HW3

5/21/2021

```
##loading library

library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.1.1     v dplyr   1.0.5
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(ROCR)
library(tree)
```

```
## Registered S3 method overwritten by 'tree':
##   method     from
##   print.tree cli
```

```
library(maptree)
```

```
## Loading required package: cluster

## Loading required package: rpart
```

```
library(class)
library(lattice)
library(ggridges)
library(superheat)
## loading the drug dataset and transform variales
drug_use <- read_csv('drug.csv',
col_names = c('ID','Age','Gender','Education','Country','Ethnicity', 'Nscore','Escore','Oscore','Ascore
'Choc','Coke','Crack','Ecstasy','Heroin','Ketamine', 'Legalh','LSD','Meth','Mushrooms','Nicotine','Seme
```

```
##
## -- Column specification --------------------------------------------------------
## cols(
##   .default = col_character(),
```

```
##   ID = col_double(),
##   Age = col_double(),
##   Gender = col_double(),
##   Education = col_double(),
##   Country = col_double(),
##   Ethnicity = col_double(),
##   Nscore = col_double(),
##   Escore = col_double(),
##   Oscore = col_double(),
##   Ascore = col_double(),
##   Cscore = col_double(),
##   Impulsive = col_double(),
##   SS = col_double()
## )
## i Use `spec()` for the full column specifications.
```

```
drug_use <- drug_use %>% mutate_at(as.ordered, .vars=vars(Alcohol:VSA))
drug_use <- drug_use %>%
mutate(Gender = factor(Gender, labels=c("Male", "Female"))) %>% mutate(Ethnicity = factor(Ethnicity, lab
```

##1. Logistic regression for drug use prediction ###a

```
## create a new factor response variable recent_cannabis_use

drug_use = drug_use %>% mutate(recent_cannabis_use=ifelse(Cannabis >= "CL3","Yes","No"))%>% mutate(recen
```

###b

```
##create a new tibble
drug_use_subset <- drug_use %>% select(Age:SS, recent_cannabis_use)
##Split drug_use_subset into a training data set and a test data set
set.seed(1)
training.indices = sample(1:nrow(drug_use_subset), 1500)
drug_use_train = drug_use_subset[training.indices,]
drug_use_test = drug_use_subset[-training.indices,]
dim(drug_use_train)
```

```
## [1] 1500   13
```

```
dim(drug_use_test)
```

```
## [1] 385  13
```

###c

```
##Fit a logistic regression
glm.fit = glm(recent_cannabis_use ~ ., data=drug_use_train, family=binomial)
# Summarize the logistic regression model
summary(glm.fit)
```

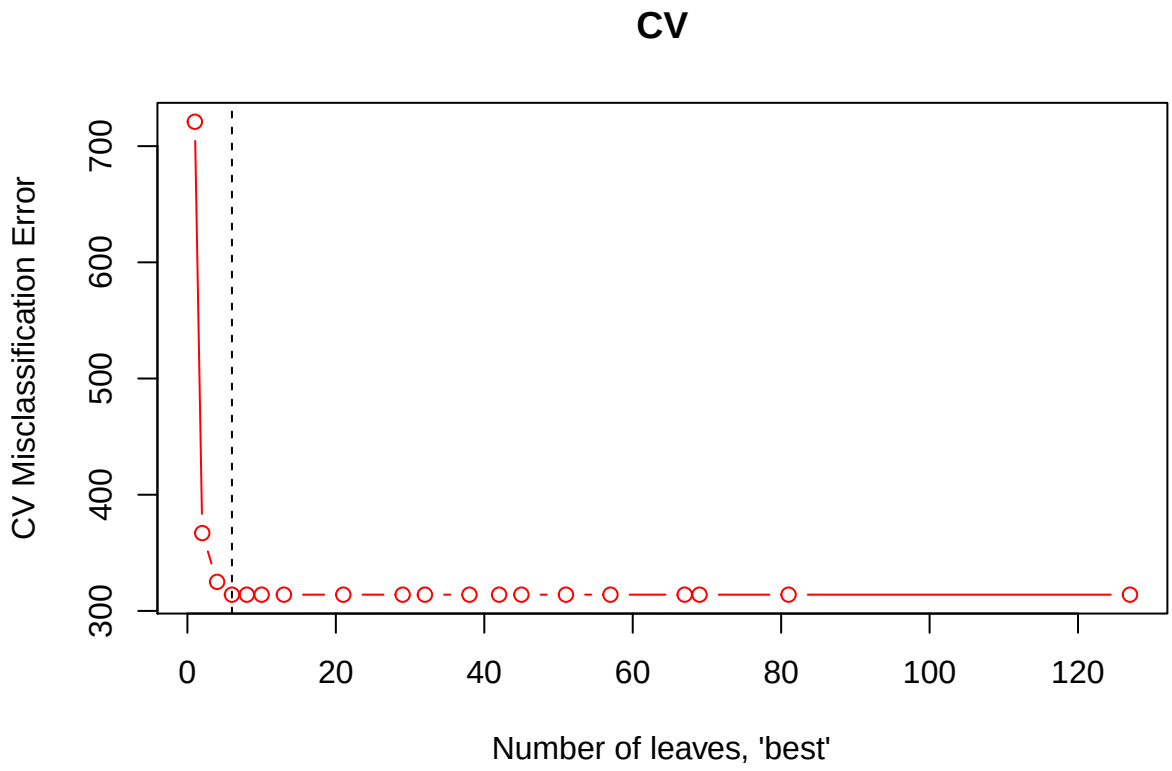
```
##
## Call:
## glm(formula = recent_cannabis_use ~ ., family = binomial, data = drug_use_train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.9072  -0.5971   0.1416   0.5426   2.6600
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  0.94949    0.64574   1.470 0.141457
## Age                         -0.84406    0.09328  -9.049  < 2e-16 ***
## GenderFemale                -0.55929    0.15715  -3.559 0.000372 ***
## Education                   -0.33389    0.07962  -4.193 2.75e-05 ***
## CountryCanada               13.10904  627.22755   0.021 0.983325
## CountryNew Zealand          -1.16844    0.31848  -3.669 0.000244 ***
## CountryOther                -0.05676    0.46772  -0.121 0.903412
## CountryIreland              -0.28763    0.67573  -0.426 0.670354
## CountryUK                   -0.43371    0.37043  -1.171 0.241674
## CountryUSA                  -1.75636    0.19262  -9.118  < 2e-16 ***
## EthnicityAsian              -0.67025    0.96037  -0.698 0.485230
## EthnicityWhite               0.74053    0.63843   1.160 0.246081
## EthnicityMixed:White/Black  -0.04713    1.09013  -0.043 0.965515
## EthnicityOther               1.07889    0.76823   1.404 0.160206
## EthnicityMixed:White/Asian   0.72525    1.01565   0.714 0.475178
## EthnicityMixed:Black/Asian  14.27149  766.28165   0.019 0.985141
## Nscore                      -0.10143    0.09034  -1.123 0.261551
## Escore                      -0.13375    0.09559  -1.399 0.161742
## Oscore                       0.71000    0.09137   7.770 7.83e-15 ***
## Ascore                       0.03058    0.08232   0.372 0.710251
## Cscore                      -0.35855    0.09132  -3.926 8.63e-05 ***
## Impulsive                   -0.09043    0.10093  -0.896 0.370290
## SS                           0.58068    0.10836   5.359 8.39e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 2077.2  on 1499  degrees of freedom
## Residual deviance: 1202.1  on 1477  degrees of freedom
## AIC: 1248.1
##
## Number of Fisher Scoring iterations: 14
```

##2. Decision tree models of drug use

```
## Construct a decision tree
tree_parameters = tree.control(nobs=nrow(drug_use_train), minsize=10, mindev=1e-3)
drugtree = tree(recent_cannabis_use~.,control = tree_parameters,data = drug_use_train)
```

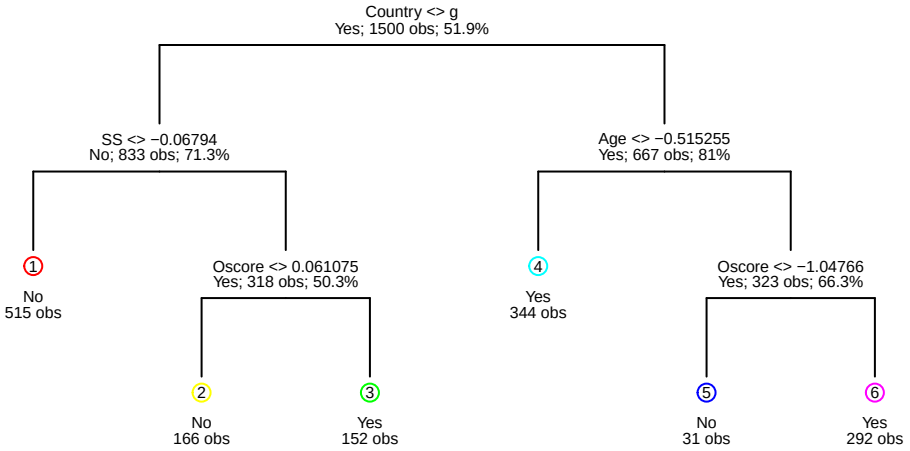
###a Use 10-fold CV to select the a tree

```
# Set random seed
set.seed(1)
cv = cv.tree(drugtree,FUN=prune.misclass, K=10)
best.size.cv = 6
plot(cv$size , cv$dev, type="b",
     xlab = "Number of leaves, \'best\'", ylab = "CV Misclassification Error",
     col = "red", main="CV")
abline(v=best.size.cv, lty=2)
```



###b Prune the tree

```
# prune the original tree using the best size in a
drugtree.pruned = prune.misclass(drugtree, best=best.size.cv)
draw.tree(drugtree.pruned, nodeinfo=TRUE,cex = 0.5)
```



The variable 'Country' is split first in this decision tree.

###c Compute and print the confusion matrix for the test data

```
# Predict on test set
predictions = predict(drugtree.pruned, drug_use_test, type="class")
# get the true response of the test data
truth = drug_use_test$recent_cannabis_use
# Obtain confusion matrix
confusion_matrix = table(truth, predictions)
confusion_matrix
```

```
##      predictions
## truth  No Yes
##   No  125  40
##   Yes  45 175
```

```
# get true positive rate
true_positive_rate = confusion_matrix[2,2]/sum(confusion_matrix[2,])
true_positive_rate
```

```
## [1] 0.7954545
```

```
# get false positive rate
false_positive_rate = confusion_matrix[1,2]/sum(confusion_matrix[1,])
false_positive_rate
```

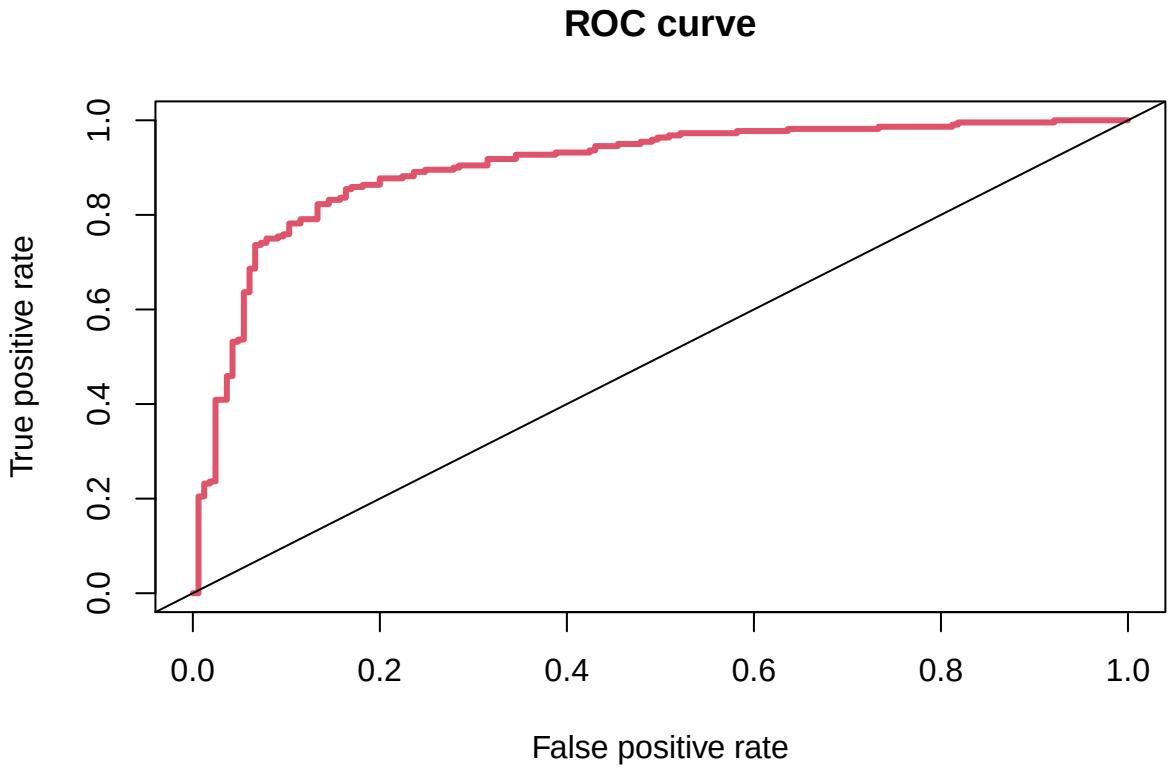
```
## [1] 0.2424242
```

##3.Model Comparison ###a

```
# get predition from logistic regression model using test data
prob_log_testing = predict(glm.fit,drug_use_test,type="response")
pred_log = prediction(prob_log_testing, truth)
#calculate the True Positive Rate and False Positive Rate by performance()
perf_log = performance(pred_log, measure="tpr", x.measure="fpr")
# for the decision tree model
```

```
prob_tree_testing = predict(drugtree.pruned,newdata = drug_use_test)[,2]
pred_tree = prediction(prob_tree_testing,truth)
perf_tree = performance(pred_tree, measure="tpr", x.measure="fpr")

plot(perf_log, col=2, lwd=3, main="ROC curve")
abline(0,1)
```



###b

```
##Compute the AUC for logistic regression model
auc_log = performance(pred_log, "auc")@y.values
auc_log
```

```
## [[1]]
## [1] 0.902562
```

```
##Compute the AUC for decision tree model
auc_tree = performance(pred_tree, "auc")@y.values
auc_tree
```

```
## [[1]]
## [1] 0.8570523
```

```
# logistic is larger
```

##4. Clustering and dimension reduction for gene expression data

```r
## read leukemia_data
leukemia_data <- read_csv("leukemia_data.csv")
```

```
## Warning: Duplicated column names deduplicated: 'FCGRT' => 'FCGRT_1' [3],
## 'TUBB4B' => 'TUBB4B_1' [49], 'SSR1' => 'SSR1_1' [67], 'HSP90AB1' =>
## 'HSP90AB1_1' [115], 'TMBIM6' => 'TMBIM6_1' [118], 'GAB1' => 'GAB1_1' [119],
## 'MPHOSPH9' => 'MPHOSPH9_1' [153], 'STK38' => 'STK38_1' [157], 'SFPQ' =>
## 'SFPQ_1' [159], 'RIPOR2' => 'RIPOR2_1' [181], 'HLA-F' => 'HLA-F_1' [188],
## 'PRPF40A' => 'PRPF40A_1' [198], 'SEPT6' => 'SEPT6_1' [205], 'CD22' =>
## 'CD22_1' [235], 'NCF4' => 'NCF4_1' [250], 'WAS' => 'WAS_1' [260], 'HLA-
## G' => 'HLA-G_1' [297], 'TRAF3IP3' => 'TRAF3IP3_1' [307], 'ZNF266' =>
## 'ZNF266_1' [364], 'CRYBG1' => 'CRYBG1_1' [441], 'BRD8' => 'BRD8_1' [460], 'MDC1'
## => 'MDC1_1' [464], 'RAC2' => 'RAC2_1' [478], 'IL10RB' => 'IL10RB_1' [483],
## 'AKAP17A' => 'AKAP17A_1' [542], 'N4BP2L1' => 'N4BP2L1_1' [547], 'ARPC4' =>
## 'ARPC4_1' [565], 'SRSF10' => 'SRSF10_1' [576], 'RAPGEF2' => 'RAPGEF2_1' [583],
## 'PARP2' => 'PARP2_1' [587], 'TRIM33' => 'TRIM33_1' [610], 'KAT8' =>
## 'KAT8_1' [665], 'ASMTL' => 'ASMTL_1' [715], 'LSM7' => 'LSM7_1' [727],
## 'HLA-DQB1' => 'HLA-DQB1_1' [732], 'FMR1' => 'FMR1_1' [826], 'RASGRP2' =>
## 'RASGRP2_1' [858], 'LIMK2' => 'LIMK2_1' [866], 'TMEM106C' => 'TMEM106C_1' [881],
## 'TGOLN2' => 'TGOLN2_1' [937], 'SLC25A1' => 'SLC25A1_1' [940], 'NMT1' =>
## 'NMT1_1' [942], 'ENSA' => 'ENSA_1' [947], 'ENSA' => 'ENSA_2' [948], 'UBR5'
## => 'UBR5_1' [963], 'UBE2J1' => 'UBE2J1_1' [966], 'ACTN1' => 'ACTN1_1' [994],
## 'TRA2A' => 'TRA2A_1' [1003], 'ATXN10' => 'ATXN10_1' [1057], 'CUL1' =>
## 'CUL1_1' [1077], 'XBP1' => 'XBP1_1' [1094], 'ATP2A2' => 'ATP2A2_1' [1110],
## 'LDLRAD4' => 'LDLRAD4_1' [1118], 'ARHGEF2' => 'ARHGEF2_1' [1134],
## 'IDH3B' => 'IDH3B_1' [1141], 'SERBP1' => 'SERBP1_1' [1188], 'TRIM44' =>
## 'TRIM44_1' [1205], 'TRIM44' => 'TRIM44_2' [1206], 'PTPRC' => 'PTPRC_1' [1219],
## 'PTPRC' => 'PTPRC_2' [1220], 'PPP2R5C' => 'PPP2R5C_1' [1235], 'PPP2R5C'
## => 'PPP2R5C_2' [1236], 'ADAM10' => 'ADAM10_1' [1241], 'NFATC3' =>
## 'NFATC3_1' [1252], 'ILF3' => 'ILF3_1' [1264], 'RBM6' => 'RBM6_1' [1274],
## 'CTNNA1' => 'CTNNA1_1' [1297], 'CTNNA1' => 'CTNNA1_2' [1298], 'IGHM' =>
## 'IGHM_1' [1302], 'IGHM' => 'IGHM_2' [1303], 'IGHM' => 'IGHM_3' [1304], 'SFPQ' =>
## 'SFPQ_2' [1321], 'RBCK1' => 'RBCK1_1' [1398], 'NFATC2IP' => 'NFATC2IP_1' [1408],
## 'ILF3' => 'ILF3_2' [1432], 'RAE1' => 'RAE1_1' [1436], 'ITPR1' =>
## 'ITPR1_1' [1443], 'NCBP2' => 'NCBP2_1' [1448], 'STAT1' => 'STAT1_1' [1486],
## 'AZIN1' => 'AZIN1_1' [1497], 'SEC13' => 'SEC13_1' [1517], 'ABI1' =>
## 'ABI1_1' [1565], 'CYB5B' => 'CYB5B_1' [1607], 'HUWE1' => 'HUWE1_1' [1624],
## 'RAB1A' => 'RAB1A_1' [1634], 'AHCYL1' => 'AHCYL1_1' [1652], 'EIF1AX' =>
## 'EIF1AX_1' [1661], 'MAGED2' => 'MAGED2_1' [1689], 'SCAF11' => 'SCAF11_1' [1709],
## 'BLCAP' => 'BLCAP_1' [1716], 'TROVE2' => 'TROVE2_1' [1729], 'CTCF' =>
## 'CTCF_1' [1745], 'RAB8A' => 'RAB8A_1' [1754], 'ACTR2' => 'ACTR2_1' [1768],
## 'HMGN4' => 'HMGN4_1' [1771], 'NDUFB7' => 'NDUFB7_1' [1793], 'VAMP3' =>
## 'VAMP3_1' [1796], 'SRSF6' => 'SRSF6_1' [1808], 'TNPO3' => 'TNPO3_1' [1811],
## 'SRSF1' => 'SRSF1_1' [1834], 'TMED10' => 'TMED10_1' [1847], 'AP3D1' =>
## 'AP3D1_1' [1872], 'MAPKAPK2' => 'MAPKAPK2_1' [1877], 'BRD2' => 'BRD2_1' [1891],
## 'BRD2' => 'BRD2_2' [1892], 'GARS' => 'GARS_1' [1901], 'SNX1' => 'SNX1_1' [1902],
## 'TSC22D3' => 'TSC22D3_1' [1927], 'AMD1' => 'AMD1_1' [1951], 'LITAF' =>
## 'LITAF_1' [2011], 'GLUD1' => 'GLUD1_1' [2059], 'KDELR1' => 'KDELR1_1' [2079],
## 'PGK1' => 'PGK1_1' [2099], 'VDAC2' => 'VDAC2_1' [2107], 'ADH5' =>
## 'ADH5_1' [2111], 'MEF2C' => 'MEF2C_1' [2113], 'MEF2C' => 'MEF2C_2' [2114],
## 'RCN2' => 'RCN2_1' [2125], 'PCMT1' => 'PCMT1_1' [2134], 'PCMT1' =>
## 'PCMT1_2' [2135], 'CD79A' => 'CD79A_1' [2149], 'MARCH6' => 'MARCH6_1' [2169],
## 'CBX3' => 'CBX3_1' [2180], 'LSM14A' => 'LSM14A_1' [2217], 'SORL1' =>
```

```
## 'SORL1_1' [2220], 'ICAM2' => 'ICAM2_1' [2244], 'SNRPB' => 'SNRPB_1' [2246],
## 'CYB5A' => 'CYB5A_1' [2248], 'BTN3A2' => 'BTN3A2_1' [2277], 'DICER1' =>
## 'DICER1_1' [2280], 'HADH' => 'HADH_1' [2281], 'HDGF' => 'HDGF_1' [2285], 'SEPT6'
## => 'SEPT6_2' [2306], 'SSBP1' => 'SSBP1_1' [2315], 'H2AFV' => 'H2AFV_1' [2318],
## 'PTPA' => 'PTPA_1' [2331], 'FBL' => 'FBL_1' [2354], 'OGT' => 'OGT_1' [2362],
## 'SLC25A1' => 'SLC25A1_2' [2377], 'FUBP1' => 'FUBP1_1' [2386], 'TUBGCP2' =>
## 'TUBGCP2_1' [2400], 'COX5B' => 'COX5B_1' [2402], 'VDAC1' => 'VDAC1_1' [2410],
## 'HNRNPDL' => 'HNRNPDL_1' [2431], 'THUMPD1' => 'THUMPD1_1' [2443], 'CDV3'
## => 'CDV3_1' [2444], 'UBE3B' => 'UBE3B_1' [2447], 'SFPQ' => 'SFPQ_3' [2451],
## 'STX16' => 'STX16_1' [2452], 'SMARCA2' => 'SMARCA2_1' [2471], 'CHD8' =>
## 'CHD8_1' [2475], 'TCF25' => 'TCF25_1' [2490], 'API5' => 'API5_1' [2491],
## 'SAP18' => 'SAP18_1' [2493], 'AHCYL1' => 'AHCYL1_2' [2501], 'CTBP1' =>
## 'CTBP1_1' [2503], 'AES' => 'AES_1' [2512], 'PURA' => 'PURA_1' [2514], 'BCL11A'
## => 'BCL11A_1' [2518], 'BUB3' => 'BUB3_1' [2534], 'RER1' => 'RER1_1' [2537],
## 'ATXN2L' => 'ATXN2L_1' [2541], 'JAK1' => 'JAK1_1' [2548], 'GUSBP11' =>
## 'GUSBP11_1' [2564], 'JTB' => 'JTB_1' [2568], 'BRD3' => 'BRD3_1' [2571], 'RSU1'
## => 'RSU1_1' [2584], 'ADD3' => 'ADD3_1' [2619], 'UBE2I' => 'UBE2I_1' [2627],
## 'MRPS12' => 'MRPS12_1' [2640], 'CTNNA1' => 'CTNNA1_3' [2641], 'XRCC5' =>
## 'XRCC5_1' [2642], 'ITGA4' => 'ITGA4_1' [2644], 'CTNNA1' => 'CTNNA1_4' [2647],
## 'FYN' => 'FYN_1' [2649], 'ERG' => 'ERG_1' [2652], 'RAC1' => 'RAC1_1' [2654],
## 'LCK' => 'LCK_1' [2657], 'PTK2B' => 'PTK2B_1' [2664], 'SKP1' =>
## 'SKP1_1' [2665], 'PRKDC' => 'PRKDC_1' [2666], 'MYC' => 'MYC_1' [2668], 'RBL2'
## => 'RBL2_1' [2673], 'AZIN1' => 'AZIN1_2' [2674], 'CCNA2' => 'CCNA2_1' [2681],
## 'FOS' => 'FOS_1' [2688], 'FOS' => 'FOS_2' [2689], 'RAF1' => 'RAF1_1' [2690],
## 'RAP1B' => 'RAP1B_1' [2692], 'ERCC1' => 'ERCC1_1' [2696], 'ERCC1' =>
## 'ERCC1_2' [2697], 'RAN' => 'RAN_1' [2702], 'TRIM27' => 'TRIM27_1' [2703],
## 'PMS2P3' => 'PMS2P3_1' [2708], 'TGFBR2' => 'TGFBR2_1' [2710], 'PCNA' =>
## 'PCNA_1' [2712], 'MYC' => 'MYC_2' [2714], 'CDK13' => 'CDK13_1' [2717],
## 'CCND3' => 'CCND3_1' [2719], 'FARSA' => 'FARSA_1' [2732], 'FARSA' =>
## 'FARSA_2' [2733], 'DAXX' => 'DAXX_1' [2734], 'UBE3A' => 'UBE3A_1' [2735],
## 'ARAF' => 'ARAF_1' [2739], 'UBE2N' => 'UBE2N_1' [2747], 'RASA1' =>
## 'RASA1_1' [2748], 'ABL1' => 'ABL1_1' [2749], 'ABL1' => 'ABL1_2' [2750], 'MTA1'
## => 'MTA1_1' [2753], 'EIF3I' => 'EIF3I_1' [2754], 'SYK' => 'SYK_1' [2761],
## 'TOP2A' => 'TOP2A_1' [2762], 'RB1' => 'RB1_1' [2764], 'TOP2B' =>
## 'TOP2B_1' [2765], 'TNFRSF1B' => 'TNFRSF1B_1' [2766], 'GRB2' => 'GRB2_1' [2769],
## 'RBM5' => 'RBM5_1' [2770], 'N4BP2L1' => 'N4BP2L1_2' [2773], 'N4BP2L2' =>
## 'N4BP2L2_1' [2774], 'NME1' => 'NME1_1' [2775], 'TYMS' => 'TYMS_1' [2776],
## 'DYRK1A' => 'DYRK1A_1' [2778], 'FEN1' => 'FEN1_1' [2779], 'FEN1' =>
## 'FEN1_2' [2780], 'ETS2' => 'ETS2_1' [2781], 'FNTA' => 'FNTA_1' [2783], 'JAK1'
## => 'JAK1_2' [2787], 'MYB' => 'MYB_1' [2792], 'MYB' => 'MYB_2' [2793], 'MYB' =>
## 'MYB_3' [2794], 'MYB' => 'MYB_4' [2795], 'MYB' => 'MYB_5' [2796], 'SMAD2' =>
## 'SMAD2_1' [2798], 'PTEN' => 'PTEN_1' [2799], 'MAPKAPK2' => 'MAPKAPK2_2' [2800],
## 'PSMD9' => 'PSMD9_1' [2801], 'PSMA4' => 'PSMA4_1' [2806], 'SRF' =>
## 'SRF_1' [2810], 'LYN' => 'LYN_1' [2815], 'IL7R' => 'IL7R_1' [2817], 'TCF3' =>
## 'TCF3_1' [2818], 'TCF3' => 'TCF3_2' [2819], 'NFKB1' => 'NFKB1_1' [2820], 'NFKB1'
## => 'NFKB1_2' [2821], 'RPA1' => 'RPA1_1' [2822], 'PPP2R2A' => 'PPP2R2A_1' [2823],
## 'TERF1' => 'TERF1_1' [2826], 'BCR' => 'BCR_1' [2828], 'RBBP4' =>
## 'RBBP4_1' [2830], 'TERF2' => 'TERF2_1' [2831], 'PSMB4' => 'PSMB4_1' [2834],
## 'PSMB7' => 'PSMB7_1' [2836], 'PARP1' => 'PARP1_1' [2838], 'RELA' =>
## 'RELA_1' [2840], 'RELA' => 'RELA_2' [2841], 'EIF2S3' => 'EIF2S3_1' [2842],
## 'YWHAZ' => 'YWHAZ_1' [2846], 'PTP4A2' => 'PTP4A2_1' [2847], 'POLR2H' =>
## 'POLR2H_1' [2850], 'GAB1' => 'GAB1_2' [2851], 'PRKDC' => 'PRKDC_2' [2852],
## 'PRKCB' => 'PRKCB_1' [2855], 'SAT1' => 'SAT1_1' [2862], 'PTPRE' =>
## 'PTPRE_1' [2865], 'RPL22' => 'RPL22_1' [2866], 'EIF2S1' => 'EIF2S1_1' [2867],
```

```
## 'CYC1' => 'CYC1_1' [2869], 'HSP90AB1' => 'HSP90AB1_2' [2870], 'CD44' =>
## 'CD44_1' [2873], 'MAP2K1' => 'MAP2K1_1' [2875], 'TNK2' => 'TNK2_1' [2877],
## 'GNA13' => 'GNA13_1' [2879], 'NR3C1' => 'NR3C1_1' [2882], 'RAB1A' =>
## 'RAB1A_2' [2888], 'ODC1' => 'ODC1_1' [2890], 'PLCG2' => 'PLCG2_1' [2891], 'RFC4'
## => 'RFC4_1' [2894], 'FLT3' => 'FLT3_1' [2895], 'EIF2AK2' => 'EIF2AK2_1' [2902],
## 'USP9X' => 'USP9X_1' [2913], 'PSMD7' => 'PSMD7_1' [2917], 'PPP1CA' =>
## 'PPP1CA_1' [2924], 'TUBB4B' => 'TUBB4B_2' [2926], 'ARRB2' => 'ARRB

##
## -- Column specification --------------------------------------------------------
## cols(
##   .default = col_double(),
##   Type = col_character()
## )
## i Use `spec()` for the full column specifications.
```

###a

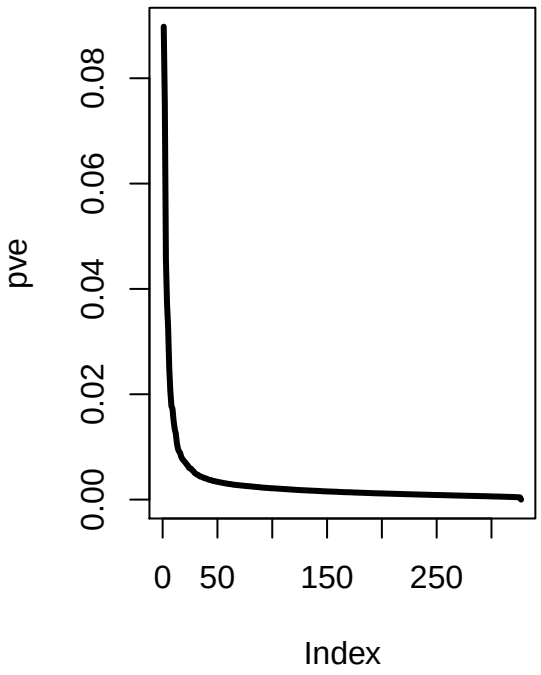
```
##Convert the Type column to factor
leukemia_data = leukemia_data %>% mutate(Type = factor(Type))
##the number of patients with each leukemia subtype
table(leukemia_data$Type)
```

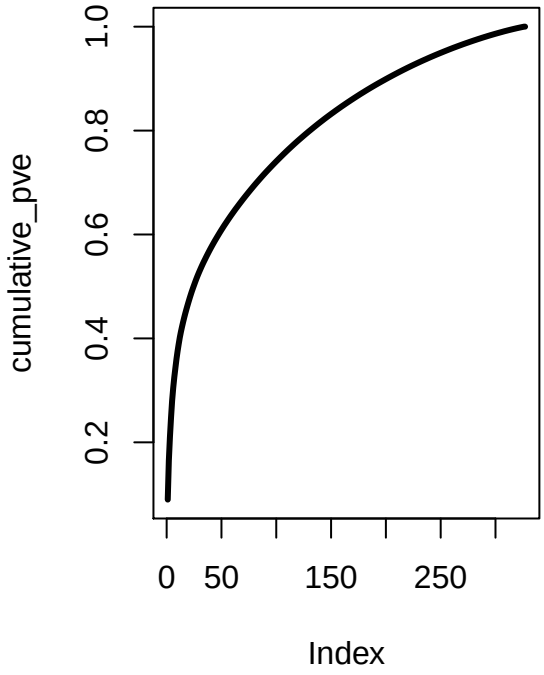
```
##
##    BCR-ABL   E2A-PBX1 Hyperdip50        MLL     OTHERS      T-ALL   TEL-AML1
##         15         27         64         20         79         43         79
```

Subtype "BCR-ABL" occurs the least in this data

###b

```
## exclude the Type column
leukemia_data_wt = leukemia_data %>% select(-Type)
pr.out=prcomp(leukemia_data_wt, scale=TRUE, center = TRUE)
## get the variance explained by each principal component
pr.var=pr.out$sdev ^2
pve=pr.var/sum(pr.var)
## get cumulative pve
cumulative_pve = cumsum(pve)
## plot PVE and cumulative pve
par(mfrow=c(1, 2))
plot(pve, type="l", lwd=3)
plot(cumulative_pve, type="l", lwd=3)
```

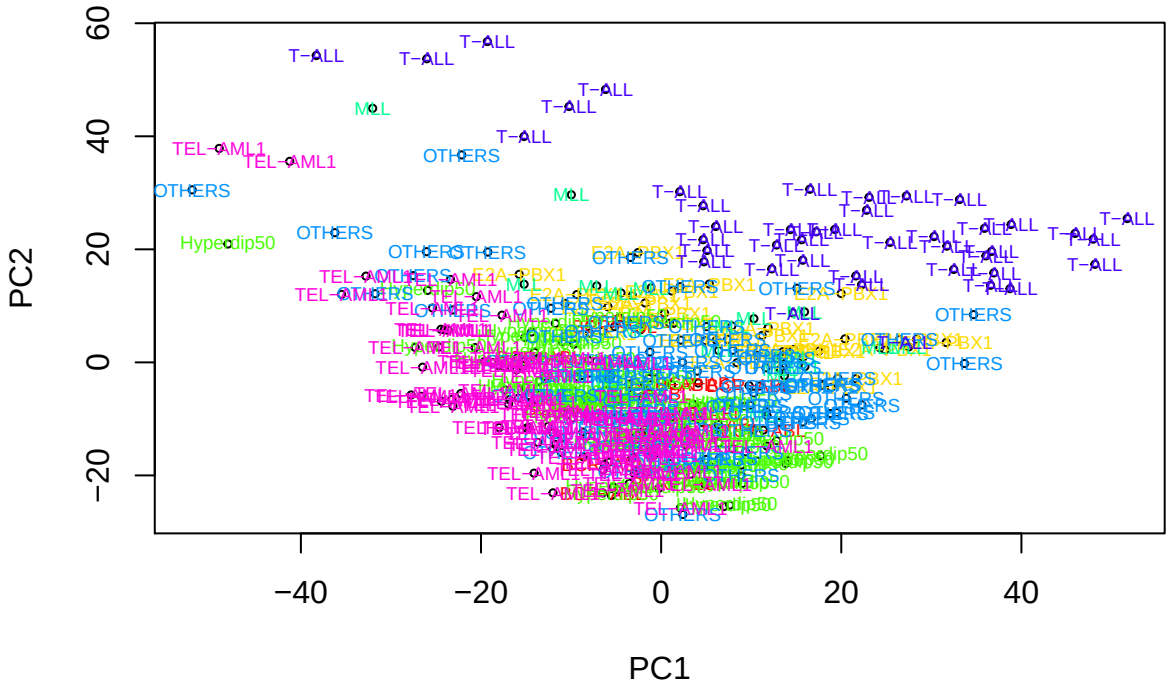




###c

```
## set color
rainbow_colors <- rainbow(7)

plot_colors <- rainbow_colors[leukemia_data$Type]
plot(pr.out$x[,1],pr.out$x[,2],xlab="PC1", ylab="PC2",cex=0.5)
text(pr.out$x[,1],pr.out$x[,2],labels = leukemia_data$Type,col=plot_colors,cex=0.6)
```



T-ALL is most clearly separated from the others along the PC1 axis

```
## create a dataframe contain Type label and numeric PC1 value
sort(abs(pr.out$rotation[,1]),decreasing = T)
```

```
##        SEMA3F          CCT2          LDHB         COX6C        SNRPD2
##  4.517148e-02  4.323818e-02  4.231619e-02  4.183480e-02  4.179822e-02
##          ELK3         SNRPE          LDHA        ATP5G3          CD40
##  4.155821e-02  4.034466e-02  4.005093e-02  4.004077e-02  3.995309e-02
##     40134_at         UQCRQ          CCT3         ITPR1          MDH1
##  3.977691e-02  3.960993e-02  3.953677e-02  3.947052e-02  3.940276e-02
##          NME1          UBA2         TBX19         SNRPG          KARS
##  3.900101e-02  3.872838e-02  3.869340e-02  3.856511e-02  3.836629e-02
##    32980_f_at        TPTEP1       PSMA4_1       YWHAQ_1         PGAM1
##  3.805177e-02  3.804482e-02  3.804281e-02  3.798229e-02  3.794595e-02
##        ERVH-1          EPOR       TUBGCP2         C1QBP        ERVK-7
##  3.790849e-02  3.783244e-02  3.762640e-02  3.739828e-02  3.733545e-02
##         SNRPA       HLA-DMB        ATXN10         HSPD1         SNRPB
##  3.721083e-02  3.720706e-02  3.720134e-02  3.717927e-02  3.713661e-02
##           MIF      40189_at       ITPR1_1        UQCRC1          SDC3
##  3.702705e-02  3.694271e-02  3.680088e-02  3.673105e-02  3.672759e-02
##         COX8A       KHDRBS1        MFSD10        SCARB1         TRA2A
##  3.669869e-02  3.658927e-02  3.654335e-02  3.653583e-02  3.647413e-02
##         FUCA1         SNRPF      32815_at          ISLR         PSMB2
##  3.645552e-02  3.631937e-02  3.628221e-02  3.621483e-02  3.621209e-02
##       AKAP17A         STAT2        TGOLN2         RAN_1       ITPR1_2
##  3.619071e-02  3.612710e-02  3.604629e-02  3.598788e-02  3.597252e-02
##       1937_at          INSR           TAZ         PAICS           RAN
##  3.586579e-02  3.559505e-02  3.558546e-02  3.546331e-02  3.541676e-02
##         OR2B6          UTRN        PRRC2B          CYCS      ATXN10_1
##  3.524901e-02  3.521147e-02  3.520911e-02  3.513441e-02  3.509530e-02
##         NCOA3     HNRNPA2B1          CCT5         FOXO1      CALCOCO1
##  3.506708e-02  3.500773e-02  3.499333e-02  3.481261e-02  3.481129e-02
##          ENO1          PAX8      39224_at        TRAFD1         EFNA3
##  3.479382e-02  3.474603e-02  3.470130e-02  3.460836e-02  3.460753e-02
##         SAP18         SPTA1        GPRIN2         HTRA2       TERF2_1
##  3.459465e-02  3.454154e-02  3.450462e-02  3.444213e-02  3.442021e-02
##        CLNS1A        TBC1D9       1627_at         PARK7       HLA-DOB
##  3.440591e-02  3.437814e-02  3.436168e-02  3.435885e-02  3.435284e-02
##          CTGF         TERF2         MEF2C          MC2R       HNRNPA3
##  3.426306e-02  3.426204e-02  3.421616e-02  3.419521e-02  3.419210e-02
##         ALDOA       MAP3K11      HSP90AB1         NUBP1       NPIPB15
##  3.417207e-02  3.416858e-02  3.416834e-02  3.412728e-02  3.402794e-02
##          ELOC       FAM214B         SSRP1        NME1_1        COX6B1
##  3.402533e-02  3.400191e-02  3.398180e-02  3.393633e-02  3.392899e-02
##        SNAP23      32872_at        MYBPC1        MAN2B2         HHLA1
##  3.388626e-02  3.388353e-02  3.386933e-02  3.381239e-02  3.377224e-02
##        CBX3_1           JRK         VAMP1        JMJD1C          AP1B1
##  3.363399e-02  3.362428e-02  3.362081e-02  3.358154e-02  3.345921e-02
##       SNRPB_1          DDB1      36104_at         UBE3B        GAB1_1
##  3.342569e-02  3.342495e-02  3.342244e-02  3.338361e-02  3.337236e-02
##     HIST1H2BE           NCL        ITGA2B      SERPINH1          SRP9
##  3.334487e-02  3.333263e-02  3.332936e-02  3.329747e-02  3.323575e-02
##         IL6ST    31522_f_at        SLC9A1       HNRNPAB         GTF3A
##  3.319240e-02  3.319006e-02  3.313786e-02  3.306500e-02  3.306426e-02
```

```
##          ELOB           HGS         MMP25      SAP18_1          PHB2
##  3.305441e-02  3.301701e-02  3.300088e-02  3.297428e-02  3.289758e-02
##        HNRNPC      34093_at         ERG_1          CBFB           JUP
##  3.284812e-02  3.284460e-02  3.284416e-02  3.280753e-02  3.280603e-02
##       HLA-DMA       ANKRD12      33415_at        LARGE1          CBX3
##  3.280560e-02  3.280357e-02  3.280334e-02  3.279051e-02  3.276945e-02
##       NDUFAB1          GRM4    33877_s_at        COX4I1     HIST1H2BN
##  3.276198e-02  3.271671e-02  3.270819e-02  3.268690e-02  3.262753e-02
##        AGPAT2          PHF1     1863_s_at      HSP90AA1          CANX
##  3.262535e-02  3.261911e-02  3.258375e-02  3.254858e-02  3.254530e-02
##        ANKS1A        GAB1_2          STX4        TRIM38    31524_f_at
##  3.244427e-02  3.240494e-02  3.239847e-02  3.237471e-02  3.231921e-02
##         PSMD8        ADAM15        SORBS3         H2AFZ        ENTPD4
##  3.225074e-02  3.223970e-02  3.218296e-02  3.218036e-02  3.216745e-02
##        TUBB2B       CD79A_1        CREBBP        TOMM20       PTPRE_1
##  3.211944e-02  3.211783e-02  3.210417e-02  3.207028e-02  3.206887e-02
##           TXN         HINT1           PML        PTP4A3        ZBTB22
##  3.201973e-02  3.200449e-02  3.189542e-02  3.187461e-02  3.183007e-02
##      MAPK8IP3     1980_s_at      1116_at         LSM12         SP100
##  3.180405e-02  3.174908e-02  3.174410e-02  3.171880e-02  3.169851e-02
##        MYL12B         CNOT4         YWHAQ         DYRK2       B4GALT3
##  3.169733e-02  3.168838e-02  3.162117e-02  3.158349e-02  3.157068e-02
##        NDUFB3       MEF2C_1        SLC6A7         ISG20     HIST2H2BE
##  3.156023e-02  3.153240e-02  3.151027e-02  3.150542e-02  3.147975e-02
##         COX5B        286_at         RAB5B        CEP135      DICER1_1
##  3.147555e-02  3.147422e-02  3.141388e-02  3.138793e-02  3.136186e-02
##      38056_at          UPF2        CAMK2G         CD79A      41584_at
##  3.135876e-02  3.133870e-02  3.127091e-02  3.124424e-02  3.122555e-02
##           MVK          RGL2          SZT2        RUVBL2        LILRA2
##  3.120694e-02  3.120089e-02  3.116577e-02  3.113261e-02  3.108732e-02
##       TP53I11         MAST3      HLA-DRB4         CECR7          DHX9
##  3.107584e-02  3.106266e-02  3.101751e-02  3.099712e-02  3.099314e-02
##         MMP11      40637_at         PTPRE       TMEM63A         EIF3K
##  3.097817e-02  3.096998e-02  3.095880e-02  3.095021e-02  3.093357e-02
##       SLC30A1          GDI1         PSMA4          IDH2           VCL
##  3.091483e-02  3.089683e-02  3.087614e-02  3.085391e-02  3.085283e-02
##          KAT7        BRD2_2      HLA-DQA1         SUMO1      40219_at
##  3.085107e-02  3.082461e-02  3.082064e-02  3.080533e-02  3.075465e-02
##          CD22      32007_at        KLHL18     EIF2AK2_1      SCAF11_1
##  3.075162e-02  3.074671e-02  3.070493e-02  3.070029e-02  3.067632e-02
##     41324_g_at         LIMK2         RAD21         ACAP2     HIST1H2BM
##  3.063258e-02  3.058023e-02  3.057923e-02  3.052959e-02  3.049033e-02
##         KDM3B         IFI35         DHRS1      TNFRSF25      HLA-DQB1
##  3.047770e-02  3.047589e-02  3.047339e-02  3.045203e-02  3.042830e-02
##          EML3        PIK3CG          CCT8         GSTO1         COX5A
##  3.041371e-02  3.041011e-02  3.040109e-02  3.039306e-02  3.037135e-02
##        LYPLA2       RPL36AL           MT4         STRAP         TRA2B
##  3.037060e-02  3.035987e-02  3.035944e-02  3.035802e-02  3.029614e-02
##         SIVA1        GABBR1    HSP90AB1_2           ERH          SNX1
##  3.026037e-02  3.025465e-02  3.024065e-02  3.023390e-02  3.020061e-02
##        PABPC4         ATP5C1         EIF3M       POU2AF1          TFF3
##  3.018692e-02  3.018406e-02  3.016916e-02  3.011169e-02  3.010201e-02
##         MGAT1       CDK13_1        SWAP70         HADHA     HIST1H2BD
##  3.002319e-02  3.002039e-02  2.999056e-02  2.995640e-02  2.993410e-02
```

```
##          NCDN       XRCC5_1         CLOCK         ZFPL1       ZKSCAN1
##  2.993268e-02  2.990962e-02  2.990836e-02  2.989667e-02  2.988100e-02
##         PSMA3      39073_at        NUP210          GOT2         AHDC1
##  2.981852e-02  2.977529e-02  2.976635e-02  2.970330e-02  2.967800e-02
##          ADD2         TMED2           FBL         CALM1         LAIR1
##  2.967128e-02  2.964562e-02  2.963796e-02  2.960429e-02  2.960253e-02
##      HNRNPC_1       SLC25A3         CLCN7        MAP4_1        NDUFB8
##  2.958161e-02  2.957001e-02  2.954128e-02  2.948158e-02  2.947318e-02
##         KHNYN        MAN1A1          SDHD      38372_at      32609_at
##  2.946988e-02  2.946224e-02  2.943356e-02  2.941767e-02  2.937711e-02
##         EIF4B        PSMA2        TRANK1      37796_at    32408_s_at
##  2.933043e-02  2.931375e-02  2.924136e-02  2.921429e-02  2.921045e-02
##       THEMIS2      34902_at          GNG7    40428_i_at         POU4F1
##  2.920335e-02  2.920067e-02  2.919628e-02  2.919175e-02  2.918585e-02
##      C6orf120         GRIK5    40888_f_at        PPP3CC         SMAD1
##  2.913761e-02  2.911913e-02  2.911601e-02  2.911436e-02  2.910618e-02
##        UQCR11          VIM     HIST1H2BL         ATP5O        ZNF592
##  2.908412e-02  2.908403e-02  2.907560e-02  2.905689e-02  2.905233e-02
##        ZNF253         EHD1          HDGF          WWP1         XRCC6
##  2.904505e-02  2.902728e-02  2.900365e-02  2.894589e-02  2.894129e-02
##         PSMA1      33261_at          WSB1         PPM1G          GAB1
##  2.893038e-02  2.890891e-02  2.888559e-02  2.888266e-02  2.886167e-02
##         CD79B         STK19         RPP38        ARAF_1         HMCES
##  2.882244e-02  2.882230e-02  2.879154e-02  2.877867e-02  2.876046e-02
##       STK38_1        CGRRF1          TUFM      39731_at         EIF3H
##  2.875776e-02  2.870746e-02  2.870522e-02  2.869285e-02  2.867543e-02
##           NF2      POLR2L_1         ERG_2         PDE4B         THOC2
##  2.867018e-02  2.866709e-02  2.866085e-02  2.864795e-02  2.864544e-02
##          E2F1        DNAJC9       RPS6KB2          TMX4    37590_g_at
##  2.862848e-02  2.862719e-02  2.857131e-02  2.856679e-02  2.856578e-02
##         GRB10      HLA-DPB1          ZEB2          NHP2       MEF2C_2
##  2.855155e-02  2.855021e-02  2.853226e-02  2.851440e-02  2.850160e-02
##          ILF2       PSMB7_1           MR1      35748_at          FEN1
##  2.850113e-02  2.848936e-02  2.848060e-02  2.847257e-02  2.847133e-02
##         EIF3I         PSMC1         TCEA1        RNF103        UBE2L3
##  2.844696e-02  2.842423e-02  2.838678e-02  2.838239e-02  2.831617e-02
##         SSBP1         SETDB1          MTF1         NELFB         MAPK3
##  2.827725e-02  2.824072e-02  2.823578e-02  2.820575e-02  2.820042e-02
##          CCT7       TMEM41B     N4BP2L1_1        MARCH6          CDV3
##  2.819659e-02  2.819054e-02  2.816489e-02  2.814679e-02  2.813785e-02
##       CTBP1_1         CDK14       COX5B_1       THUMPD1        INPP5D
##  2.807658e-02  2.806863e-02  2.805710e-02  2.804008e-02  2.803757e-02
##     33458_r_at           GAK        LGALS9        ELOVL5          PIGB
##  2.803654e-02  2.801649e-02  2.800190e-02  2.799894e-02  2.799851e-02
##          MFN1          TBCA         PRDM2         BAZ2A          ATIC
##  2.799764e-02  2.799239e-02  2.798597e-02  2.794148e-02  2.793698e-02
##        IFNGR1       VAMP3_1     TNFRSF10B       UQCRFS1    41723_s_at
##  2.791136e-02  2.790906e-02  2.789719e-02  2.785014e-02  2.784152e-02
##         COPS5         ITSN2           ERG        HECTD4          CD55
##  2.783617e-02  2.783490e-02  2.783078e-02  2.776934e-02  2.774627e-02
##         HAUS5          BTF3     HIST1H2BK         GRINA      NAP1L1_1
##  2.773525e-02  2.769519e-02  2.768977e-02  2.767472e-02  2.767366e-02
##         FBL_1         KDM5C    36112_r_at          IRF2         PPM1D
##  2.765746e-02  2.763402e-02  2.760489e-02  2.757110e-02  2.756641e-02
```

```
##        CHST15           ENG         PRMT1         CEP68          LSM3
##  2.756245e-02  2.754350e-02  2.754125e-02  2.752379e-02  2.751029e-02
##         GFPT1      SERBP1_1         WDR37       YTHDF3         PCBP1
##  2.747630e-02  2.745969e-02  2.743865e-02  2.742745e-02  2.741211e-02
##      40819_at       UBE2I_1        LONRF1         SGSM2         VDAC3
##  2.739961e-02  2.736180e-02  2.734686e-02  2.734194e-02  2.733157e-02
##       GSTP1_1         HLA-F    31993_f_at         PSMD5       EIF3I_1
##  2.731901e-02  2.729233e-02  2.728488e-02  2.726113e-02  2.720465e-02
##      38257_at      36696_at         INTS3          CBLB          NPY
##  2.717578e-02  2.717471e-02  2.716060e-02  2.714758e-02  2.707235e-02
##          LSM1      34841_at          RXRB      37693_at         SP110
##  2.706019e-02  2.705143e-02  2.704096e-02  2.701924e-02  2.700697e-02
##          CCR7         USP11         TCFL5         UQCRB          PGD
##  2.699691e-02  2.698267e-02  2.697585e-02  2.694286e-02  2.694140e-02
##          FCMR        PIK3C3        SFSWAP       CIAPIN1         BRMS1
##  2.693558e-02  2.693502e-02  2.692848e-02  2.692721e-02  2.688753e-02
##         CENPC         RUSC1    HLA-DQB1_1       SRSF3_1       HERC2P2
##  2.686403e-02  2.685667e-02  2.683988e-02  2.680568e-02  2.678769e-02
##        PPP1CC         MLXIP     ARHGEF2_1         CD200        WDR45B
##  2.678568e-02  2.676572e-02  2.674855e-02  2.674032e-02  2.673659e-02
##         SMAGP        TRIM28        SLC2A3           BAX           ADA
##  2.669752e-02  2.668617e-02  2.668350e-02  2.666344e-02  2.663957e-02
##      35858_at         DCAF7        CSNK2B       PRKCB_1          LSM2
##  2.663449e-02  2.663120e-02  2.663028e-02  2.662507e-02  2.661834e-02
##       1199_at          ATF4        ZMYND8         SIPA1         PCGF3
##  2.657579e-02  2.657263e-02  2.656036e-02  2.654374e-02  2.651851e-02
##       PPIP5K2        SKP1_1       DNAJC16          PXDN       SNRNP27
##  2.651747e-02  2.650764e-02  2.648159e-02  2.647562e-02  2.647141e-02
##         CDK10        IGSF9B        BTN2A1      40130_at       ZNF271P
##  2.646819e-02  2.646735e-02  2.644912e-02  2.642062e-02  2.641456e-02
##       XRCC5_2       1179_at       TMEM187        NDUFA1          SUB1
##  2.640007e-02  2.639983e-02  2.636661e-02  2.634962e-02  2.630018e-02
##        BTN3A3       XRCC5_3          FHIT         P2RX1        PTPN18
##  2.629714e-02  2.625346e-02  2.624532e-02  2.624451e-02  2.617313e-02
##          PRKY         HMHB1         GPR35        PIM1_1        UQCRC2
##  2.613415e-02  2.612383e-02  2.610526e-02  2.610476e-02  2.610306e-02
##          HHEX         ZNF85        TNK2_1         ATP5H       1294_at
##  2.610156e-02  2.609944e-02  2.608975e-02  2.602682e-02  2.601751e-02
##        IMPDH2         CLIP2         SEC62          MCM7         NCOA2
##  2.598271e-02  2.598033e-02  2.596832e-02  2.593725e-02  2.592948e-02
##      35961_at         PCLAF        ZBTB17         ALDOC          ENSA
##  2.592854e-02  2.592794e-02  2.586750e-02  2.585044e-02  2.584788e-02
##         POLD4         PSMB4       ARRB2_1          MFN2     2075_s_at
##  2.584283e-02  2.583863e-02  2.583467e-02  2.583380e-02  2.583204e-02
##      34791_at         TRAK1           NBN          AMFR          CSF1
##  2.582262e-02  2.581055e-02  2.580794e-02  2.580600e-02  2.580439e-02
##          CD19         RIPK1        HMGXB3          NUDC       SERINC5
##  2.579214e-02  2.578772e-02  2.576304e-02  2.573652e-02  2.571918e-02
##         FABP5        LPGAT1    36111_s_at       PLCG2_1         SF3B1
##  2.571488e-02  2.571459e-02  2.569155e-02  2.568766e-02  2.566046e-02
##           LY9          IRF9        EIF1B       PSMB4_1         PRKCB
##  2.563119e-02  2.559176e-02  2.557737e-02  2.553532e-02  2.552056e-02
##       KLF10_1         FDPS     SLC25A1_2         PEX19       PRKCB_2
##  2.550105e-02  2.548686e-02  2.546127e-02  2.545595e-02  2.544616e-02
```

```
##         KDM1A         SRSF1     PTP4A2_1         UGCG         REEP5
##  2.541152e-02  2.540751e-02  2.540482e-02  2.540054e-02  2.539809e-02
##          PTPA          NAE1         JTB_1       GOLGA1     HIST1H2AL
##  2.536565e-02  2.536368e-02  2.536259e-02  2.534063e-02  2.533801e-02
##       FCHSD2      C11orf58     SMARCD2_1      34279_at         ISCA1
##  2.530778e-02  2.530052e-02  2.527844e-02  2.526375e-02  2.525227e-02
##          IARS       TUBGCP4         WDR47         SERP1       VDAC2_1
##  2.524650e-02  2.524405e-02  2.523432e-02  2.523200e-02  2.523010e-02
##       AGPAT1         ACTN4         JMJD6         BANF1         GSK3A
##  2.521805e-02  2.520967e-02  2.519238e-02  2.518258e-02  2.518028e-02
##          POLB         PSMB1          STX7       RANBP3       STK38_2
##  2.515553e-02  2.515486e-02  2.514758e-02  2.513928e-02  2.513456e-02
##         BLCAP         AUTS2           ESD          NCF4         AZIN1
##  2.512026e-02  2.509691e-02  2.509594e-02  2.509573e-02  2.506611e-02
##          SND1          LCP1         HSPE1          CD27         SRRM1
##  2.506462e-02  2.505697e-02  2.505344e-02  2.504183e-02  2.503523e-02
##    41215_s_at        PSMD14       SMARCC2          CUL2         ASCC2
##  2.503144e-02  2.501843e-02  2.496665e-02  2.495103e-02  2.493460e-02
##        PRKCSH        BTF3_1         PDCD6        CAMTA2       KLHDC10
##  2.492223e-02  2.491142e-02  2.490785e-02  2.490400e-02  2.488331e-02
##          SLF2         PNRC1          PREP     TSC22D3_1         TAF11
##  2.488157e-02  2.485823e-02  2.485749e-02  2.485524e-02  2.484350e-02
##       ZMYND11    TNFRSF1B_1       PPP2R5E        NDUFB1       NCKAP1L
##  2.482846e-02  2.482442e-02  2.480979e-02  2.480763e-02  2.477379e-02
##        PTPN12          NRDC        ABI1_1        PRPF4B         POLE3
##  2.476273e-02  2.471478e-02  2.470925e-02  2.470644e-02  2.470397e-02
##       MAPKAP1         CRIM1        ZNF117         WBP1L          AP2S1
##  2.469778e-02  2.468275e-02  2.467498e-02  2.464053e-02  2.463583e-02
##         LRP10         PSMB3        TUBB4B        HADH_1          IRF7
##  2.463496e-02  2.463317e-02  2.462850e-02  2.462307e-02  2.456765e-02
##      TBC1D22A        MAP3K7      ARHGAP25      SLC25A11         IFFO1
##  2.453299e-02  2.453087e-02  2.452718e-02  2.452293e-02  2.451443e-02
##         ADA_1       ZDHHC17          MSH2         PRPF3        FBXW11
##  2.449840e-02  2.449261e-02  2.447758e-02  2.444061e-02  2.443030e-02
##        INPP5E          CTR9          CKS2        WASHC4       CDK2AP2
##  2.442792e-02  2.442277e-02  2.441975e-02  2.441283e-02  2.439586e-02
##        MAPRE1         NUDT3        ZNF266        STARD7         CASP7
##  2.438438e-02  2.437601e-02  2.436271e-02  2.434864e-02  2.434634e-02
##          PRKX           GPI        NMT1_1         SSR2        RASSF1
##  2.433130e-02  2.433113e-02  2.432926e-02  2.432284e-02  2.428856e-02
##        MAN2C1    41131_f_at        RCN2_1          BBX         ATP5D
##  2.426438e-02  2.424426e-02  2.423953e-02  2.420675e-02  2.417791e-02
##        NDUFV2      39126_at           DCK         NPC1       FAM189B
##  2.414075e-02  2.410325e-02  2.409725e-02  2.409141e-02  2.409102e-02
##        MTHFD2          COIL          DPM2        ATP5G1          OPTN
##  2.406253e-02  2.402622e-02  2.400973e-02  2.398858e-02  2.398121e-02
##         EEF1D           YY1        CEP350         LTA4H        NFKBIA
##  2.397531e-02  2.397165e-02  2.396967e-02  2.396122e-02  2.394565e-02
##         EDEM1      TNFRSF1B        POLR2I        FMR1_1         PTP4A2
##  2.394183e-02  2.391985e-02  2.387617e-02  2.383462e-02  2.382721e-02
##        SLC2A5        DAXX_1          LIG4        SFPQ_3         CCND2
##  2.382458e-02  2.382284e-02  2.382260e-02  2.381704e-02  2.381198e-02
##         TRAF5         CDK13        CUL1_1       TSPOAP1          TLE1
##  2.378712e-02  2.376044e-02  2.374689e-02  2.373242e-02  2.372887e-02
```

```
##          GRK2        NDUFV1         APEX1        MYL12A        NDUFC1
##  2.372441e-02  2.371432e-02  2.369002e-02  2.368849e-02  2.368782e-02
##         FTSJ1          BUB3       DENND4B         GHITM        AMD1_3
##  2.367326e-02  2.366234e-02  2.366116e-02  2.365668e-02  2.362117e-02
##         TSTA3          CDYL         ABCC5         COX7C        AKR1A1
##  2.358765e-02  2.356921e-02  2.356864e-02  2.355262e-02  2.354188e-02
##      HNRNPUL1        SNRPB2           DPT        FOXK2       RPL22_1
##  2.353163e-02  2.352524e-02  2.350104e-02  2.347567e-02  2.346766e-02
##      38698_at          H1F0        TNRC6B          TSC2          PPIB
##  2.344353e-02  2.344008e-02  2.342387e-02  2.341866e-02  2.340635e-02
##           PHB          STOM       N4BP2L2         MCM6       PTK2B_1
##  2.339091e-02  2.337445e-02  2.335914e-02  2.335520e-02  2.335469e-02
##         RFTN1         KDM6B         UBXN7      32921_at       ZNF91_1
##  2.334857e-02  2.334850e-02  2.333751e-02  2.332925e-02  2.332412e-02
##         EIF4H           CIC         CNIH1          YBX3          DNM2
##  2.332200e-02  2.332093e-02  2.331986e-02  2.330409e-02  2.327594e-02
##          CDK8     SECISBP2L        POLR2L         STK38        COX7A2
##  2.325544e-02  2.323071e-02  2.322486e-02  2.322229e-02  2.321652e-02
##          CD24      TRAF3IP2    MAPKAPK2_2         SOCS2        TRIM33
##  2.321162e-02  2.321061e-02  2.318480e-02  2.315294e-02  2.313963e-02
##         ZBED1         DHRS7      SLC9A3R1          PCNA      40765_at
##  2.313162e-02  2.309884e-02  2.308353e-02  2.308132e-02  2.306545e-02
##         SCML2          PCBP3        SEC61B          PPIE        GTF2A2
##  2.305360e-02  2.304270e-02  2.302262e-02  2.300337e-02  2.299260e-02
##        ATP2A2          CSRP2         LTBP4      TUBB4B_2         HDAC5
##  2.297819e-02  2.297459e-02  2.295989e-02  2.295668e-02  2.294863e-02
##          LPXN        TSPAN31        TARDBP        SEC61G          FIBP
##  2.294304e-02  2.292633e-02  2.291715e-02  2.291542e-02  2.291308e-02
##     38350_f_at          GSTP1          VAPA        PAPOLA        SREBF1
##  2.289648e-02  2.288871e-02  2.288725e-02  2.288095e-02  2.287958e-02
##        CITED2        ZDHHC3         FCGRT        DDX19A      38710_at
##  2.287533e-02  2.287024e-02  2.285960e-02  2.285519e-02  2.284739e-02
##         ABCB7        RNF114        LEPROT           MYC          EZH1
##  2.284410e-02  2.284063e-02  2.283013e-02  2.281011e-02  2.280197e-02
##         HLA-J          SOS2         TERF1      37250_at         PRPF6
##  2.279677e-02  2.279461e-02  2.277712e-02  2.276468e-02  2.273690e-02
##         RBM14           JTB         TOMM70         NIPBL          WWOX
##  2.271567e-02  2.270295e-02  2.269036e-02  2.268247e-02  2.266994e-02
##          PHF8        POLR2C         SETD3       CSHL1_1       PRPF40A
##  2.266034e-02  2.262112e-02  2.260091e-02  2.259646e-02  2.259423e-02
##         ZNF91      32573_at        RPS15A          ZZZ3         NRIP1
##  2.258979e-02  2.256464e-02  2.255552e-02  2.254896e-02  2.254548e-02
##         PSMC3          NGDN         RBM4B         EIF3G        HSPB11
##  2.253523e-02  2.252359e-02  2.251773e-02  2.249486e-02  2.248569e-02
##          DOK1          VAV1        HNRNPL         USP12          WBP4
##  2.247372e-02  2.245390e-02  2.245283e-02  2.242069e-02  2.241852e-02
##          SUN2         HSBP1          SNX2         YWHAB        PTEN_1
##  2.241391e-02  2.235433e-02  2.231210e-02  2.231139e-02  2.230615e-02
##        GTF2H1         RNPS1        HPCAL1          HCCS         S1PR4
##  2.229956e-02  2.229633e-02  2.227238e-02  2.225260e-02  2.222789e-02
##       SLC25A5          MSL3        ZNF451         PIBF1          CHD9
##  2.222020e-02  2.221775e-02  2.221568e-02  2.220311e-02  2.219169e-02
##         PLCL2         NOLC1        ANP32A           BTK        SLC9A6
##  2.218416e-02  2.217676e-02  2.216645e-02  2.213903e-02  2.211541e-02
```

```
##          LSM4          PIM1          RPA3         AP1G2         TOMM34
##  2.209858e-02  2.207523e-02  2.203405e-02  2.203380e-02  2.201408e-02
##        CTNNA1         NUCB2         AP2M1        EIF4A3           GNE
##  2.200451e-02  2.197990e-02  2.196674e-02  2.195386e-02  2.195021e-02
##       C9orf16         EIF5B      36940_at      MARCH6_1        ANAPC5
##  2.194453e-02  2.194439e-02  2.192903e-02  2.192836e-02  2.192279e-02
##       SEC23IP         INTS1        HNRNPM         WASF1         EFR3A
##  2.191580e-02  2.190657e-02  2.190480e-02  2.190350e-02  2.188216e-02
##      CTNNA1_4          CLK3      CSNK1D_1         KRIT1        UBE2D3
##  2.188135e-02  2.187286e-02  2.186604e-02  2.180403e-02  2.179231e-02
##         PSMD6        TALDO1         RBBP6        SETD1B         PSMD1
##  2.173668e-02  2.171329e-02  2.170252e-02  2.166056e-02  2.165902e-02
##          RCN2          RAG1    34099_f_at        NDUFS3         DUSP7
##  2.165767e-02  2.165116e-02  2.163969e-02  2.159689e-02  2.158658e-02
##           SSB        ADGRE5          SEM1        ANKLE2         ZNF43
##  2.157618e-02  2.157537e-02  2.156397e-02  2.155127e-02  2.154151e-02
##          ETFA         CCNT2          RFX5           MME      CTNNA1_3
##  2.152137e-02  2.150008e-02  2.149952e-02  2.149761e-02  2.148227e-02
##         KHSRP         DCAF8      STAT6_1         SHOC2      RAB3GAP1
##  2.147723e-02  2.145747e-02  2.143197e-02  2.143100e-02  2.142918e-02
##       ARPC4_1          OAS2         P4HA1          NMT1           ATM
##  2.141508e-02  2.140919e-02  2.140919e-02  2.140722e-02  2.137672e-02
##       BLCAP_1     LINC00847        ZC3H14          PKD2        PBXIP1
##  2.137089e-02  2.135146e-02  2.134954e-02  2.134533e-02  2.132405e-02
##          ECH1         EIF3B         ADCY6         REV3L       SLC35A1
##  2.132211e-02  2.128631e-02  2.128618e-02  2.127540e-02  2.126691e-02
##        NCF4_1        BICRAL         TGIF2     HIST1H2AC      40593_at
##  2.124731e-02  2.122607e-02  2.122312e-02  2.122018e-02  2.122015e-02
##         CASP4          TMX1         LMNB2         POLR3C      PMS2P1_1
##  2.119070e-02  2.118173e-02  2.117878e-02  2.117770e-02  2.116533e-02
##         LCK_1         USP34        SPTBN1      CTNNA1_2       TMEM243
##  2.115204e-02  2.114926e-02  2.113866e-02  2.113385e-02  2.109276e-02
##        ACTL6A        ADD3_1          CYC1         PLCB2           RXRA
##  2.106489e-02  2.105934e-02  2.105804e-02  2.104834e-02  2.104508e-02
##        CLASP1        FEN1_2         PLCG2        GTF2F1         ATP5A1
##  2.102953e-02  2.102635e-02  2.102526e-02  2.098775e-02  2.098425e-02
##       C14orf2          UBR2      TUBB4B_1          NARS         HIF1A
##  2.092134e-02  2.091075e-02  2.090765e-02  2.089333e-02  2.088513e-02
##          CD52          GMPS        SERBP1          E2F4        HNRNPU
##  2.087523e-02  2.087088e-02  2.086111e-02  2.084975e-02  2.083425e-02
##           DUT         JADE3           LYN      33361_at          PHF3
##  2.081229e-02  2.080762e-02  2.080520e-02  2.080242e-02  2.079014e-02
##         COPB2         H2AFY         FOXN3        CSNK1D      PPP1R15A
##  2.078693e-02  2.077324e-02  2.076448e-02  2.076118e-02  2.076106e-02
##        DDX39A       DYNC1H1      LSM14A_1          PIGA       CBFA2T3
##  2.075818e-02  2.075215e-02  2.074921e-02  2.070894e-02  2.068071e-02
##        ANP32B         SYK_2          GAB2         ACTR3           HLX
##  2.067334e-02  2.064618e-02  2.063417e-02  2.062987e-02  2.062137e-02
##         CLIC1        BUB3_1         PPIL2          CUL1        TMEM11
##  2.061588e-02  2.057508e-02  2.057200e-02  2.055843e-02  2.055522e-02
##         TXNIP       PRPSAP1          GMFB         LPIN1         COASY
##  2.052620e-02  2.051523e-02  2.051310e-02  2.050656e-02  2.048366e-02
##      35304_at        SLC4A2         TBL1X         PFDN4          GGCT
##  2.047313e-02  2.044886e-02  2.043044e-02  2.040453e-02  2.040288e-02
```

```
##          PIGF       PRKDC_1        CLSTN1         TSPO2          SUN1
##  2.036473e-02  2.035871e-02  2.035628e-02  2.035261e-02  2.035051e-02
##           CNP         BOLA2     PPP1R12A    35566_f_at        SSR1_1
##  2.031520e-02  2.031324e-02  2.028088e-02  2.027595e-02  2.026519e-02
##        DHRS3          DVL3        P4HB_1       RAB1A_2        CORO1A
##  2.025837e-02  2.024430e-02  2.024065e-02  2.023721e-02  2.023497e-02
##        ZMIZ1      41174_at       RAPGEF2        TRIM22         MBNL1
##  2.023434e-02  2.022927e-02  2.022632e-02  2.020907e-02  2.018662e-02
##         FMR1         DUSP6         SYNPO           GSN          ETS2
##  2.018300e-02  2.018024e-02  2.016268e-02  2.014916e-02  2.010719e-02
##         TAF5        ZNF254         DYRK3          CTCF        NAP1L1
##  2.009268e-02  2.009063e-02  2.008503e-02  2.007986e-02  2.007522e-02
##         HAX1          RPGR         SRRM2         U2AF1          NMT2
##  2.005568e-02  2.004156e-02  2.003758e-02  2.003253e-02  2.002875e-02
##         MTMR9        KBTBD2          AMD1        PHLPP1         DMTF1
##  2.001897e-02  1.996905e-02  1.996854e-02  1.995424e-02  1.994540e-02
##         COPE         NT5C2          LCK           GLS        PLXNB2
##  1.994327e-02  1.994281e-02  1.994249e-02  1.993758e-02  1.993263e-02
##         USP14         VAT1          PNMT         HDAC2        SCAF11
##  1.992705e-02  1.992576e-02  1.991129e-02  1.990344e-02  1.989023e-02
##         XRCC5       RBBP4_1           MDK         WDR18           CAD
##  1.987135e-02  1.985505e-02  1.985389e-02  1.985261e-02  1.985104e-02
##       HNRNPA1     RAPGEF2_1        PGK1_1          C1D         ACIN1
##  1.983832e-02  1.983756e-02  1.983431e-02  1.981970e-02  1.979138e-02
##          BRD1           RP2          FUS       PITPNM1        GAPVD1
##  1.978918e-02  1.978672e-02  1.977054e-02  1.974870e-02  1.973718e-02
##        GTF3C1      41288_at         PRKDC      36234_at       CSNK2A1
##  1.971667e-02  1.970613e-02  1.969950e-02  1.968884e-02  1.968047e-02
##       SLC35D1       VEZF1_1         UBXN1         ATG14       FAM120A
##  1.967025e-02  1.964332e-02  1.963215e-02  1.963065e-02  1.960533e-02
##         MAML1         MRPL3          CD53       DENND3          USP1
##  1.960287e-02  1.958909e-02  1.958616e-02  1.956706e-02  1.956249e-02
##         MYC_1        SMURF2         BCR_1         CERS6         PRKD2
##  1.955597e-02  1.954022e-02  1.953914e-02  1.952374e-02  1.951936e-02
##      36625_at         HPRT1         VAMP5        JARID2          CD69
##  1.951816e-02  1.949841e-02  1.949765e-02  1.949302e-02  1.948645e-02
##          GARS          GLUL       MORF4L2    MAPKAPK2_1          WDR1
##  1.947120e-02  1.947019e-02  1.946115e-02  1.945961e-02  1.944574e-02
##          GLO1       ARHGDIB          CCL5       ERCC1_2         DDOST
##  1.941958e-02  1.941086e-02  1.941008e-02  1.939829e-02  1.937696e-02
##      GTF2A2_1         IFI44        EEF1E1          TCF3          YARS
##  1.937477e-02  1.936393e-02  1.934469e-02  1.929805e-02  1.929734e-02
##         PSMB7      MTHFD1_1          TNK2          DCTD       PPP1R10
##  1.927423e-02  1.926171e-02  1.922296e-02  1.920706e-02  1.920341e-02
##           QKI      POLR2I_1        DYNLL1       SLC39A8         HLA-E
##  1.919053e-02  1.917773e-02  1.912341e-02  1.910993e-02  1.910493e-02
##         TXLNA      KDELR1_1          SS18      TRIM44_2         VTI1B
##  1.908720e-02  1.908693e-02  1.907500e-02  1.906722e-02  1.904953e-02
##          RERE       NT5C2_1    33500_i_at         H2AFX           LTB
##  1.904495e-02  1.903987e-02  1.903629e-02  1.903247e-02  1.902170e-02
##        BCLAF1         SKAP2          LSM7          SIK3         POLD2
##  1.901693e-02  1.898704e-02  1.898529e-02  1.897995e-02  1.895288e-02
##          EEF2         PURA_1         FANCG         HMGN3          KAT8
##  1.894848e-02  1.894846e-02  1.894092e-02  1.893504e-02  1.892890e-02
```

```
##          SOD1         NEDD8          RBM3     36135_at         TMED9
##  1.891086e-02  1.890687e-02  1.888421e-02  1.887311e-02  1.887282e-02
##           DEK      UBE3B_1         AKAP9       TUBGCP3     LOC155060
##  1.886432e-02  1.886134e-02  1.884488e-02  1.883438e-02  1.882635e-02
##           MX1          GYPB     TNFRSF14         FARSA         ATP5I
##  1.879082e-02  1.876906e-02  1.876898e-02  1.876862e-02  1.875743e-02
##           PKM       MAP3K4        SYK_1        NDUFB5          IDI1
##  1.875137e-02  1.874916e-02  1.874538e-02  1.870371e-02  1.867952e-02
##        PTP4A1       CAPRIN1          DRG1          RHEB        ODC1_1
##  1.867242e-02  1.867043e-02  1.867024e-02  1.866757e-02  1.865663e-02
##          CIZ1       ASMTL_1        PPP1CA       VDAC1_1    HSP90AB1_1
##  1.865102e-02  1.862226e-02  1.861103e-02  1.860980e-02  1.859583e-02
##          NSL1         RPL22       TERF1_1        CYC1_1      ATP6V0E2
##  1.859345e-02  1.858411e-02  1.858223e-02  1.857577e-02  1.856701e-02
##        PTGES3        RBM5_1            FH          SNRK          ARAF
##  1.854406e-02  1.852879e-02  1.852576e-02  1.851685e-02  1.851637e-02
##     1007_s_at         CTBP2        FKBP15         MKNK1         IKZF1
##  1.849452e-02  1.849379e-02  1.847801e-02  1.847243e-02  1.842799e-02
##          ODC1      38835_at        CAPNS1         GNA13         EIF3D
##  1.842571e-02  1.839024e-02  1.837466e-02  1.837411e-02  1.836199e-02
##          LSM6      40567_at          RPA2          TPI1       GNA13_1
##  1.835728e-02  1.834968e-02  1.832443e-02  1.830123e-02  1.829342e-02
##      35615_at           NNT         CNOT8         UVRAG         MEF2D
##  1.829323e-02  1.829215e-02  1.828677e-02  1.828216e-02  1.826109e-02
##         COPS6        TCIRG1        CD22_1          TUBB       TSC22D4
##  1.826013e-02  1.825607e-02  1.825318e-02  1.824454e-02  1.824314e-02
##         SH2B3          NREP      APOBEC3C      39077_at      33300_at
##  1.823969e-02  1.823248e-02  1.823234e-02  1.818371e-02  1.816918e-02
##       NDUFAF3         RSBN1        FEN1_1         CSHL1       NDUFAF1
##  1.816726e-02  1.816269e-02  1.813416e-02  1.812673e-02  1.812666e-02
##          IPO7        TOPORS         CNPY3       CEBPZ_1       TSC22D3
##  1.812389e-02  1.808114e-02  1.808097e-02  1.805764e-02  1.804314e-02
##       FCGRT_1      KIAA0232          CNBP          EPRS          GRB2
##  1.803831e-02  1.801708e-02  1.800409e-02  1.800394e-02  1.800096e-02
##          HAGH         ARPC2          COQ9       CREB3L2          RPN2
##  1.799111e-02  1.798824e-02  1.798684e-02  1.798048e-02  1.797972e-02
##          BPHL        RAF1_1          DARS         STRN3          MPC2
##  1.797542e-02  1.796855e-02  1.796728e-02  1.796675e-02  1.796537e-02
##           CSK        NDUFS5         NR2C1          CLK2         SAR1A
##  1.796393e-02  1.796391e-02  1.795359e-02  1.794566e-02  1.793860e-02
##          MDC1          FOSB         BCR_2        JAK1_1      EIF1AX_1
##  1.793680e-02  1.791442e-02  1.789705e-02  1.789637e-02  1.787756e-02
##          CHKB      41219_at         KCNA5          SDHB           OS9
##  1.785581e-02  1.785034e-02  1.782914e-02  1.781241e-02  1.780915e-02
##         ARPC5         LRIG1        ATAD2B         CENPB          FRYL
##  1.778820e-02  1.778268e-02  1.776834e-02  1.776814e-02  1.773528e-02
##          IRF3         OARD1        RAC1_1       ZCCHC11          MCM3
##  1.771623e-02  1.771153e-02  1.769879e-02  1.769403e-02  1.769170e-02
##         RBM10      TMEM184B        TAGLN2         SUGP1          MLEC
##  1.767177e-02  1.766177e-02  1.766172e-02  1.765892e-02  1.765119e-02
##          P4HB         PLSCR1         EIF3E          MAP4          RALY
##  1.763264e-02  1.762488e-02  1.762089e-02  1.760606e-02  1.760212e-02
##       COX7A2L         BICD2       TRAPPC3          ICE1        ETS2_1
##  1.758813e-02  1.758404e-02  1.758389e-02  1.758152e-02  1.757501e-02
```

```
##          MXI1         VDAC2         MPRIP    N4BP2L2_1         TUBB3
##  1.756732e-02  1.755957e-02  1.755719e-02  1.755234e-02  1.755184e-02
##    33501_r_at        ZNF273        PRRC2A           AIP       PARP2_1
##  1.754339e-02  1.753001e-02  1.751679e-02  1.751312e-02  1.751227e-02
##      UBE2N_1    33499_s_at          E2F5     ATXN2L_1         SIAH1
##  1.750536e-02  1.749504e-02  1.748613e-02  1.743857e-02  1.742669e-02
##        810_at      TRIM44_1          AATF         IFT27      CRYBG1_1
##  1.740819e-02  1.739747e-02  1.739723e-02  1.739199e-02  1.738760e-02
##       STXBP3    40877_s_at           SYK    SMARCA2_1        DYNLT3
##  1.737496e-02  1.734641e-02  1.731468e-02  1.730608e-02  1.730452e-02
##          GCDH          TAP1          CUX1       DCUN1D4         SMAD2
##  1.728390e-02  1.727448e-02  1.727437e-02  1.727424e-02  1.727408e-02
##         NUP62        TUBA4A         SEPT2    SLC25A1_1         SRSF4
##  1.725735e-02  1.725554e-02  1.725521e-02  1.724622e-02  1.724281e-02
##        CHMP2A          GNG5         IDH3B       ATP13A3         HADHB
##  1.723999e-02  1.722281e-02  1.718641e-02  1.717163e-02  1.716403e-02
##          NCK1        SFPQ_2    33893_r_at        DDAH2         RAB8A
##  1.714013e-02  1.712234e-02  1.712088e-02  1.711566e-02  1.711321e-02
##           FTO         KMT2A          WSB2        TYMS_1          OCRL
##  1.710828e-02  1.710799e-02  1.710571e-02  1.708235e-02  1.707159e-02
##        SMCHD1        SSSCA1        TMSB10         RPRD2        RSL1D1
##  1.706136e-02  1.703767e-02  1.702931e-02  1.702099e-02  1.701922e-02
##        PTPN11         CASC3         MDK_1        ARID5A        ZNF217
##  1.701570e-02  1.701559e-02  1.699672e-02  1.699291e-02  1.698718e-02
##         TGIF1      TROVE2_1          LMO4        PTDSS1         CPSF4
##  1.698702e-02  1.698094e-02  1.697455e-02  1.697240e-02  1.696913e-02
##      ATP6V0D1       TMEM147        SEC22B          FLNB        RBL2_1
##  1.696505e-02  1.696011e-02  1.693624e-02  1.693531e-02  1.690188e-02
##          CD72          BZW1      ARHGEF18        TUBB4A       HLA-G_1
##  1.690149e-02  1.687320e-02  1.686569e-02  1.686519e-02  1.686412e-02
##          XBP1          PSAP        RPA3_1          PIN1       SLC25A6
##  1.684796e-02  1.684446e-02  1.683587e-02  1.683411e-02  1.683210e-02
##      RIPOR2_1         C1QL1          CLN3        RASSF2         EXTL3
##  1.681658e-02  1.679929e-02  1.679360e-02  1.677072e-02  1.676961e-02
##         PCDH9          CLTA        PCNA_1       SIGMAR1        GTF2E2
##  1.676629e-02  1.675980e-02  1.671582e-02  1.667363e-02  1.666780e-02
##           SMS        TRIM27        ILF3_2          HBP1          CAPG
##  1.665647e-02  1.664744e-02  1.661801e-02  1.657727e-02  1.656229e-02
##        RAB22A         PARP2          NBAS        METAP1        MRPS12
##  1.655734e-02  1.654604e-02  1.653558e-02  1.651076e-02  1.649710e-02
##          JAK1          CBX1          PAN2        MAP2K2          PIM2
##  1.648406e-02  1.643897e-02  1.643470e-02  1.643320e-02  1.643155e-02
##         SF3A3       CTDNEP1      LGALS9_1         HIP1R         KDM5A
##  1.642949e-02  1.641456e-02  1.641338e-02  1.640982e-02  1.640649e-02
##       S100A13         HSPA4         ITGA6      TNFRSF1A         SREK1
##  1.639934e-02  1.637122e-02  1.636947e-02  1.634846e-02  1.634458e-02
##          ZHX2        XBP1_1          RTN4          TPX2          GIT2
##  1.634081e-02  1.634068e-02  1.633553e-02  1.632940e-02  1.631293e-02
##          GPS2        KDELR2        CSF2RB       ACTN1_1         MORC3
##  1.630877e-02  1.629177e-02  1.628386e-02  1.626465e-02  1.625925e-02
##        TCF3_1       SMAD4_2        SQSTM1        RIPOR2        MAN2B1
##  1.625646e-02  1.624937e-02  1.624509e-02  1.623803e-02  1.623593e-02
##        442_at      31895_at       SELENOF      TRIM27_1          SDHC
##  1.623430e-02  1.621604e-02  1.618971e-02  1.618938e-02  1.618510e-02
```

```
##         NPRL2      MRFAP1L1        TEX261 DKFZP586I1420           SRM
##  1.618006e-02  1.614354e-02  1.614274e-02  1.613828e-02  1.611054e-02
##          ELF4         GGPS1        SPTLC1          PMS1       FARSA_2
##  1.610512e-02  1.610308e-02  1.609640e-02  1.608437e-02  1.607208e-02
##          SOX4         TTC37          POLE        RAE1_1         UBE2S
##  1.606942e-02  1.606604e-02  1.605335e-02  1.604456e-02  1.602275e-02
##        IQSEC1         RAP1A         WBP2          RTCB        STOML2
##  1.600931e-02  1.599867e-02  1.598672e-02  1.596406e-02  1.595564e-02
##       H2AFV_1         PFDN5      39722_at         ATP5L       IKZF1_1
##  1.595459e-02  1.594278e-02  1.594131e-02  1.592912e-02  1.591612e-02
##       GUCY1A3        CLDND1         RTF1         MTMR3        CCSER2
##  1.591534e-02  1.590963e-02  1.589463e-02  1.588056e-02  1.587175e-02
##       SMARCD2        IMPDH1        AMD1_1         PSEN1          PFKP
##  1.587140e-02  1.587018e-02  1.584250e-02  1.583705e-02  1.581475e-02
##         TPST2      PPP1R2_1        COMMD4         ZBED4          CLK1
##  1.581224e-02  1.580546e-02  1.578994e-02  1.577380e-02  1.575890e-02
##        MTA1_1         NR3C1         RNMT         BASP1       HLA-F_1
##  1.566451e-02  1.564796e-02  1.564515e-02  1.559126e-02  1.556535e-02
##          TAF2        SLC4A1       GADD45A         MARF1    33301_g_at
##  1.556121e-02  1.555838e-02  1.555189e-02  1.553488e-02  1.551817e-02
##      ARHGAP45          ATRX         PPM1A         PPM1F         CMTR1
##  1.551453e-02  1.551448e-02  1.551251e-02  1.551056e-02  1.550349e-02
##        MRPL49         PCF11        CRYBG1        PMS2P3       ARHGDIA
##  1.548968e-02  1.548180e-02  1.547109e-02  1.544269e-02  1.543781e-02
##         MYL6B         RING1         VPS72         PSMC2          TBCB
##  1.543458e-02  1.541970e-02  1.541882e-02  1.541162e-02  1.540525e-02
##          STX8      39434_at        AHCYL1        NDUFA2    37209_g_at
##  1.539096e-02  1.539040e-02  1.537416e-02  1.537023e-02  1.534928e-02
##         SMC1A          IL1B          BLNK       USP9X_1        U2SURP
##  1.531902e-02  1.530668e-02  1.530648e-02  1.529826e-02  1.529629e-02
##        RANBP1        MLLT11         RASA1      RAP1GAP2          VBP1
##  1.528710e-02  1.527724e-02  1.526639e-02  1.526364e-02  1.525519e-02
##         IL2RG       RABGAP1          MTOR        GRB2_1          CD47
##  1.523476e-02  1.523199e-02  1.522847e-02  1.522812e-02  1.522677e-02
##         VGLL4      ZNF266_1         ARIH2        FRMD4B         TAPBP
##  1.522343e-02  1.521962e-02  1.521631e-02  1.518770e-02  1.518046e-02
##          TPP1          DPF2        AKAP10        DCAF11         MAK16
##  1.517449e-02  1.516365e-02  1.516232e-02  1.514983e-02  1.514014e-02
##          ELF2        ATP11B          IK_1         RCAN1          DBN1
##  1.513307e-02  1.511667e-02  1.511397e-02  1.510339e-02  1.508549e-02
##         RAB2A          GNB2       SYNCRIP        MAN2A2        CDV3_1
##  1.506411e-02  1.505903e-02  1.505825e-02  1.505467e-02  1.505353e-02
##      C10orf10        GLT8D1        MTHFD1       ZFP36L2         PCMT1
##  1.504043e-02  1.501891e-02  1.501532e-02  1.500768e-02  1.500744e-02
##         MRE11           MPI       SUPT4H1         PSMB9        ZNF292
##  1.499922e-02  1.498715e-02  1.493893e-02  1.493672e-02  1.493421e-02
##         WIPF2        MRPL23          PHF2        GALNT1         NCOR2
##  1.493329e-02  1.491852e-02  1.491332e-02  1.490654e-02  1.489206e-02
##          PRCC         PSMA5        JAK1_2          TBCC       EIF2AK2
##  1.488801e-02  1.486710e-02  1.484448e-02  1.482235e-02  1.481849e-02
##         MCFD2          PAK1      PECAM1_1        POLR2J          LYL1
##  1.481759e-02  1.481126e-02  1.480702e-02  1.480437e-02  1.480258e-02
##       SPECC1L           ILK          MSL1        MCM3AP      38160_at
##  1.480071e-02  1.479718e-02  1.479295e-02  1.479102e-02  1.478818e-02
```

```
##        INPP5K        PDCD10    THUMPD1_1      AASDHPPT        CD34_1
##  1.477167e-02  1.476574e-02  1.474167e-02  1.472875e-02  1.471877e-02
##        ZC3H15          UGP2          IRF1         STX16        LPCAT1
##  1.470795e-02  1.469599e-02  1.469411e-02  1.468431e-02  1.467840e-02
##         ZAP70         LAMP2          WNK1         PTK2B         FOXO3
##  1.466166e-02  1.466074e-02  1.464694e-02  1.462763e-02  1.462203e-02
##         ATP5J          TAB2          MAEA          TOB1         UBE2C
##  1.457971e-02  1.457011e-02  1.455044e-02  1.454880e-02  1.452225e-02
##          FLT3        DCTD_1        IL10RB       SERINC3        CTCF_1
##  1.452085e-02  1.450482e-02  1.448834e-02  1.446704e-02  1.445265e-02
##         JOSD1          TYK2       ZFP36L1         BUD31      34532_at
##  1.444453e-02  1.442939e-02  1.440408e-02  1.436655e-02  1.435600e-02
##         PFDN1          TLE4    31526_f_at        EIF4G3      41224_at
##  1.434022e-02  1.433316e-02  1.431494e-02  1.429739e-02  1.429179e-02
##           LBR       ARHGAP1          TARS         PSIP1          HELZ
##  1.428703e-02  1.428077e-02  1.427981e-02  1.426145e-02  1.425118e-02
##         PAPD7      SLC39A14         SDCBP      769_s_at         TCOF1
##  1.424734e-02  1.423154e-02  1.422128e-02  1.420382e-02  1.419339e-02
##         NISCH        ENSA_2         DEGS1          LMO2        POLR2G
##  1.418243e-02  1.416907e-02  1.416380e-02  1.414583e-02  1.414250e-02
##       LAMTOR5      PTPN18_1         HDAC1         RNGTT        PITPNB
##  1.413791e-02  1.413165e-02  1.412353e-02  1.412001e-02  1.408540e-02
##         WIPI2        SYNGR2          MSH3        TRIM13       SELENOW
##  1.406054e-02  1.404913e-02  1.404637e-02  1.401437e-02  1.399695e-02
##       HMGN4_1         KAT6A      37339_at          MZF1        DNAJC8
##  1.399663e-02  1.394666e-02  1.394405e-02  1.394335e-02  1.393638e-02
##         HSPA9         VDAC1          PDHB      TMED10_1           MNT
##  1.393081e-02  1.392859e-02  1.391672e-02  1.391284e-02  1.390803e-02
##      39025_at          DDX1        MAP2K1          PPID         BAZ2B
##  1.389912e-02  1.389895e-02  1.388978e-02  1.388190e-02  1.388090e-02
##         PSME4       TMEM109          MTF2        CAPZA1        RPS4Y1
##  1.387172e-02  1.386935e-02  1.386507e-02  1.386037e-02  1.385833e-02
##          KXD1         PTPN6         KDM3A         BTBD2         DHX15
##  1.385807e-02  1.385611e-02  1.385414e-02  1.384376e-02  1.383923e-02
##          SFPQ    37864_s_at         MKRN1       ATP6AP2        SEC24B
##  1.383464e-02  1.382709e-02  1.382704e-02  1.382680e-02  1.381949e-02
##       DYNC1I2         SEPT7         SART1        FAM89B         IFI16
##  1.380005e-02  1.379695e-02  1.379668e-02  1.377831e-02  1.376366e-02
##      39969_at        MAP2K3       TRAPPC8          PGK1       B4GALT1
##  1.374313e-02  1.372256e-02  1.371909e-02  1.371458e-02  1.371292e-02
##         RAB1A         CREB1         PEBP1          ADSL         TOP2A
##  1.370539e-02  1.370422e-02  1.368666e-02  1.368361e-02  1.368037e-02
##         HCLS1         KAT6B          CYBA         DCP2          BTG2
##  1.366704e-02  1.365809e-02  1.364216e-02  1.363999e-02  1.363352e-02
##        TXNDC9        PMAIP1       SMARCE1          SAFB         ZFP36
##  1.361680e-02  1.361508e-02  1.358864e-02  1.357573e-02  1.356982e-02
##         HMGN1       ANAPC13        UBQLN2      UBE2J1_1          ADD3
##  1.356795e-02  1.355673e-02  1.354671e-02  1.353000e-02  1.352168e-02
##         HMGB1         COX7B         SPCS2         SIK1          SRP19
##  1.351172e-02  1.349743e-02  1.349620e-02  1.349385e-02  1.349058e-02
##        PPP1R2       TNFAIP3         UPF3A         HMGB2       PPP2R5A
##  1.347003e-02  1.345413e-02  1.345332e-02  1.345291e-02  1.343806e-02
##           WAS        UBE2E3        MAP4_2       ANKRD46         CRLF3
##  1.342947e-02  1.341904e-02  1.340389e-02  1.336735e-02  1.335819e-02
```

```
##         PTPRA         ACADM        EEF1A2     BCL11A_1       TNFAIP8
##  1.335696e-02  1.335687e-02  1.333364e-02  1.332300e-02  1.331710e-02
##         FOXJ2    39879_s_at       STAT1_1        THAP11          WTAP
##  1.331433e-02  1.331038e-02  1.330729e-02  1.330470e-02  1.329666e-02
##         DGUOK         GANAB       TMEM123          TSR3          ARF4
##  1.328517e-02  1.328037e-02  1.327973e-02  1.326915e-02  1.325798e-02
##         MECP2       TOP2B_1        FLT3_1       LANCL1          BCL2
##  1.325569e-02  1.324225e-02  1.323425e-02  1.317843e-02  1.317813e-02
##         RPL15       N4BP2L1        PSMB6        TMED10        ARID5B
##  1.317225e-02  1.314585e-02  1.313571e-02  1.312321e-02  1.311466e-02
##        RSU1_1          ADAR        PMS1_1       TMEM131      MRPS12_1
##  1.309639e-02  1.307398e-02  1.306497e-02  1.306282e-02  1.303935e-02
##          PEX3         PRKCI         ZNF32        ADGRG1     37313_at
##  1.303926e-02  1.303880e-02  1.302759e-02  1.302313e-02  1.302261e-02
##         UBXN4         CTBP1          JUNB         HLA-G        HNRNPR
##  1.298985e-02  1.298953e-02  1.297657e-02  1.297079e-02  1.295145e-02
##          MEN1       RPS6KA1        DPYSL2       SLC25A1       RAB1A_1
##  1.294772e-02  1.294062e-02  1.293445e-02  1.293382e-02  1.292187e-02
##        TRIM26     33817_at        AKR1B1         DESI2          NONO
##  1.291865e-02  1.291559e-02  1.291419e-02  1.290125e-02  1.290036e-02
##          APRT        CLK1_1     RASGRP2_1         AHSA1          DFFA
##  1.289709e-02  1.288721e-02  1.288618e-02  1.288031e-02  1.286668e-02
##         UBE2M         DUSP1         ZWINT          DNTT      TRIM33_1
##  1.286622e-02  1.284587e-02  1.284260e-02  1.283501e-02  1.283420e-02
##        CHD8_1     39421_at        KPNA2          ACLY          CDK9
##  1.283076e-02  1.281739e-02  1.281351e-02  1.281295e-02  1.279966e-02
##       NUMA1_1          PTEN       LIMK2_1     39342_at         COPS3
##  1.279284e-02  1.277517e-02  1.275527e-02  1.274295e-02  1.273927e-02
##      EIF2S3_1         DECR1        MED13L         CEBPG        TSG101
##  1.273479e-02  1.273478e-02  1.271515e-02  1.268611e-02  1.267200e-02
##    35450_s_at           CD9        RFC4_1         YWHAH        JCHAIN
##  1.266272e-02  1.264867e-02  1.264584e-02  1.263381e-02  1.262749e-02
##         HCFC1          XPO1       PRPSAP2     36122_at        EIF1AX
##  1.262634e-02  1.262542e-02  1.260713e-02  1.257793e-02  1.257393e-02
##       GUSBP11      TGOLN2_1          CD58       PCMT1_1          LST1
##  1.256660e-02  1.255739e-02  1.254971e-02  1.254169e-02  1.254026e-02
##        ARPP19          RYBP          UBN1         MICU2          PUM2
##  1.253840e-02  1.253245e-02  1.252783e-02  1.250129e-02  1.249732e-02
##          CD37          ARL2       TCF25_1          SKP1          IGHD
##  1.248267e-02  1.246242e-02  1.246139e-02  1.245713e-02  1.244968e-02
##          SSR4        KIFAP3         CENPF          PARG          CSTB
##  1.244610e-02  1.243221e-02  1.243099e-02  1.242891e-02  1.242429e-02
##        UBE2E1         ALAS2          NOP2          GGA3         ZMYM2
##  1.242086e-02  1.239234e-02  1.238598e-02  1.237432e-02  1.237080e-02
##          IDH1         RRP1B     35351_at         UBAC1     40951_at
##  1.236816e-02  1.234852e-02  1.233504e-02  1.233274e-02  1.232823e-02
##         C2CD5          RBM5       SSBP1_1         RAB9A          MBD2
##  1.228093e-02  1.226852e-02  1.226151e-02  1.225631e-02  1.225514e-02
##         HEBP2         FADS3     41407_at         NFRKB        ZNF337
##  1.225445e-02  1.224853e-02  1.224259e-02  1.223430e-02  1.222836e-02
##         TGFB1    38194_s_at          CDK1          DDB2         TRBC1
##  1.221808e-02  1.221532e-02  1.219751e-02  1.218279e-02  1.215715e-02
##       RASGRP2         G3BP1           FOS        FAM8A1        CKS1B
##  1.215273e-02  1.215156e-02  1.214655e-02  1.214181e-02  1.213662e-02
```

```
##        CYFIP2         DRAP1        POLR2A         SRP14         MGRN1
##  1.213533e-02  1.211141e-02  1.207797e-02  1.204205e-02  1.203420e-02
##       CLEC11A         IL23A         PTPN2         MGAT5        LSM14A
##  1.203373e-02  1.201382e-02  1.200973e-02  1.199807e-02  1.199031e-02
##         PTPRC          TECR      38709_at          ALG3        PSMD12
##  1.198676e-02  1.198481e-02  1.196671e-02  1.196555e-02  1.196399e-02
##         TNPO3         STIP1        RABEP1       GLUD1_1        HMGXB4
##  1.196302e-02  1.195846e-02  1.195586e-02  1.194716e-02  1.194650e-02
##         PUF60          BIN1         ANXA7        DNAJB1          DEXI
##  1.193643e-02  1.187837e-02  1.187454e-02  1.186852e-02  1.185828e-02
##         TOR1A         PSMC5          TCF7          BRD3          CHD1
##  1.185112e-02  1.184961e-02  1.184804e-02  1.183316e-02  1.180104e-02
##          GNB1        VAT1_1          GUSB        ATRX_1         CDC37
##  1.179062e-02  1.178993e-02  1.178908e-02  1.178460e-02  1.178022e-02
##      31800_at         SNRPC          KLC1          RHOA     GABARAPL2
##  1.177450e-02  1.177257e-02  1.176257e-02  1.176160e-02  1.176018e-02
##         PSMD4         OXSR1         PRDX2          LTN1          PIGC
##  1.175081e-02  1.173565e-02  1.173522e-02  1.172652e-02  1.172513e-02
##        TM9SF2          CHD8    34677_f_at         MED13          CLTB
##  1.170933e-02  1.170552e-02  1.170290e-02  1.169341e-02  1.167881e-02
##          PCNT         PRPS2          TMC6         TFDP2        955_at
##  1.167081e-02  1.166908e-02  1.166128e-02  1.164559e-02  1.164361e-02
##      35736_at         ARPC4         EHMT2       NR3C1_1         MEF2A
##  1.163068e-02  1.162267e-02  1.159886e-02  1.157755e-02  1.157368e-02
##         FOS_2        NCAPD3           NSF         RUBCN        ZNF146
##  1.156696e-02  1.156131e-02  1.154662e-02  1.154313e-02  1.153431e-02
##         SEC13      37264_at         CNOT1          CTSC         KIF11
##  1.152910e-02  1.152434e-02  1.152203e-02  1.151673e-02  1.151213e-02
##       CSNK1A1          GNL2        RELA_2         GPSM3        TCEAL1
##  1.149784e-02  1.148094e-02  1.147246e-02  1.146645e-02  1.145863e-02
##         ALAS1      38019_at          NAB1       TAF11_1         IGF2R
##  1.144114e-02  1.142232e-02  1.141947e-02  1.140908e-02  1.140429e-02
##         SUSD6         H2AFV       FAM193A      EIF4EBP2        LYPLA1
##  1.134544e-02  1.133082e-02  1.131948e-02  1.129414e-02  1.127638e-02
##       C6orf62         CCT6A        SEC23A       TOP2A_2         NCSTN
##  1.126631e-02  1.126628e-02  1.125103e-02  1.122992e-02  1.121914e-02
##         TADA3       FAM208A         ITGA4       GABARAP        NDUFS2
##  1.121674e-02  1.121479e-02  1.119851e-02  1.118342e-02  1.118292e-02
##       RBCK1_1         TAF10          CRYZ         LYN_1        943_at
##  1.115402e-02  1.114437e-02  1.114427e-02  1.113442e-02  1.113059e-02
##        CDC123          FAF2          NFYC          NEK9        POLR2F
##  1.112906e-02  1.112015e-02  1.108997e-02  1.108780e-02  1.106675e-02
##        RAB11A          SSR1         MARK3         SRSF6       NR3C1_2
##  1.106654e-02  1.106592e-02  1.106417e-02  1.105359e-02  1.104096e-02
##         CFDP1         STAG2         VEZF1         ENTPD6        PHF21A
##  1.102215e-02  1.100879e-02  1.099615e-02  1.098838e-02  1.095439e-02
##          IPO5      PPP1CA_1          EAPP          OGFR         STK10
##  1.094662e-02  1.094582e-02  1.094518e-02  1.093104e-02  1.091367e-02
##          SAT1         PLIN3     ARHGAP1_1        AKAP11         RSRC2
##  1.091228e-02  1.090813e-02  1.090353e-02  1.089161e-02  1.088292e-02
##        PECAM1          MIA2          SETX          FHL1        SEC31A
##  1.087369e-02  1.087046e-02  1.086593e-02  1.086381e-02  1.086281e-02
##      ADAM10_1         CELF1          NXF1      SLC25A44       PRKDC_2
##  1.084676e-02  1.084163e-02  1.082624e-02  1.081748e-02  1.081633e-02
```

```
##          NKG7          NFYA        IL27RA         MMS19         HMGA1
##  1.081349e-02  1.081193e-02  1.080609e-02  1.080264e-02  1.079312e-02
##          OFD1       RABGGTB        DNAJC7         TOP2B          RAC2
##  1.078938e-02  1.077030e-02  1.076187e-02  1.074836e-02  1.073974e-02
##          AMOT      SERPINB1        193_at          DAP3         ATXN2
##  1.073682e-02  1.072406e-02  1.072150e-02  1.071220e-02  1.071102e-02
##         NCOA1       CDK2AP1          SARS         FYN_1       TRA2A_1
##  1.070635e-02  1.070516e-02  1.070478e-02  1.070037e-02  1.069544e-02
##         DDX21       SMARCC1         FOS_1        TROVE2         USP33
##  1.069115e-02  1.069085e-02  1.068831e-02  1.068119e-02  1.067692e-02
##         ASAH1        TCEAL4      ATP6V1G1          RBM6        BRD2_1
##  1.066595e-02  1.066544e-02  1.066160e-02  1.064780e-02  1.062303e-02
##            CS      38445_at       RBMS1_1         CYTH2      NFATC2IP
##  1.061123e-02  1.059880e-02  1.059685e-02  1.059176e-02  1.058656e-02
##           MX2        HNRNPK          TSFM          E2F3         AURKB
##  1.056497e-02  1.056361e-02  1.056143e-02  1.056047e-02  1.055767e-02
##         RECQL         YWHAZ         MTMR1           ME2     N4BP2L1_2
##  1.050982e-02  1.049954e-02  1.049342e-02  1.046679e-02  1.046564e-02
##      KIAA0922      APOBEC3G          RPA1          USP5          NASP
##  1.045077e-02  1.043187e-02  1.043118e-02  1.041567e-02  1.041498e-02
##        GRAMD4         PLPBP          PDHX           ID3         BLVRB
##  1.041251e-02  1.041197e-02  1.041121e-02  1.040787e-02  1.040109e-02
##       MRPS18B         ERCC3       PIP4K2A    MPHOSPH9_1     AKAP17A_1
##  1.038981e-02  1.038229e-02  1.036215e-02  1.035023e-02  1.032592e-02
##          KRT8         UTP3        YTHDC1        EIF2S3        TOPBP1
##  1.031396e-02  1.030320e-02  1.028343e-02  1.025345e-02  1.024458e-02
##     1158_s_at         RCOR1        CD44_1      PMS2P3_1        MDC1_1
##  1.023428e-02  1.023392e-02  1.021753e-02  1.021688e-02  1.016872e-02
##         PNISR          LY86          IST1        ZFC3H1         VPS52
##  1.015866e-02  1.015076e-02  1.013340e-02  1.013245e-02  1.013240e-02
##       AP3D1_1         FSCN1         PRPF8         TAF6L           BRE
##  1.012876e-02  1.012804e-02  1.012346e-02  1.011548e-02  1.011483e-02
##          FLNA        ARMCX6      CTNNA1_1          IGHM          STAM
##  1.010821e-02  1.009885e-02  1.009791e-02  1.009133e-02  1.009030e-02
##         UBE3A        RUVBL1         PSMD9    40552_s_at        BTN3A1
##  1.007746e-02  1.007688e-02  1.006630e-02  1.006557e-02  1.005379e-02
##          GPX1          NPAT         KDM2A          RIF1          GCN1
##  1.005053e-02  1.004753e-02  1.004618e-02  1.004031e-02  1.003407e-02
##         KDM5D         ZMYM4         STK39         VAMP2           CAT
##  1.003188e-02  1.000229e-02  9.999490e-03  9.996970e-03  9.995180e-03
##       TP53BP1           UNG        BIN1_1         ZMYM3        TOP1P2
##  9.994479e-03  9.986613e-03  9.962996e-03  9.962339e-03  9.945497e-03
##       SMAD2_1       UBE2S_2          SLBP      NIPSNAP1          WEE1
##  9.932878e-03  9.925123e-03  9.905697e-03  9.902963e-03  9.902306e-03
##         DAAM1          CALU        KCNAB2         ROCK1      NDUFB7_1
##  9.900186e-03  9.898942e-03  9.886441e-03  9.885384e-03  9.867490e-03
##        UBR5_1         MOB1A      IGHV5-78         CHTOP    32004_s_at
##  9.845516e-03  9.834891e-03  9.822859e-03  9.819821e-03  9.808490e-03
##          UGDH       PIK3C2B       PTPRC_2         GPAA1          SPOP
##  9.798553e-03  9.795352e-03  9.770973e-03  9.757316e-03  9.727563e-03
##          TYMS        SEC24C          IER2          BST2          SHC1
##  9.727450e-03  9.726091e-03  9.713487e-03  9.692563e-03  9.686242e-03
##      KIAA0100         MOAP1          NME3           SFN     RPS6KA3_1
##  9.686237e-03  9.682366e-03  9.678139e-03  9.677161e-03  9.676169e-03
```

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##      AHCYL1_1       LDLRAD4          GPN1        DNPEP          PUM1
##  9.665084e-03  9.648507e-03  9.646888e-03  9.642146e-03  9.635598e-03
##         FMNL1         ASXL1          BPTF       MBTPS1         HSPB1
##  9.619781e-03  9.615926e-03  9.609441e-03  9.600967e-03  9.600653e-03
##       ARL6IP1          DHFR         MUTYH          CRY1           AES
##  9.585380e-03  9.582466e-03  9.556019e-03  9.555748e-03  9.553298e-03
##       LITAF_1        BRD8_1          MDN1          GLRX        CABIN1
##  9.547203e-03  9.542317e-03  9.535444e-03  9.530769e-03  9.512272e-03
##       ST6GAL1          UFD1        RBM6_1          GNL1          CD34
##  9.487854e-03  9.463228e-03  9.463052e-03  9.456389e-03  9.452583e-03
##         PDE6D       ARFGEF1     HNRNPDL_1          TBCE          PHIP
##  9.449683e-03  9.447858e-03  9.446177e-03  9.432176e-03  9.426914e-03
##         SRF_1        RNF167      32547_at          EID1          GM2A
##  9.414007e-03  9.411801e-03  9.381769e-03  9.367784e-03  9.361196e-03
##        API5_1        CNPPD1       UBE2S_1          DPM1         LARP4
##  9.358840e-03  9.354192e-03  9.329798e-03  9.318301e-03  9.316380e-03
##        CTNNB1      MAPKAPK2       TSC22D1      33414_at       LAPTM4A
##  9.312856e-03  9.312366e-03  9.293634e-03  9.286361e-03  9.282198e-03
##       TOP2A_1       SERTAD2     PRKAR1A_2       DDX3X_1          SBF1
##  9.269513e-03  9.256706e-03  9.253387e-03  9.251435e-03  9.251325e-03
##         CYB5A        CAMKK2         DSCR3         SENP3        CYFIP1
##  9.245213e-03  9.231951e-03  9.225792e-03  9.222666e-03  9.219886e-03
##        NDUFS4         CYB5B        SLC7A1         PRKCH         FUBP1
##  9.219173e-03  9.214994e-03  9.207465e-03  9.203659e-03  9.196553e-03
##          UPF1        LSM7_1        RAC2_1         GNA15          SCP2
##  9.187446e-03  9.176945e-03  9.167610e-03  9.159811e-03  9.156806e-03
##          SPEN         MED12         BCAP31          CD63         NDC80
##  9.153363e-03  9.147649e-03  9.141152e-03  9.140615e-03  9.134094e-03
##          CDK4       HNRNPH3          AFF1       STX16_1         SARAF
##  9.126460e-03  9.110108e-03  9.099745e-03  9.079862e-03  9.061261e-03
##        RALBP1          PBX3         TAF15         DEAF1          KRAS
##  9.060219e-03  9.027777e-03  9.020802e-03  9.019189e-03  9.008227e-03
##         ARIH1       ARHGAP4          URI1         ARRB2          LCP2
##  9.000411e-03  8.992381e-03  8.987060e-03  8.971077e-03  8.967054e-03
##    TRAF3IP3_1      SLC25A46         SATB1         MAPK6         MRPL9
##  8.966625e-03  8.956032e-03  8.952910e-03  8.935332e-03  8.929069e-03
##        RABAC1         ADAM10       SUMO1_1        MSH2_1         TACC1
##  8.923979e-03  8.919201e-03  8.915481e-03  8.912618e-03  8.906580e-03
##    31444_s_at         RBCK1         NCOA4         SRSF5        TCF3_2
##  8.901288e-03  8.884275e-03  8.865711e-03  8.857914e-03  8.849417e-03
##          MANF        METTL3        PRRC2C         DHX38         UCKL1
##  8.842211e-03  8.804450e-03  8.804378e-03  8.797676e-03  8.796545e-03
##         USP24        ZNF428      36158_at         ZNF22        SUPT5H
##  8.791375e-03  8.787748e-03  8.784896e-03  8.754319e-03  8.751007e-03
##        SLC1A5           GNS         TRIM37         ERP29          CD44
##  8.749522e-03  8.747527e-03  8.741930e-03  8.741033e-03  8.738893e-03
##        RER1_1       CLEC16A       SDR39U1         TUSC2       SERINC1
##  8.732706e-03  8.731221e-03  8.727938e-03  8.720534e-03  8.711608e-03
##         NDRG1         SEC63          EIF1          RBPJ        EIF2B2
##  8.702577e-03  8.697542e-03  8.694713e-03  8.690925e-03  8.686339e-03
##         SEPT6         VEGFB       HNRNPA0        EIF2S1        HIVEP2
##  8.680785e-03  8.680314e-03  8.677014e-03  8.675326e-03  8.616208e-03
##      35292_at         DDHD2       NFKB1_1         LYRM1        TGFBR2
##  8.613047e-03  8.597997e-03  8.595840e-03  8.581814e-03  8.580699e-03
```

```
##       CCDC28A         TRIB2         AP3S1           MGA        PRKAG1
##  8.571304e-03  8.568333e-03  8.556435e-03  8.553714e-03  8.540963e-03
##          CAP1          SDHA        UBE2G2       PPP2R1A        PLXND1
##  8.523436e-03  8.512014e-03  8.504199e-03  8.498144e-03  8.485586e-03
##          CHD4         CD164         NUP93         CNPY2          BAG5
##  8.479081e-03  8.478104e-03  8.475796e-03  8.471537e-03  8.462504e-03
##         STAT1         CLIC4         EVI2A         UTP18         RGS19
##  8.461452e-03  8.452686e-03  8.451115e-03  8.449697e-03  8.436599e-03
##       PRKAR1A          SACS       TNFAIP2         MEGF9         ACBD3
##  8.433227e-03  8.427863e-03  8.425462e-03  8.422338e-03  8.415847e-03
##        NUP188      33987_at         SF3B2          GDI2       IGF2BP3
##  8.407784e-03  8.403602e-03  8.402602e-03  8.395878e-03  8.390248e-03
##          HAT1        TMEM59           SPN         MTMR4         CEP57
##  8.378495e-03  8.371860e-03  8.364372e-03  8.361053e-03  8.358256e-03
##        DIAPH1        MAPRE2         YWHAE    31519_f_at         FOXM1
##  8.346396e-03  8.331205e-03  8.326622e-03  8.301094e-03  8.294305e-03
##       SEPT6_2        PICALM         RIOK3          FNTA         TRRAP
##  8.289832e-03  8.286817e-03  8.246990e-03  8.235005e-03  8.232219e-03
##          MPP1      ATP6V0E1         SART3         TCF25         ELAC2
##  8.230598e-03  8.226979e-03  8.224240e-03  8.215025e-03  8.173970e-03
##       PTTG1IP       PTPRCAP          COA1          PFKL          DAD1
##  8.172686e-03  8.171272e-03  8.169806e-03  8.167156e-03  8.157663e-03
##         MYD88         SMAD4      TMEM106C        STAMBP        IQGAP2
##  8.152430e-03  8.134745e-03  8.127522e-03  8.119933e-03  8.115892e-03
##          RFC5         HACD2         TRAM1         MGST2           DBI
##  8.114506e-03  8.113385e-03  8.108294e-03  8.107213e-03  8.103145e-03
##           BCR         SASH3        EIF2S2          CCNH           MYB
##  8.090003e-03  8.087959e-03  8.083113e-03  8.080267e-03  8.059864e-03
##          SMG7          ADNP        PPP4R1        SLC7A5      KIAA1109
##  8.056391e-03  8.054022e-03  8.050226e-03  8.045123e-03  8.027160e-03
##          CDC7           VCP        DHX9_1        IARS2      MPHOSPH6
##  8.019138e-03  8.012448e-03  8.003192e-03  8.001011e-03  7.994259e-03
##      TRAF3IP3       SRSF6_1          CD46         HUWE1         LARP1
##  7.992645e-03  7.987862e-03  7.971625e-03  7.963704e-03  7.947263e-03
##          SNW1         DHX16       AZIN1_1           TDG      MPHOSPH9
##  7.945491e-03  7.942332e-03  7.917652e-03  7.911616e-03  7.908819e-03
##          FLI1        FNTA_1         GLOD4    32878_f_at      FKBP1A_1
##  7.892524e-03  7.873933e-03  7.862207e-03  7.849024e-03  7.846110e-03
##          PARN     PRPF40A_1          MPST         TK1_1         GLUD1
##  7.846024e-03  7.841301e-03  7.828926e-03  7.794959e-03  7.785451e-03
##         AP3B1         CHMP1A          SDF2         CELF2         GNPAT
##  7.784183e-03  7.784065e-03  7.774139e-03  7.768400e-03  7.765025e-03
##        NUP205         GOSR1       TIMM17A          NPC2          NME4
##  7.733177e-03  7.709275e-03  7.703709e-03  7.701782e-03  7.684842e-03
##          BLMH         MTMR6         KLF10        PKMYT1          PKN1
##  7.682892e-03  7.662870e-03  7.662508e-03  7.656176e-03  7.654501e-03
##         KLHL9          BTG1        POLR2B         CDC16         ERCC1
##  7.641062e-03  7.629914e-03  7.625629e-03  7.619415e-03  7.617931e-03
##         TSNAX          POP5      41143_at        IGHM_3       PSMD9_1
##  7.616700e-03  7.609957e-03  7.608577e-03  7.606283e-03  7.589332e-03
##         STIM1        TRIP12           TTK       ARHGEF6          EIF5
##  7.587709e-03  7.582021e-03  7.573785e-03  7.557458e-03  7.552120e-03
##         PCBP2          GUK1         PRMT2         NFKB1     1106_s_at
##  7.548660e-03  7.546468e-03  7.535913e-03  7.533628e-03  7.529241e-03
```

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##         ELMO1        PIK3R3         AP3D1         KIF2A          EDC4
##  7.515728e-03  7.514207e-03  7.502749e-03  7.502334e-03  7.496816e-03
##        SAMM50         ISG15           MLX      RAB8A_1         DDX3Y
##  7.478293e-03  7.474476e-03  7.474472e-03  7.471803e-03  7.468825e-03
##         SEPT9      SMAD4_1         DDX11      S100A10         MGEA5
##  7.460737e-03  7.458650e-03  7.454037e-03  7.452619e-03  7.451022e-03
##      MAP1LC3B         VAMP7          ELF1          KTN1         SYPL1
##  7.449272e-03  7.446413e-03  7.443726e-03  7.441885e-03  7.438950e-03
##        TSPAN3         DOCK2         FKBP4        ACOT13        NAP1L4
##  7.437368e-03  7.435164e-03  7.429769e-03  7.424601e-03  7.415829e-03
##       TNPO3_1      41258_at        IFITM2         TFDP1        ARL2BP
##  7.402528e-03  7.397381e-03  7.395616e-03  7.385873e-03  7.381824e-03
##      ATP6V1B2        AMD1_2         VOPP1           XPC          SF3B4
##  7.374032e-03  7.355555e-03  7.338052e-03  7.333067e-03  7.311525e-03
##       TPD52L2        TRIP13          AIF1           AK2          RSU1
##  7.311161e-03  7.300195e-03  7.281337e-03  7.267725e-03  7.255289e-03
##       SRSF1_1         CCNG2         CHERP          SRGN        RPA1_1
##  7.250753e-03  7.250375e-03  7.245321e-03  7.242639e-03  7.218968e-03
##         CRADD        AKR7A2      DNAJA1_1        CAPZA2    TMEM106C_1
##  7.215463e-03  7.212157e-03  7.204607e-03  7.200938e-03  7.189144e-03
##        ZNHIT3          GPX4         NCOA6       FUBP1_1         IFITM1
##  7.184750e-03  7.184660e-03  7.180742e-03  7.157558e-03  7.149868e-03
##         COPS2       C5orf15          USP7        NUP153           RB1
##  7.145441e-03  7.134440e-03  7.130062e-03  7.112829e-03  7.076529e-03
##         KAT2A          HSF1       PTPRC_1          NADK       HERPUD1
##  7.074207e-03  7.060796e-03  7.060578e-03  7.058966e-03  7.028136e-03
##      CALCOCO2      34647_at         EIF3F      KIAA0907        NPEPPS
##  7.014570e-03  7.004160e-03  7.000974e-03  6.991801e-03  6.987802e-03
##        RMND5A          XPO7         MYH10        CDKN1B         CIRBP
##  6.982398e-03  6.934736e-03  6.930399e-03  6.915050e-03  6.910793e-03
##        NFE2L2        DUSP11         MAT2A          CD3E      POLR2H_1
##  6.906716e-03  6.896567e-03  6.895086e-03  6.881783e-03  6.858806e-03
##          EZH2      IL10RB_1         PRKRA         STMN1       RAP1B_1
##  6.852470e-03  6.851515e-03  6.841970e-03  6.837188e-03  6.832545e-03
##       HNRNPH1      UBE2D3_1         PRDX6         TCF12          AKT1
##  6.801118e-03  6.790878e-03  6.787321e-03  6.785324e-03  6.780680e-03
##         MYC_2         SCAF8         MYBL2      NFATC3_2      41733_at
##  6.774701e-03  6.771999e-03  6.771895e-03  6.769481e-03  6.762789e-03
##      41243_at       ATP6AP1        MAD2L1        MAGED1          CD81
##  6.755067e-03  6.754532e-03  6.743998e-03  6.740799e-03  6.714017e-03
##          TLN1          TBCD           TKT        BRD3_1          TFRC
##  6.705881e-03  6.695087e-03  6.673184e-03  6.671704e-03  6.669872e-03
##       POLDIP3        PSMD11      33836_at         RBBP8         ETHE1
##  6.649040e-03  6.630869e-03  6.629059e-03  6.627731e-03  6.626915e-03
##        KDELR1         CAPZB          RPN1         CASP8        ABL1_2
##  6.618350e-03  6.615944e-03  6.594308e-03  6.593020e-03  6.585298e-03
##        DNAJA1        ENSA_1       ALDH9A1       SORL1_1        ACADVL
##  6.585143e-03  6.575073e-03  6.561170e-03  6.552972e-03  6.549170e-03
##     41718_g_at         FGFR1         ITM2B     2064_g_at         RNF11
##  6.547092e-03  6.544976e-03  6.517320e-03  6.515733e-03  6.513707e-03
##         DDX18      39728_at         MXRA7         AP1S2    31673_s_at
##  6.512542e-03  6.508779e-03  6.507427e-03  6.499305e-03  6.496461e-03
##        IGHM_1        KAT8_1       CSNK1G2        FAM53B        BTN3A2
##  6.484783e-03  6.475562e-03  6.474051e-03  6.469870e-03  6.466415e-03
```

```
##       SLC30A9       1184_at          TDP2         ARCN1       ALOX5AP
##  6.445967e-03  6.393714e-03  6.383781e-03  6.378096e-03  6.362933e-03
##       HUWE1_1       SULT1A1          PAK2         DDX3X         OXA1L
##  6.349231e-03  6.328225e-03  6.311979e-03  6.309708e-03  6.303433e-03
##         RAB14          TIA1      41562_at        INSIG1     LDLRAD4_1
##  6.301641e-03  6.299230e-03  6.289257e-03  6.282416e-03  6.278038e-03
##        ZBTB18          PRNP         MYO9B         CAD_1          RAF1
##  6.274028e-03  6.261353e-03  6.254759e-03  6.246752e-03  6.229780e-03
##       SKIV2L2        VPS13B       CCND3_1      374_f_at         HDLBP
##  6.219733e-03  6.194135e-03  6.184472e-03  6.177384e-03  6.175480e-03
##       RARRES3          CCNF          CARS       ALDH5A1         CDC20
##  6.167576e-03  6.136248e-03  6.134463e-03  6.131647e-03  6.114121e-03
##       PSMD7_1         FNBP1         SRP54      38585_at          IMP4
##  6.109705e-03  6.109121e-03  6.094617e-03  6.092622e-03  6.087379e-03
##        TXNL4A        SEPHS2        SACM1L        466_at        TSPAN7
##  6.081574e-03  6.078301e-03  6.051976e-03  6.038137e-03  6.022637e-03
##      MAGED2_1          RNF4          TUG1           PNP         ANXA11
##  6.019246e-03  6.018995e-03  5.993896e-03  5.993700e-03  5.986343e-03
##          KLF6        DYNLT1    39065_s_at      TMBIM6_1          RFC4
##  5.984831e-03  5.976607e-03  5.970538e-03  5.954487e-03  5.942143e-03
##       SMARCA2        VPS26A           MAZ         SAFB2       IVNS1ABP
##  5.939798e-03  5.934716e-03  5.927599e-03  5.922402e-03  5.912355e-03
##       RASA1_1         GRHPR          UFL1         MPPE1         IGFBP7
##  5.896599e-03  5.896318e-03  5.894596e-03  5.877180e-03  5.874688e-03
##       PLEKHB2          EMP3        CLINT1        EIF4G1         PRPS1
##  5.871294e-03  5.856192e-03  5.846925e-03  5.846668e-03  5.843494e-03
##        NUDT21     MAPK1IP1L         FNBP4         YME1L1         PSMC6
##  5.832788e-03  5.818444e-03  5.816188e-03  5.809639e-03  5.791745e-03
##        SCAMP3          AHCY        PPP2CA         TFAP4    32317_s_at
##  5.756856e-03  5.754388e-03  5.748390e-03  5.740686e-03  5.736688e-03
##       HNRNPDL        TARBP1      969_s_at         AEBP1          CIB1
##  5.734238e-03  5.734081e-03  5.730227e-03  5.715821e-03  5.695890e-03
##          PURA        SPTAN1         PTOV1          BRD8        STAT5A
##  5.692284e-03  5.686162e-03  5.669223e-03  5.651899e-03  5.638224e-03
##        FKBP1A         LAGE3        MARCH7          NSA2     PRKAR1A_1
##  5.633990e-03  5.631130e-03  5.629926e-03  5.627965e-03  5.626854e-03
##         CNOT2          LRMP       SEPT6_1          FTH1         HDDC2
##  5.624300e-03  5.624140e-03  5.620928e-03  5.599879e-03  5.599206e-03
##       1728_at          XPO6         PSMD3         BARD1        POM121
##  5.574632e-03  5.573395e-03  5.553169e-03  5.544031e-03  5.536496e-03
##          RHOH          COPA         SURF1        NUP214           TK1
##  5.533050e-03  5.528843e-03  5.504576e-03  5.503578e-03  5.499426e-03
##         BCL7A      33234_at         PTTG1        PPP1R7         SUMO3
##  5.494039e-03  5.491644e-03  5.490616e-03  5.488374e-03  5.484991e-03
##        GARS_1       YWHAZ_1         OTUD4          GYPC         VAMP3
##  5.484845e-03  5.483971e-03  5.481382e-03  5.475814e-03  5.474297e-03
##      39416_at        RANBP2         RBMS1         MKI67        R3HCC1
##  5.473255e-03  5.471861e-03  5.463717e-03  5.454384e-03  5.453238e-03
##         TMED5        IGHM_2      NIPSNAP2          ADD1         PATZ1
##  5.445274e-03  5.430095e-03  5.418247e-03  5.407951e-03  5.403799e-03
##        ERGIC3          SMC4         UBE4A      37907_at      40427_at
##  5.399575e-03  5.398079e-03  5.391514e-03  5.375143e-03  5.364442e-03
##      EIF2S1_1        RAD23A         SORL1          SGTA    40783_s_at
##  5.355241e-03  5.351682e-03  5.321039e-03  5.314839e-03  5.313164e-03
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##          TP53      39372_at        ADH5_1         SSBP2       NFKB1_2
##  5.311293e-03  5.301947e-03  5.298284e-03  5.290645e-03  5.285816e-03
##    41132_r_at       ATP6V1A        IGFBP4        BCL11A        PMS2P1
##  5.283529e-03  5.283293e-03  5.282215e-03  5.278081e-03  5.262931e-03
##         CRIP1        OSBPL8        PSMD10       LRRFIP1       SLC35A3
##  5.245757e-03  5.230035e-03  5.203902e-03  5.161772e-03  5.147186e-03
##         ASMTL          BYSL          CCT4       SEC14L1         BAZ1B
##  5.113100e-03  5.064270e-03  5.063276e-03  5.062568e-03  5.055012e-03
##          SMC5        HDGF_1        RBM42         ANXA6        TRIM14
##  5.031861e-03  5.019554e-03  5.014094e-03  5.010865e-03  5.002251e-03
##           ZFR       CYB5B_1         CKAP5        TYROBP       ICAM2_2
##  4.999275e-03  4.995920e-03  4.983345e-03  4.981240e-03  4.963767e-03
##    33689_s_at         CHSY1        CHAF1A          CALR          ISCU
##  4.937184e-03  4.927999e-03  4.924514e-03  4.918605e-03  4.915327e-03
##     SMARCC1_1         CCNB1          UROD        STAT5B         PSMD7
##  4.908579e-03  4.902557e-03  4.895483e-03  4.891485e-03  4.860104e-03
##         PDIA6         SNU13         DDIT4      TGFBR2_1        PPP6R1
##  4.858979e-03  4.857616e-03  4.838424e-03  4.832644e-03  4.829177e-03
##        925_at         FEZ2          BEX4          XPOT         GRSF1
##  4.826320e-03  4.818852e-03  4.813719e-03  4.813232e-03  4.807502e-03
##       SH3GLB1         LSP1          CBX6         UBE2I           SRF
##  4.797379e-03  4.796706e-03  4.783136e-03  4.773695e-03  4.772297e-03
##        PGRMC1         ETF1         FKBP2         HIPK1         CYTH1
##  4.770114e-03  4.764506e-03  4.737350e-03  4.734316e-03  4.731427e-03
##         PRDX3       FBXO21         TIAL1       NCBP2_1           ATR
##  4.717913e-03  4.700016e-03  4.672382e-03  4.659048e-03  4.646461e-03
##          TTC1     41128_at          TPR         ATP2B4          SCAP
##  4.623966e-03  4.621249e-03  4.604415e-03  4.586544e-03  4.584446e-03
##    32877_i_at         FKBP5         HAUS7       SNRNP70      RAP1GDS1
##  4.581611e-03  4.575337e-03  4.551646e-03  4.538053e-03  4.532915e-03
##         TUBG1        SRSF11          ADH5      LEPROTL1    NFATC2IP_1
##  4.517003e-03  4.507539e-03  4.495129e-03  4.484180e-03  4.482905e-03
##          TOP1        SH3BP5        GNAI2          RNH1           EED
##  4.475063e-03  4.468193e-03  4.461926e-03  4.455764e-03  4.454429e-03
##       SMARCB1         IGLC1         PA2G4          HADH         RNPEP
##  4.454113e-03  4.452920e-03  4.447290e-03  4.445901e-03  4.439463e-03
##        S100A4         ADCY7         PSMD2        DAZAP2     PPP2R1A_1
##  4.437799e-03  4.436219e-03  4.429477e-03  4.419747e-03  4.419137e-03
##         AHNAK         MYB_1         NUMA1           SP3         G3BP2
##  4.412720e-03  4.398237e-03  4.390990e-03  4.363777e-03  4.347712e-03
##      37742_at      38923_at          IMMT          PPT1        EXOSC8
##  4.323671e-03  4.315768e-03  4.309706e-03  4.291592e-03  4.290540e-03
##          PSD4        PTPA_1          UBR4    31510_s_at          PLP2
##  4.277007e-03  4.274757e-03  4.266979e-03  4.256371e-03  4.240069e-03
##      ATP6V1E1      MARCKSL1       RETREG3          GMFG        NDUFB7
##  4.228658e-03  4.225972e-03  4.223912e-03  4.218314e-03  4.202332e-03
##          UBA3           HBD        PITRM1    33274_f_at         CAPN2
##  4.201755e-03  4.192187e-03  4.186277e-03  4.183978e-03  4.176217e-03
##         SUZ12         EPS15          SRRT          MT1E        CLEC2B
##  4.166840e-03  4.164058e-03  4.136685e-03  4.129721e-03  4.115444e-03
##      39129_at         ACAA2          HLTF         TXNL1       FAM168B
##  4.112958e-03  4.112534e-03  4.104949e-03  4.104640e-03  4.103361e-03
##         DGCR2         APLP2        MBOAT7    35688_g_at       TERF2IP
##  4.101617e-03  4.100482e-03  4.100013e-03  4.093947e-03  4.073527e-03
```

```
##       TBC1D1       GDI2_1       ABL1_1       INTS10         SMC3
##  4.063374e-03 4.055309e-03 4.044238e-03 4.031053e-03 4.017949e-03
##      EFCAB14        PPP6C       BNIP3L        IMPA1          SLA
##  4.015608e-03 4.015569e-03 4.012829e-03 3.995349e-03 3.981656e-03
##         WAPL        RBBP4        CSTF3         CRKL         DHPS
##  3.970988e-03 3.969240e-03 3.964929e-03 3.964641e-03 3.962583e-03
##     TOR1AIP1        ACAP1         LEF1         RBL2         BRD2
##  3.946715e-03 3.943021e-03 3.925919e-03 3.903129e-03 3.897744e-03
##        FBXO9         GBE1       DICER1         ULK1     31503_at
##  3.892184e-03 3.885410e-03 3.864582e-03 3.863224e-03 3.850973e-03
##    40132_g_at        LASP1        FOXJ3         NEK7       R3HDM1
##  3.804319e-03 3.802494e-03 3.793163e-03 3.790164e-03 3.774655e-03
##     SMIM10L1       ZNF384      ITGB3BP      ITGA4_1        ATOX1
##  3.759364e-03 3.758210e-03 3.725181e-03 3.715843e-03 3.709427e-03
##       IL7R_1        FDFT1        MFAP1       SLC39A6       CUL4B
##  3.698420e-03 3.687271e-03 3.661532e-03 3.657913e-03 3.646350e-03
##         MTA1     729_i_at       RELA_1       SRSF10        SUMO4
##  3.628754e-03 3.627134e-03 3.626914e-03 3.619393e-03 3.612181e-03
##       NDUFS7        NAA10        POLA1          DR1          TAF7
##  3.591422e-03 3.588204e-03 3.585921e-03 3.585187e-03 3.559269e-03
##        DDX42         ARF3        RRAGA      ATP6V0C     41233_at
##  3.548930e-03 3.546768e-03 3.525441e-03 3.523495e-03 3.512876e-03
##        YIF1A       CYB5R3        CNOT9      IDH3B_1       CDKN2C
##  3.512670e-03 3.493291e-03 3.483199e-03 3.455139e-03 3.423441e-03
##        CDK19       MYCBP2    PPP2R5C_1      ANKRD17     37703_at
##  3.419378e-03 3.394900e-03 3.391221e-03 3.372155e-03 3.369426e-03
##        RB1_1        SF3A2          SF1         TRAP1         SIAH2
##  3.365086e-03 3.360735e-03 3.357114e-03 3.343028e-03 3.342683e-03
##      CYB5A_1    TAX1BP1_1        RAB5A        SPG11       LUC7L3
##  3.342426e-03 3.340607e-03 3.332299e-03 3.312254e-03 3.308713e-03
##       SFPQ_1      UBE2I_2         CHD3       IQGAP1        CCNG1
##  3.307518e-03 3.295087e-03 3.285706e-03 3.274677e-03 3.272721e-03
##        USP22         RAG2        UBE2A      HTATSF1         ACO2
##  3.270883e-03 3.258323e-03 3.242597e-03 3.231900e-03 3.223816e-03
##        PDAP1       MRPS27     MAP2K1_1        CETN3        GTSE1
##  3.213771e-03 3.201839e-03 3.193755e-03 3.191873e-03 3.182359e-03
##       DDX19B         H1FX        GTF2B     AHCYL1_2         EMG1
##  3.176989e-03 3.118901e-03 3.108822e-03 3.107396e-03 3.066832e-03
##         VARS     TRAPPC6A        MACF1         UBTF       PAPSS1
##  3.041889e-03 3.037404e-03 3.033142e-03 3.032942e-03 3.031688e-03
##         ABI1        CEBPB     40036_at       MAGED2      SEC13_1
##  3.025061e-03 3.023665e-03 2.994032e-03 2.990141e-03 2.989861e-03
##       ATP2A3        ECHS1         RAE1        COPB1         IL7R
##  2.978850e-03 2.977322e-03 2.969024e-03 2.948804e-03 2.945326e-03
##       GOLGA3         TLK1         USF2        SPAG7        PPWD1
##  2.938382e-03 2.929258e-03 2.928943e-03 2.924472e-03 2.921290e-03
##        FBXO7        ICAM2         MBD4          FYN         FLII
##  2.920046e-03 2.917144e-03 2.888169e-03 2.884362e-03 2.883417e-03
##        LMNB1         EI24        MYB_5      RANGAP1    PPP2R5C_2
##  2.873310e-03 2.868161e-03 2.864917e-03 2.861856e-03 2.857809e-03
##        CCND3       IFITM3       PIEZO1       SAT1_1   35926_s_at
##  2.855130e-03 2.849162e-03 2.839203e-03 2.815434e-03 2.813057e-03
##      SNRNP40      DNAJC11       HMGN4       LARP4B        MAPK1
##  2.810393e-03 2.809527e-03 2.800051e-03 2.798585e-03 2.788156e-03
```

```
##         EWSR1     KIDINS220         ABCD3        ATXN2L         PRDX1
##  2.770070e-03  2.762269e-03  2.762008e-03  2.747230e-03  2.734838e-03
##       PARP1_1         ITGB1          API5         LITAF          TLK2
##  2.721206e-03  2.720419e-03  2.697873e-03  2.682845e-03  2.682505e-03
##        CTDSP2       ZC3HAV1         AARS         PSME1       SLC20A1
##  2.679800e-03  2.674402e-03  2.664926e-03  2.660519e-03  2.660342e-03
##      SRSF10_1      34882_at      UBE2D2_1        SLC7A6           EBP
##  2.656749e-03  2.645139e-03  2.619799e-03  2.606154e-03  2.560844e-03
##      ATXN7L3B         PRPF4          GPX7          MGMT         NCBP2
##  2.560700e-03  2.554736e-03  2.533066e-03  2.509244e-03  2.500862e-03
##        AFG3L2        MAPK14         ACTR2        PNPLA6          PJA2
##  2.489990e-03  2.487604e-03  2.485183e-03  2.484261e-03  2.478266e-03
##          WDR7          ATF2         P2RX5      PAFAH1B1        PPP2CB
##  2.471492e-03  2.470531e-03  2.467980e-03  2.455969e-03  2.454814e-03
##         PDS5A          MICB         ITGB2       DENND5A          DGKA
##  2.449811e-03  2.431217e-03  2.412050e-03  2.405029e-03  2.401529e-03
##        RCBTB2         WAS_1        UBE2L6         SUGP2           OAT
##  2.399539e-03  2.390650e-03  2.382886e-03  2.381090e-03  2.357141e-03
##         JADE2         AMPD2          MSH6        HNRNPD         ACYP1
##  2.356571e-03  2.352651e-03  2.351462e-03  2.342236e-03  2.338171e-03
##           SON         PSMC4         STK24        PEX11B          UCP2
##  2.330068e-03  2.323355e-03  2.318786e-03  2.315126e-03  2.290432e-03
##         SF3A1        TMBIM6         ARPC3      34829_at         IDH3G
##  2.287525e-03  2.284310e-03  2.275717e-03  2.272614e-03  2.232990e-03
##         PSMB5         GINS1        PSMB10         SRSF3        TCERG1
##  2.230924e-03  2.230002e-03  2.202775e-03  2.190250e-03  2.176700e-03
##         MYDGF      ATP2A2_1         BECN1        LRPPRC        MAP4K1
##  2.173507e-03  2.170688e-03  2.135152e-03  2.124057e-03  2.109551e-03
##         PPP4C          PHC2         CD2AP         MYB_2        UBE2D2
##  2.108603e-03  2.106852e-03  2.104457e-03  2.100032e-03  2.093571e-03
##        S100A8        TRIM44        ZNF207          NFYB         IGBP1
##  2.092395e-03  2.071522e-03  2.071001e-03  2.050889e-03  2.045199e-03
##          CBX5       CCNA2_1         GCFC2           NMI        TSPYL4
##  2.044607e-03  2.036996e-03  2.026882e-03  2.023071e-03  2.001860e-03
##       ATP6V0B      HSD17B10          PGM1         EIF6         SPOCK2
##  1.994985e-03  1.963764e-03  1.960744e-03  1.957998e-03  1.956138e-03
##           BLM        NDUFA7         PRIM1       ICAM2_1          ACP1
##  1.954181e-03  1.950269e-03  1.933575e-03  1.926758e-03  1.926719e-03
##          SNX3        SLC3A2          ILF3         SNX4          PWP1
##  1.923252e-03  1.915501e-03  1.913932e-03  1.901348e-03  1.897823e-03
##         UBE2N      39050_at         FUBP3       FARSA_1          SELL
##  1.887766e-03  1.885704e-03  1.874283e-03  1.860710e-03  1.854690e-03
##          ARF5       PIP4K2B        SLC5A3         PSMB8        ATP5F1
##  1.853600e-03  1.849137e-03  1.844738e-03  1.838556e-03  1.836344e-03
##          MCM5     31600_s_at         MCL1_1         ASF1A          OGT
##  1.833538e-03  1.830185e-03  1.796610e-03  1.762893e-03  1.757275e-03
##         LAMP1          BAG6         CD247         USP4          UBR5
##  1.724267e-03  1.709562e-03  1.704877e-03  1.685346e-03  1.674547e-03
##          GNAQ      PPP2R2A_1         ILF3_1         OGT_1         MYB_4
##  1.674147e-03  1.666526e-03  1.655367e-03  1.648951e-03  1.644786e-03
##          ARF6         VAMP8         DNMT1         MPV17         STAT3
##  1.635393e-03  1.629162e-03  1.592096e-03  1.589295e-03  1.581819e-03
##     MPHOSPH10         FAM32A         RNF44            IK          CHUK
##  1.570860e-03  1.560153e-03  1.550090e-03  1.549054e-03  1.545485e-03
```

```
##          ITPA         DCTN2       PCMT1_2    41597_s_at        PRKACB
##  1.539724e-03  1.535626e-03  1.532380e-03  1.529428e-03  1.528614e-03
##       RPS6KA3         CDIPT          MBD3          VRK1          POGZ
##  1.528415e-03  1.526445e-03  1.524515e-03  1.515685e-03  1.493180e-03
##     TUBGCP2_1       ATP6V1F       R3HDM2          ALG8           MT3
##  1.476129e-03  1.458978e-03  1.442291e-03  1.440742e-03  1.440635e-03
##        SNRPA1          ABL1         PARP1        SCCPDH         AIMP2
##  1.438148e-03  1.424408e-03  1.405295e-03  1.387031e-03  1.383872e-03
##         IRAK1        SPINT2          CTSH          MT1B      38072_at
##  1.382998e-03  1.372070e-03  1.368710e-03  1.366674e-03  1.356369e-03
##         SRP72        LETMD1         GSPT1          RHOG        CDKN2D
##  1.339519e-03  1.337087e-03  1.300125e-03  1.273071e-03  1.264146e-03
##         BAZ1A       UBE3A_1         NUP98          TSPO      EIF1AX_2
##  1.253329e-03  1.251788e-03  1.249759e-03  1.248350e-03  1.243761e-03
##        MRPL33         CAPN1          MCL1      34842_at          CD48
##  1.230854e-03  1.203481e-03  1.200879e-03  1.198623e-03  1.195972e-03
##     GUSBP11_1        ZNHIT1    41185_f_at         ESYT1     PPP2R5C_3
##  1.172795e-03  1.172049e-03  1.167148e-03  1.161702e-03  1.158217e-03
##          NPTN          DAXX       PPP1R11      32674_at          RAC1
##  1.157567e-03  1.153130e-03  1.152033e-03  1.144137e-03  1.143769e-03
##       SH3BGRL         MYB_3         TPGS2        SREBF2      33132_at
##  1.138716e-03  1.134079e-03  1.131171e-03  1.121541e-03  1.115529e-03
##         IGLL1       ERCC1_1       ACTR2_1          RNF6       ADIPOR2
##  1.114425e-03  1.103698e-03  1.102930e-03  1.084751e-03  1.082464e-03
##        PDLIM1        EIF4E2         NUDT1          TMF1       PPP2R5C
##  1.080275e-03  1.073748e-03  1.072276e-03  1.061440e-03  1.048266e-03
##         CCNA2         DDX46          DGKD           BSG        SNX1_1
##  1.035799e-03  1.026049e-03  9.968248e-04  9.903010e-04  9.886669e-04
##         BCL7B        UBAP2L      DYRK1A_1      41170_at       ARHGEF2
##  9.771515e-04  9.674280e-04  9.651185e-04  9.522824e-04  9.157203e-04
##          MYH9         DCTN3       SMARCA5         ACTN1         SSNA1
##  9.134535e-04  8.890275e-04  8.745456e-04  8.573573e-04  8.499408e-04
##       PPP2R2A          MTX1      39133_at        NFATC3          POLG
##  8.405383e-04  8.268736e-04  8.054509e-04  7.988562e-04  7.910434e-04
##          RRM1         PAIP1         ANXA5      39341_at         RBM39
##  7.850166e-04  7.833753e-04  7.811430e-04  7.748676e-04  7.719494e-04
##         PRDX4        UBE2J1          CDK2        DYRK1A      SLC25A36
##  7.653927e-04  7.596108e-04  7.550153e-04  7.488844e-04  7.488368e-04
##        POLR2H        NDUFA5        EXOSC7          PHKB        CLASP2
##  7.464619e-04  7.271278e-04  7.239739e-04  7.237445e-04  7.200520e-04
##          ST13          RPIA      RNASEH2B       HDAC1_1        ATP1B3
##  7.120455e-04  7.008217e-04  6.935114e-04  6.837224e-04  6.741265e-04
##         ZNF24          DGKZ         USP9X          MCM2         STAT6
##  6.548647e-04  6.490966e-04  6.414715e-04  6.231849e-04  6.185794e-04
##         CPNE1       TAX1BP1       METTL7A         ABCF1          MDM1
##  6.134568e-04  6.118785e-04  6.057066e-04  5.758713e-04  5.742352e-04
##         USP10         CEBPZ         CSE1L        EIF5_1         BNIP2
##  5.681019e-04  5.517715e-04  5.461995e-04  5.343836e-04  5.338330e-04
##       ARFGAP2       SMARCA4      41171_at         PLIN2       PIKFYVE
##  5.267058e-04  5.190541e-04  5.033864e-04  5.012445e-04  4.746192e-04
##        ARPC1B         HYOU1          COMT         SRSF7         NUP88
##  4.724262e-04  4.713211e-04  4.603091e-04  4.561579e-04  4.554182e-04
##          MLH1          CD99         ZC3H4      393_s_at          RER1
##  4.531458e-04  4.419164e-04  4.379201e-04  4.302755e-04  4.214908e-04
```

```
##         KRT10         NUP50           DAP          TPM4        TXNRD1
##  4.134017e-04  4.061259e-04  3.948040e-04  3.907445e-04  3.873447e-04
##      432_s_at      LGALS3BP      C21orf33         ITPKB         AES_1
##  3.848690e-04  3.785471e-04  3.561622e-04  3.545129e-04  3.504927e-04
##         SRPK1       GORASP2         RAP1B           PNN        ATP8A1
##  3.415470e-04  3.398254e-04  3.281394e-04  3.264299e-04  3.088563e-04
##      NFATC3_1        RAD23B          RARS          RELA     1420_s_at
##  2.986639e-04  2.982330e-04  2.943287e-04  2.801652e-04  2.781550e-04
##       AZIN1_2         STAU1       ARHGEF7      BTN3A2_1          ZPR1
##  2.550922e-04  2.526246e-04  2.477764e-04  2.380802e-04  2.299243e-04
##          NSD2          MEA1        NDUFS6      37735_at         DDX17
##  2.255866e-04  2.091612e-04  2.069900e-04  1.956215e-04  1.607080e-04
##          UBA1         PQBP1       MKI67_1           EZR        CCDC69
##  1.576586e-04  1.493142e-04  1.281797e-04  1.277985e-04  1.186925e-04
##         BIRC2         ICAM3         IFT20        GTF3C2         HSPA5
##  1.160605e-04  1.065337e-04  5.701387e-05  5.199234e-05  3.773451e-05
##        ZFAND5         EVI2B      35985_at        SEC11A         BUB1B
##  3.513191e-05  3.282533e-05  3.193166e-05  2.400636e-05  3.499181e-06
##         SRSF8
##  7.950999e-07
```

```
pc_1 = data.frame(leukemia_data$Type,pr.out$x[,1])
colnames(pc_1) <- c('Tpye','PC1')
## sort the PC1 value
sorted <- pc_1[order(-abs(pc_1$PC1)),]
head(sorted,6)
```

```
##           Tpye       PC1
## 161     OTHERS -52.06836
## 247      T-ALL  51.75384
## 303   TEL-AML1 -49.06527
## 231      T-ALL  48.16035
## 56  Hyperdip50 -48.09339
## 214      T-ALL  47.96769
```

###f

```
## load dendextend library
library(dendextend)
```

```
##
## ---------------------
## Welcome to dendextend version 1.15.1
## Type citation('dendextend') for how to cite the package.
##
## Type browseVignettes(package = 'dendextend') for the package vignette.
## The github page is: https://github.com/talgalili/dendextend/
##
## Suggestions and bug-reports can be submitted at: https://github.com/talgalili/dendextend/issues
## Or contact: <tal.galili@gmail.com>
##
##  To suppress this message use:  suppressPackageStartupMessages(library(dendextend))
## ---------------------
```

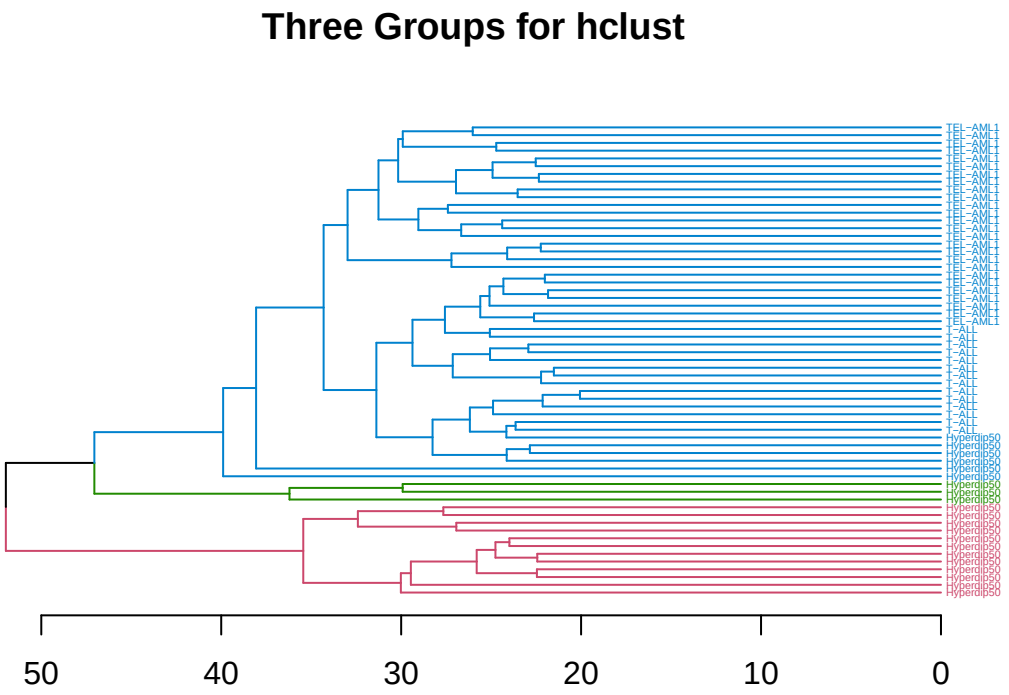
```
##
## Attaching package: 'dendextend'

## The following object is masked from 'package:rpart':
##
##     prune

## The following object is masked from 'package:stats':
##
##     cutree
```

```
##subsetting to include only rows for which Type is either T-ALL, TEL-AML1, or Hyperdip50
leukemia_subset_1 <- filter(leukemia_data, Type == c("T-ALL","TEL-AML1","Hyperdip50"))
## exclude the first column Type
leukemia_subset = leukemia_subset_1 %>% select(-Type)
## calculate the distance matrix
subset_dist = dist(leukemia_subset)
set.seed(1)
## Hierarchical Clustering using complete linkage
drug.hclust = hclust(subset_dist)
```

```
## first plot
x = as.dendrogram(drug.hclust)
x %>% set_labels(leukemia_subset_1$Type) %>%
  set("labels_col",k=3) %>%
  set("branches_k_color", k = 3) %>%
  set("labels_cex", 0.3) %>%
  plot(main='Three Groups for hclust',horiz = TRUE)
```



```
## second plot
y = as.dendrogram(drug.hclust)
y %>% set_labels(leukemia_subset_1$Type) %>% set("labels_col",k=5) %>% set("branches_k_color", k = 5) %>%
  set("labels_cex", 0.3) %>% plot(main='Five Groups for hclust',horiz = TRUE)
```