148	TAF4	0.0005904934	0.0002309129	2.5572	1.625682e-02	0.03198434
407	ALG13.AS1	0.0012404807	0.0004880769	2.5416	1.685658e-02	0.03238547
51	DDHD2	0.0006663264	0.0002622833	2.5405	1.689888e-02	0.03238547
120	PLAGL1	0.0005631792	0.0002217277	2.5400	1.691942e-02	0.03238547
79	INTS10	0.0006068336	0.0002389245	2.5399	1.692349e-02	0.03238547
93	C2CD5	0.0006058432	0.0002388042	2.5370	1.703600e-02	0.03238547
194	KANSL2	0.0008872758	0.0003497542	2.5369	1.704122e-02	0.03238547
201	MBD1	0.0005425321	0.0002138634	2.5368	1.704277e-02	0.03238547
140	SLC10A3	0.0009829393	0.0003875876	2.5360	1.707319e-02	0.03238547
189	PEX5	0.0012932405	0.0005123686	2.5240	1.755266e-02	0.03308346
58	CMTM6	0.0017058897	0.0006763425	2.5222	1.762628e-02	0.03308346

	names	Estimate	Std.Error	t.statistic	p.value	FDR
197	NCOA2	0.0008054192	0.0003197018	2.5193	1.774630e-02	0.03308346
261	DSCR3	0.0007514300	0.0002984882	2.5175	1.782122e-02	0.03308346
117	BCAS2	0.0006090178	0.0002420605	2.5160	1.788207e-02	0.03308346
316	ARL6IP1	0.0012345264	0.0004908098	2.5153	1.791043e-02	0.03308346
183	SPPL2A	0.0003746729	0.0001491085	2.5128	1.801503e-02	0.03313199
339	PLEKHF2	0.0009489622	0.0003789851	2.5040	1.838314e-02	0.03366263
43	SLC25A43	0.0007730279	0.0003093247	2.4991	1.859005e-02	0.03389478
224	ZNF92	0.0008118875	0.0003252765	2.4960	1.872234e-02	0.03398949
103	INO80D	0.0005541580	0.0002225594	2.4899	1.898425e-02	0.03431769
200	C18orf21	0.0005903150	0.0002378130	2.4823	1.932053e-02	0.03477695
379	IRAK4	0.0004210703	0.0001708270	2.4649	2.010277e-02	0.03594822
311	CMAHP	0.0007431652	0.0003016023	2.4641	2.014120e-02	0.03594822
29	NDUFB4	0.0012061236	0.0004926986	2.4480	2.089158e-02	0.03713084
296	QSOX2	0.0007713730	0.0003164605	2.4375	2.139559e-02	0.03773607
238	ZFP36L2	0.0009926851	0.0004073066	2.4372	2.141054e-02	0.03773607
403	NAXD	0.0006257749	0.0002581703	2.4239	2.206628e-02	0.03873044
206	POGZ	0.0005290698	0.0002199662	2.4052	2.301626e-02	0.04023090
218	OCIAD2	0.0011568864	0.0004819161	2.4006	2.325806e-02	0.04048625
163	RNASEL	0.0005132963	0.0002140144	2.3984	2.337249e-02	0.04051870
275	WDR26	0.0006515947	0.0002721005	2.3947	2.356992e-02	0.04069418
362	LRRC37B	0.0005456514	0.0002290466	2.3823	2.423695e-02	0.04165622
222	RNF44	0.0008658175	0.0003638340	2.3797	2.437711e-02	0.04165622
190	POC1B	0.0008908280	0.0003749501	2.3759	2.458843e-02	0.04165622
40	MYDGF	0.0013760987	0.0005796144	2.3742	2.468211e-02	0.04165622
76	ZDHHC2	0.0008333087	0.0003511122	2.3733	2.472766e-02	0.04165622
402	CLIC1	0.0012607929	0.0005315114	2.3721	2.479704e-02	0.04165622
370	PNRC2	0.0003989600	0.0001682140	2.3717	2.481647e-02	0.04165622
237	UHMK1	0.0004286115	0.0001811670	2.3658	2.514684e-02	0.04204393
4	UFL1	0.0002919023	0.0001234915	2.3637	2.526484e-02	0.04207491
71	RBM3	0.0005036289	0.0002139201	2.3543	2.580482e-02	0.04278526
234	SLC25A4	0.0005374443	0.0002284328	2.3527	2.589368e-02	0.04278526
83	RHEB	0.0007299891	0.0003113427	2.3446	2.636571e-02	0.04339570
304	NEMP1	0.0007306429	0.0003124816	2.3382	2.674752e-02	0.04359065
39	LMAN1	0.0004120478	0.0001762690	2.3376	2.678247e-02	0.04359065
221	BTF3	0.0007895802	0.0003380330	2.3358	2.689002e-02	0.04359065
192	NUP58	0.0003018967	0.0001292531	2.3357	2.689636e-02	0.04359065
95	E2F3	0.0004408303	0.0001903357	2.3161	2.809512e-02	0.04535968
331	STAT5B	0.0005039565	0.0002201011	2.2897	2.978401e-02	0.04790355
167	TBC1D4	0.0005707604	0.0002512980	2.2712	3.101521e-02	0.04941936
322	PPP1CA	0.0016181707	0.0007124900	2.2711	3.102207e-02	0.04941936
6	MDH1	0.0007345141	0.0003235255	2.2703	3.107695e-02	0.04941936
193	N4BP2L1	0.0006144075	0.0002727501	2.2526	3.230647e-02	0.05112888
160	TMED7	0.0007902107	0.0003510073	2.2513	3.240365e-02	0.05112888
298	GHITM	0.0005344812	0.0002375786	2.2497	3.251458e-02	0.05112888
367	FAM92A1	0.0005762252	0.0002567619	2.2442	3.290777e-02	0.05155551
390	CIPC	0.0008912699	0.0003982984	2.2377	3.337830e-02	0.05209971
168	ITM2B	0.0004897186	0.0002203091	2.2229	3.447298e-02	0.05361055
416	NBPF11	0.0010286471	0.0004632914	2.2203	3.466590e-02	0.05371310
116	SWT1	0.0005573456	0.0002517846	2.2136	3.517542e-02	0.05430367
309	MAPK1IP1L	0.0004050776	0.0001831922	2.2112	3.535626e-02	0.05437553
34	CDC42	0.0006636772	0.0003003585	2.2096	3.547907e-02	0.05437553
91	GOLT1B	0.0006769670	0.0003078936	2.1987	3.632713e-02	0.05547429

	names	Estimate	Std.Error	t.statistic	p.value	FDR
172	FAM8A1	0.0007134686	0.0003249411	2.1957	3.656488e-02	0.05563650
246	ATP5J	0.0006059132	0.0002764456	2.1918	3.687311e-02	0.05584547
100	CCNG1	0.0009476893	0.0004326103	2.1906	3.696627e-02	0.05584547
264	SLC37A3	0.0006772117	0.0003095265	2.1879	3.718503e-02	0.05597604
265	PPP1R15B	0.0003703321	0.0001695817	2.1838	3.751496e-02	0.05627244
232	ACAD8	0.0008073511	0.0003708445	2.1771	3.806320e-02	0.05689305
319	C1GALT1C1	0.0003654775	0.0001687227	2.1661	3.896687e-02	0.05803868
122	ALG2	0.0005243923	0.0002426652	2.1610	3.940165e-02	0.05848034
267	BTG2	0.0008326295	0.0003874272	2.1491	4.041372e-02	0.05959607
67	PRELID3B	0.0007507225	0.0003493557	2.1489	4.043516e-02	0.05959607
225	LACTB2	0.0006140509	0.0002877463	2.1340	4.173969e-02	0.06130517
64	CCNB1IP1	0.0005475081	0.0002568260	2.1318	4.193364e-02	0.06137692
220	SRD5A1	0.0005940853	0.0002803846	2.1188	4.310927e-02	0.06288007
176	BUD13	0.0003578329	0.0001692056	2.1148	4.348059e-02	0.06320375
361	NSMCE3	0.0007652536	0.0003630958	2.1076	4.414937e-02	0.06395611
26	TAF2	0.0003690563	0.0001753284	2.1049	4.439658e-02	0.06409472
263	TAB3	0.0003835229	0.0001828200	2.0978	4.507065e-02	0.06484655
110	KDM3A	0.0004990147	0.0002381331	2.0955	4.528908e-02	0.06493993
102	ARL6	0.0004884750	0.0002333599	2.0932	4.550977e-02	0.06503593
345	ARL6IP6	0.0005010816	0.0002423068	2.0680	4.799464e-02	0.06835601
336	GPR171	-0.0006351095	0.0003075104	-2.0653	4.826082e-02	0.06850445
198	GLYR1	0.0003953837	0.0001919390	2.0599	4.880808e-02	0.06890109
48	CHMP2B	0.0006023677	0.0002924997	2.0594	4.886602e-02	0.06890109
68	TM9SF4	0.0003141463	0.0001529613	2.0538	4.944360e-02	0.06948386
70	METTL4	0.0003353403	0.0001641694	2.0426	5.060449e-02	0.07087980
111	NOL10	0.0005385585	0.0002638952	2.0408	5.079938e-02	0.07091795
277	EIF4E3	0.0006749756	0.0003312498	2.0377	5.113291e-02	0.07114876
226	EBAG9	0.0002531786	0.0001249288	2.0266	5.232500e-02	0.07256877
291	KIAA0196	0.0006748153	0.0003343753	2.0181	5.324999e-02	0.07361029
242	CEBPG	0.0003382728	0.0001691162	2.0002	5.525800e-02	0.07613724
66	GINS1	0.0004133047	0.0002070490	1.9962	5.572380e-02	0.07652977
256	RPL30	0.0010584229	0.0005370339	1.9709	5.869738e-02	0.08035272
9	TBPL1	0.0005922521	0.0003013754	1.9652	5.938660e-02	0.08103398
92	CLEC4A	0.0006298252	0.0003218304	1.9570	6.038429e-02	0.08213040
73	UBFD1	0.0004220478	0.0002163656	1.9506	6.117573e-02	0.08294017
368	CERKL	0.0006413762	0.0003316120	1.9341	6.326380e-02	0.08549708
318	XKR6	0.0007320168	0.0003794257	1.9293	6.388776e-02	0.08606536
398	TRIM59	0.0004475526	0.0002331387	1.9197	6.513994e-02	0.08747363
112	RAB3GAP1	0.0001484510	0.0000775788	1.9136	6.595167e-02	0.08828341
343	ZDHHC13	0.0004121858	0.0002163343	1.9053	6.705519e-02	0.08947744
99	ARSB	0.0007622662	0.0004006705	1.9025	6.743992e-02	0.08970782
207	INTS7	0.0004438954	0.0002389414	1.8578	7.374883e-02	0.09779233
401	PPP1CB	0.0005954306	0.0003243724	1.8356	7.705333e-02	0.10185487
357	SH2D1A	-0.0010664737	0.0005841488	-1.8257	7.858091e-02	0.10355055
46	EPB41L2	0.0004749644	0.0002605469	1.8230	7.900557e-02	0.10378682
219	NAF1	0.0003232984	0.0001781255	1.8150	8.025013e-02	0.10509537
328	LRRN3	0.0005224470	0.0002891260	1.8070	8.152216e-02	0.10643170
411	IFNG.AS1	-0.0005213398	0.0002889400	-1.8043	8.194942e-02	0.10666032
65	PCIF1	0.0003926356	0.0002184605	1.7973	8.308496e-02	0.10780656
364	RPS23	0.0009191039	0.0005167797	1.7785	8.617954e-02	0.11147995
126	ELF1	0.0002563900	0.0001448954	1.7695	8.770487e-02	0.11310720
271	SLC37A1	0.0005017942	0.0002841260	1.7661	8.828227e-02	0.11350578

	names	Estimate	Std.Error	t.statistic	p.value	FDR
414	CTD.2501E16.2	-0.0004297026	0.0002450789	-1.7533	9.048961e-02	0.11583623
400	LEPROT	0.0003988975	0.0002276230	1.7524	9.064254e-02	0.11583623
223	PRIM2	0.0003960630	0.0002319783	1.7073	9.882851e-02	0.12591705
77	NBN	0.0002593332	0.0001538730	1.6854	1.030318e-01	0.13087824
86	MAP3K8	0.0003230892	0.0001926483	1.6771	1.046552e-01	0.13254236
23	GLTSCR1	0.0005455170	0.0003304745	1.6507	1.099723e-01	0.13886056
146	INO80	0.0003574968	0.0002176332	1.6427	1.116388e-01	0.14054529
352	HMGN4	0.0003790929	0.0002328074	1.6284	1.146514e-01	0.14390966
63	RPS6KA5	0.0003569852	0.0002208474	1.6164	1.172134e-01	0.14669020
355	TMEM50A	0.0003298804	0.0002059599	1.6017	1.204513e-01	0.15029767
216	ATG3	0.0002814391	0.0001763578	1.5958	1.217507e-01	0.15147222
321	JMJD1C	0.0002355853	0.0001488240	1.5830	1.246574e-01	0.15463372
287	ACSL6	0.0003418470	0.0002214593	1.5436	1.339107e-01	0.16562633
75	SGK3	0.0002287546	0.0001486286	1.5391	1.350053e-01	0.16649339
334	TLR1	0.0003310792	0.0002182402	1.5170	1.404668e-01	0.17272522
22	ELMO2	-0.0002208026	0.0001496608	-1.4754	1.512749e-01	0.18547618
422	RP11.5C23.1	0.0004822673	0.0003328020	1.4491	1.584145e-01	0.19366864
127	SERP1	0.0002765769	0.0001912003	1.4465	1.591312e-01	0.19398417
294	REEP3	0.0002490233	0.0001772586	1.4049	1.710609e-01	0.20792743
97	COX7A2	0.0003770975	0.0002690354	1.4017	1.720036e-01	0.20847423
266	ELK4	0.0002358329	0.0001685073	1.3995	1.726328e-01	0.20850472
16	MSMO1	0.0006178092	0.0004418429	1.3983	1.730146e-01	0.20850472
273	SLC30A7	0.0002524850	0.0001813272	1.3924	1.747533e-01	0.20911244
240	TXNDC11	0.0004285994	0.0003079821	1.3916	1.749901e-01	0.20911244
179	RABGGTB	0.0002572125	0.0001848325	1.3916	1.750019e-01	0.20911244
386	PNP	0.0005169485	0.0003741499	1.3817	1.780016e-01	0.21209772
139	FAM78A	-0.0004110140	0.0003055129	-1.3453	1.893154e-01	0.22494495
233	KIN	-0.0001571441	0.0001174608	-1.3378	1.917129e-01	0.22715564
406	LINC00623	0.0004825797	0.0003664253	1.3170	1.985182e-01	0.23456201
157	TSPAN2	0.0003308056	0.0002531384	1.3068	2.019067e-01	0.23790121
259	SEC13	0.0003203131	0.0002464649	1.2996	2.043265e-01	0.24008365
57	PUS7	0.0003487348	0.0002698505	1.2923	2.068084e-01	0.24232670
302	TMX3	0.0001285896	0.0001035059	1.2423	2.244158e-01	0.26223167
388	SFMBT2	-0.0003342819	0.0002749787	-1.2157	2.342634e-01	0.27298460
41	ARHGAP15	0.0003028796	0.0002499343	1.2118	2.357025e-01	0.27390703
397	HLA.A	-0.0003110477	0.0002589004	-1.2014	2.396529e-01	0.27772186
393	NAGA	-0.0001797986	0.0001498661	-1.1997	2.402983e-01	0.27772186
155	ARNTL	0.0002977453	0.0002553670	1.1660	2.534703e-01	0.29214698
153	KIAA0907	0.0002815062	0.0002448897	1.1495	2.600651e-01	0.29893349
418	RP11.154H23.3	0.0002438949	0.0002153350	1.1326	2.669758e-01	0.30604541
215	NFKBIZ	0.0003477685	0.0003187559	1.0910	2.845648e-01	0.32532683
255	DCK	0.0002361779	0.0002223772	1.0621	2.972833e-01	0.33895109
213	CSRNP1	0.0003158340	0.0002993308	1.0551	3.003840e-01	0.34156570
53	PGS1	0.0002443465	0.0002334440	1.0467	3.041886e-01	0.34496460
356	TBK1	0.0001635782	0.0001585079	1.0320	3.109100e-01	0.35164424
174	FCHSD2	0.0001757848	0.0001720343	1.0218	3.156229e-01	0.35602268
154	USPL1	0.0001802700	0.0001772060	1.0173	3.177253e-01	0.35744095
134	AMD1	0.0002048975	0.0002032442	1.0081	3.220230e-01	0.36131489
81	BET1	0.0001432647	0.0001431950	1.0005	3.256432e-01	0.36441022
162	CCDC146	-0.0002046587	0.0002063436	-0.9918	3.297727e-01	0.36805768
181	CENPO	0.0002556448	0.0002606132	0.9809	3.350248e-01	0.37293548
118	LGALS8	-0.0001535076	0.0001596473	-0.9615	3.445104e-01	0.38248795

	names	Estimate	Std.Error	t.statistic	p.value	FDR
114	TIA1	0.0001340060	0.0001430689	0.9367	3.569461e-01	0.39525704
417	NBPF12	0.0002500393	0.0002936150	0.8516	4.016672e-01	0.44361682
228	NOTCH1	0.0002255744	0.0002745347	0.8217	4.182118e-01	0.46068643
405	AC093818.1	-0.0001544513	0.0001928562	-0.8009	4.299549e-01	0.47239201
254	FAM161B	0.0001707463	0.0002155638	0.7921	4.349671e-01	0.47666079
72	FNDC3A	-0.0000864837	0.0001127031	-0.7674	4.492914e-01	0.49108600
33	CLEC2D	-0.0002886735	0.0003785102	-0.7627	4.520454e-01	0.49282270
317	EMB	0.0002175476	0.0003087050	0.7047	4.868113e-01	0.52936032
32	FTSJ1	0.0001453912	0.0002112883	0.6881	4.970405e-01	0.53909780
235	PARP8	-0.0001145582	0.0001808481	-0.6334	5.315806e-01	0.57508592
59	FKBP5	0.0001195887	0.0001947815	0.6140	5.441959e-01	0.58723185
346	GRAMD1C	0.0001536877	0.0002524835	0.6087	5.476277e-01	0.58943139
394	SYT15	-0.0001414527	0.0002354582	-0.6008	5.528355e-01	0.59352642
372	CTBP1.AS2	0.0000932044	0.0001606312	0.5802	5.663947e-01	0.60654418
396	LIN52	0.0001061371	0.0001892216	0.5609	5.793176e-01	0.61881658
208	EFNA3	0.0001452409	0.0002619324	0.5545	5.836408e-01	0.62186416
136	BTN2A2	0.0002092487	0.0003796075	0.5512	5.858526e-01	0.62265234
280	CD200R1	0.0001451742	0.0002794209	0.5196	6.074578e-01	0.64399663
27	SNX24	-0.0000721165	0.0001572330	-0.4587	6.500188e-01	0.68739486
308	MLST8	0.0001090875	0.0002483357	0.4393	6.638345e-01	0.70025432
286	ERAP1	0.0000753807	0.0001799174	0.4190	6.784319e-01	0.71387232
408	RP11.666F17.1	0.0001137887	0.0003055701	0.3724	7.124125e-01	0.74776793
335	GCSAM	0.0000684795	0.0002141775	0.3197	7.515448e-01	0.78688976
82	TWISTNB	-0.0000537111	0.0001749610	-0.3070	7.611231e-01	0.79495082
278	EIF5A2	0.0000648502	0.0002168951	0.2990	7.671531e-01	0.79927525
326	HPSE	-0.0000651726	0.0002295999	-0.2839	7.786116e-01	0.80922045
320	SPSB1	-0.0000472106	0.0001794178	-0.2631	7.943754e-01	0.82358037
329	PARP15	-0.0000860351	0.0003765571	-0.2285	8.209350e-01	0.84903542
132	SPATA1	0.0000504419	0.0002296293	0.2197	8.277243e-01	0.85396927
290	TP53INP1	0.0000602933	0.0002936949	0.2053	8.388290e-01	0.86332041
80	OAZ1	0.0000337373	0.0001668469	0.2022	8.412182e-01	0.86367793
147	TEP1	0.0000376748	0.0002100193	0.1794	8.589254e-01	0.87972260
35	RDH11	-0.0000376852	0.0002357859	-0.1598	8.741639e-01	0.89316747
11	UBA6	0.0000182077	0.0001364712	0.1334	8.948172e-01	0.91206666
419	NBPF19	0.0000271767	0.0002230679	0.1218	9.039027e-01	0.91911256
161	BICDL1	0.0000301402	0.0002643958	0.1140	9.100541e-01	0.92314837
143	IRF5	0.0000333176	0.0003344932	0.0996	9.213667e-01	0.93238782
288	CREBRF	-0.0000155241	0.0001662916	-0.0934	9.262863e-01	0.93512917
358	VPS33B	-0.0000086162	0.0001557421	-0.0553	9.562737e-01	0.96149559
186	CNOT6L	-0.0000072987	0.0001340006	-0.0545	9.569495e-01	0.96149559
384	BAZ1A	0.0000101561	0.0001973896	0.0515	9.593305e-01	0.96160384
5	ZC3H3	0.0000042798	0.0002471585	0.0173	9.863072e-01	0.98630720

2.2.3 Compare the Associations between Genelists

```
gene_FunRegRaw <- function(gene_matrix, clinical_variable, genelistname,clin_var_name){
  ## number of gene to test, also the number of multiple test
  n_gene = ncol(gene_matrix)
  ## outcome lm
  outcome_lm = lapply(1:n_gene, function(i){
  lm = lm(gene_matrix[,i]~ clinical_variable + isgs.rld.lin$age + isgs.rld.lin$sex )
```

```r
  coef = summary(lm)$coefficients[2, ]
  return(coef)
})
    outcome_lm = data.frame(matrix(unlist(outcome_lm), ncol = 4, byrow = TRUE,
                          dimnames = list(
                    c(colnames(gene_matrix)),
                      c("Estimate", "Std.Error", "t.statistic", "p.value"))))

    # adjusted p-value
     outcome_lm =  outcome_lm %>%
                              dplyr::mutate(FDR = p.adjust(p.value, "BH", n_gene ),
                                    names = colnames(gene_matrix)) %>%
                              dplyr::mutate(Estimate = round(Estimate, 10),
                                      Std.Error = round(Std.Error, 10),
                                      t.statistic = round(t.statistic,4)
                                      )%>%
                              select(names, everything())
    # sort by p.value
     outcome_lm = outcome_lm[order(outcome_lm$p.value), ]

    ## sample size
     size = length(clinical_variable) - sum(clinical_variable)

    # ## summary table
    # kable(outcome_lm,
    #        caption = paste("Top Genes from ", genelistname, " Associated with Outcome: ", clin_var_name
    #                  " by p.value", " (Sample Size = ", size, ") ", sep = "" , collapse = ""),
    #        digits = c(2,10,10,4,20,20))
     return(outcome_lm)
}


### cd4 counts
################## CD4 Counts ##################
## whole isgs
isgs.cd4 <- gene_FunRegRaw(as.matrix(isgs.rld.lin[,2:231]), isgs.rld.lin[,234], "Core ISGs", "CD4 Counts

## betas
genesbeta.cd4 <- gene_FunRegRaw(as.matrix(genesbeta.rld.lin[,2:424]), genesbeta.rld.lin[,427], "IFN-beta

## enchanced volcano plots
## volcano plot
rownames(isgs.cd4) <- isgs.cd4$names
EnhancedVolcano(isgs.cd4,
      lab = rownames(isgs.cd4),
      x = "Estimate",
      y = "FDR",
      FCcutoff = 0.002,
      xlab = bquote("Effect Size"),
      ylab = bquote(~-Log[10]~adjusted~italic(P)),
      title = "Core ISGs: Association with CD4 Counts",
      xlim = c(-0.003, 0.003),
      ylim = c(0, -log10(10e-10)),
      # adjust the legend
```
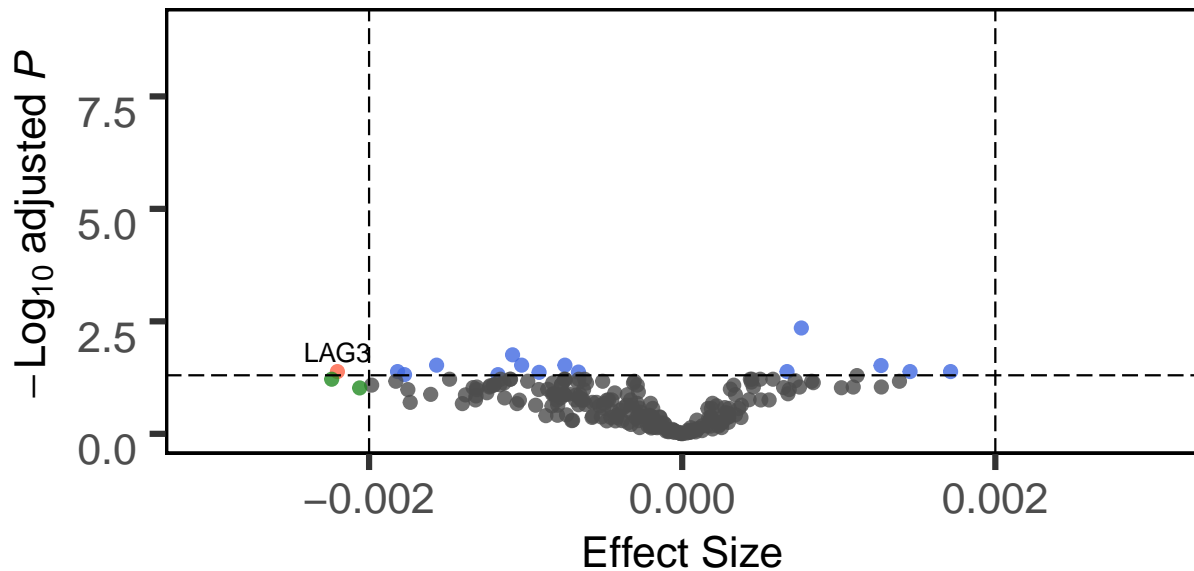
```
legend=c("NS","log2 Fold Change >= 0.002","adjusted p-value <= 0.05",
    "adjusted p-value <= 0.05 & log2 Fold Change >= 0.002"),
pLabellingCutoff = 5e-2,
pCutoff = 5e-2,
## select labels to show
# selectLab = c("cg18587484","cg00803922", " cg19425295"),
## point and label size
transcriptPointSize = 2.0,
transcriptLabSize = 3.5,
#Modify border and remove gridlines
gridlines.major = FALSE,
gridlines.minor = FALSE,
border = "full",
borderWidth = 1.0,
borderColour = "black",
# the transparence of the dots
colAlpha = 0.8,
legendPosition = "bottom",
legendLabSize = 9,
legendIconSize = 3,
# connectors
DrawConnectors = TRUE,
#
widthConnectors = 0.3,
#
colConnectors = "grey40",
col = c("grey30", "forestgreen", "royalblue", "tomato")
)
```
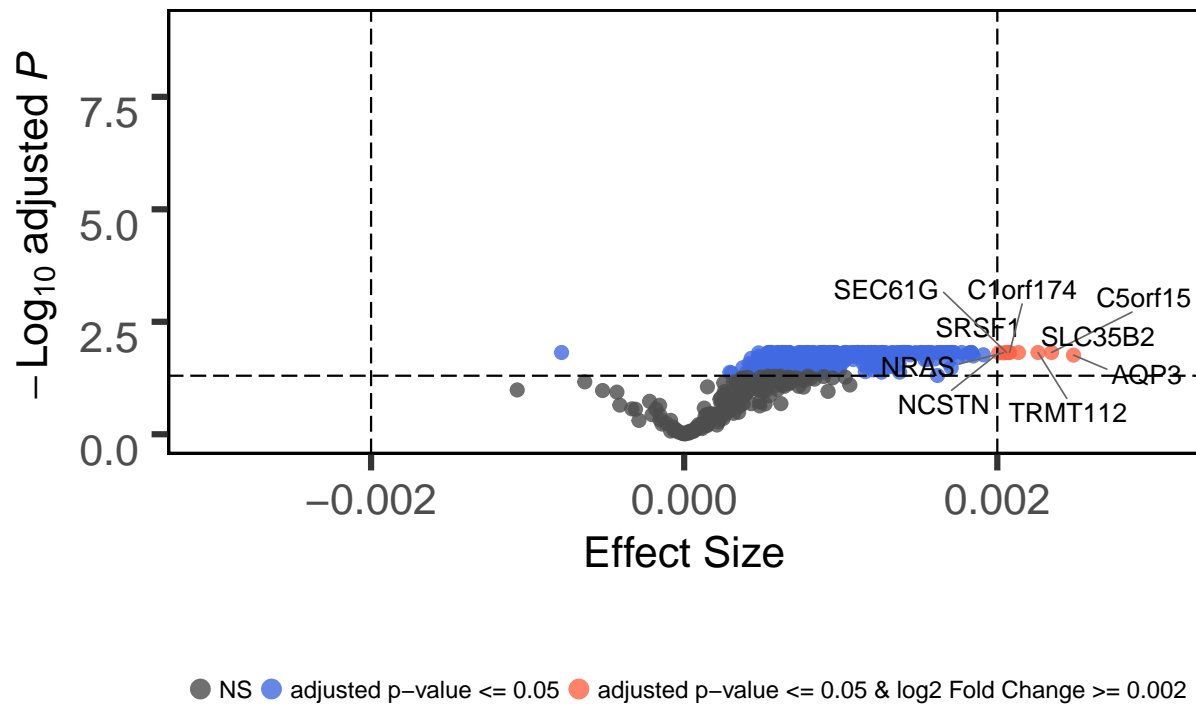

Core ISGs: Association with CD4 Counts

83

```r
## volcano plot
rownames(genesbeta.cd4) <- genesbeta.cd4$names
EnhancedVolcano(genesbeta.cd4,
        lab = rownames(genesbeta.cd4),
        x = "Estimate",
        y = "FDR",
        FCcutoff = 0.002,
        xlab = bquote("Effect Size"),
        ylab = bquote(~-Log[10]~adjusted~italic(P)),
        title = "IFN-beta Genes: Association with CD4 Counts",
        xlim = c(-0.003, 0.003),
        ylim = c(0, -log10(10e-10)),
        # adjust the legend
        legend=c("NS","log2 Fold Change >= 0.002","adjusted p-value <= 0.05",
            "adjusted p-value <= 0.05 & log2 Fold Change >= 0.002"),
        pLabellingCutoff = 5e-2,
        pCutoff = 5e-2,
        ## select labels to show
        # selectLab = c("cg18587484","cg00803922", " cg19425295"),
        ## point and label size
        transcriptPointSize = 2.0,
        transcriptLabSize = 3.5,
        #Modify border and remove gridlines
        gridlines.major = FALSE,
        gridlines.minor = FALSE,
        border = "full",
        borderWidth = 1.0,
        borderColour = "black",
        # the transparence of the dots
        colAlpha = 0.8,
        legendPosition = "bottom",
        legendLabSize = 9,
        legendIconSize = 3,
        # connectors
        DrawConnectors = TRUE,
        #
        widthConnectors = 0.3,
        #
        colConnectors = "grey40",
        col = c("grey30", "forestgreen", "royalblue", "tomato")
        )
```

IFN–beta Genes: Association with CD4 Counts

3 Reference

1. A comparison of per sample global scaling and per gene normalization methods for differential expression analysis of RNA-seq data, PLos One. 2017.

2. Voom: precision weights unlock linear model analysis tools for RNA-seq read counts, Charity W Law, Yunshun Chen, Wei Shi and Gordon K Smyth, Genome Biology, 2014 15:R29.

3. Michael I Love, Wolfgang Huber, Simon Anders: Moderated estimation of fold change and dispersion for RNA-seq data with DESeq2. Genome Biology 2014, 15:550. http://dx.doi.org/10.1186/s13059-014-0550-8.