

Radiomic features parallel RNA-seq analysis and enrichment

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```
library(limma)
library(sva)
library(ggplot2)
library(org.Hs.eg.db)
library(annotate)
library(hgu133plus2.db)
library(clusterProfiler)
library(enrichplot)
```

This analysis will be performed with counts from **sputum samples**:

```
load("/Users/carlacasanova/.../Radiomics/Radiomic features/Results_rfeatures/R objects/rdr_assay_scaled.rda")
load("/Users/carlacasanova/.../Radiomics/Radiomic features/Results_rfeatures/R objects/sputum_eset_countsOK.rda")
load("/Users/carlacasanova/.../Radiomics/Radiomic features/Results_rfeatures/R objects/sputum_eset_phenoOK.rda")

variables_interest <- data.frame(Sex = as.factor(phenoDataFrame$SEX), Age =
phenoDataFrame$AGE,
Dwalk = phenoDataFrame$DWALK, BMI = phenoDataFrame$BMI, Smoke_history =
phenoDataFrame$SUSMHS,
Years_smoke = phenoDataFrame$SUSMYR, Cough = as.factor(phenoDataFrame$COUGH),
ex_first_year = phenoDataFrame$Y1EXBS, Group = as.factor(phenoDataFrame$GROUP_bin),
N_cigarette_day = phenoDataFrame$SUCGSMDY, Cr_bronchitis =
as.factor(phenoDataFrame$CBRONCH),
Cr_wheezeeng = as.factor(phenoDataFrame$ATS3EG), history_asthma =
as.factor(phenoDataFrame$ATS5G),
fume_expose = as.factor(phenoDataFrame$ATS6C), dusty_expose =
as.factor(phenoDataFrame$ATS6B),
phlegm = as.factor(phenoDataFrame$PHLEGM), heart_failure =
as.factor(phenoDataFrame$ATS8F),
stroke = as.factor(phenoDataFrame$ATS8E), diabetes = as.factor(phenoDataFrame$ATS8L),
osteoporosis = as.factor(phenoDataFrame$ATS8H), FEVVCVD = phenoDataFrame$FEVVCVD,
FEV1PSPC = phenoDataFrame$FEV1PSPC, TLC = phenoDataFrame$TLC, FRC =
phenoDataFrame$FRC,
Low_percentile = phenoDataFrame$LOW15PCT, row.names = rownames(phenoDataFrame))

# Code for removing columns with some NA
variables_interest <- variables_interest[, apply(variables_interest, 2, function(x)
!any(is.na(x))]

# Add radiomic features without grouping them
```

```

identical(colnames(rdr_assay), rownames(variables_interest))

## [1] TRUE

variables_interest <- cbind(variables_interest, t(rdr_assay))

## Select counts
countData <- counts.ok[rowSums(counts.ok) > 10, ]

# Check for variables with only 1 factor to remove them from the analysis
variables.1.factor <- sapply(lapply(variables_interest, unique), length)
names(variables.1.factor[variables.1.factor == 1])

## [1] "Smoke_history"

# Remove variables with just one factor
variables_interest[, "Smoke_history"] <- NULL

r.features <- rownames(rdr_assay)
# Features que faltan por calcular small.r.features <- r.features[25]

# Prepare data in object: variables_interest
names(variables_interest)[names(variables_interest) == "10Percentile.original"] <-
  "X10Percentile.original"
names(variables_interest)[names(variables_interest) == "90Percentile.original"] <-
  "X90Percentile.original"

# Prepare data in object: small.r.features
r.features[15] <- "X10Percentile.original"
r.features[16] <- "X90Percentile.original"

```

Compute analysis for individual features by iterating (code parallelize):

```

library(parallel)

# Use the detectCores() function to find the number of cores in system
no_cores <- detectCores()

# Setup cluster: good practice not to use all the cores Don't use all the cores
# at ISGlobal's cluster!!
clust <- makeCluster(no_cores - 3) #This line will take time

# Export objects from global environment
clusterExport(cl = clust, varlist = c("variables_interest", "countData", "r.features"))

# Export packages to use
clusterEvalQ(clust, {
  library(tidyverse)
  library(limma)
  library(sva)
})

de_radiomic_features_indv <- function(x) {

  # Null formula

```

```

m.model <- "~ Group + Sex + Age + Dwalk + FEV1PSPC + fume_expose + dusty_expose +
history_asthma + Cough + BMI + Cr_wheezeng"

# -----SVA----- Create a model with the feature and a null model
mod1 <- model.matrix(formula(paste(m.model, x, sep = "+")), data =
variables_interest)
mod0 <- model.matrix(~Group + Sex + Age + Dwalk + FEV1PSPC + fume_expose +
dusty_expose +
history_asthma + Cough + BMI + Cr_wheezeng, data = variables_interest)

# This estimates the required number of surrogate variables
res <- svaseq(countData, mod1, mod0)
# Add SVs to column data information
variables_interest_sva <- data.frame(variables_interest, res$sv)

# Add sva names to formula
sva.names <- colnames(variables_interest_sva[, (ncol(variables_interest_sva) +
1 - res$n.sv):ncol(variables_interest_sva)])
sva.collapsed <- paste(sva.names, collapse = "+")

# -----VOOM----- Normalize data with voom and add tumor stage as
# covariate in design
design <- model.matrix(formula(paste(m.model, x, sva.collapsed, sep = "+")),
data = variables_interest_sva)
v <- voom(countData, design = design, plot = FALSE)

# fit the model
fit <- lmFit(v, design)
fit <- eBayes(fit)

# Store the object
save(fit, file = paste("/Users/carlacasanova/Deskt.../Radiomic features models
(indiv)/",
x, ".rda", sep = ""))
}

# With parallel
system.time(result <- parLapply(clust, r.features, de_radiomic_features_indv))
# Good practise to do that at the end
stopCluster(clust)

```

Results DE of individual radiomic features

Check summaries of voom results for each feature:

```

load("/Users/carlacasanova/Deskt.../Radiomic features models
(indiv)/Elongation.original.rda")

summa.fit.elongation <- decideTests(fit)

summary(summa.fit.elongation)

##          (Intercept) GroupSevere  SexM    Age  Dwalk  FEV1PSPC fume_exposeY
## Down           555            0     75      0      0            0            0

```

```

## NotSig      22926      48525 48393 48525 48523      48525      48525
## Up         25044          0    57    0    2          0          0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig      48525      48525          0          0          0          0
## Up          0          0          0          0          0          0
##       Elongation.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down          0 18468 16189 14065 12406 10547 10701 7086 7190
## NotSig      48525 12772 19790 21872 25064 26823 28379 32507 33637
## Up          0 17285 12546 12588 11055 11155 9445 8932 7698
##       X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down     8179 7918 8317 5548 5382 5633 4567 4149 3123 2597 2755
## NotSig  32403 32542 33291 36394 36443 37176 38873 40133 41220 43549 43252
## Up        7943 8065 6917 6583 6700 5716 5085 4243 4182 2379 2518

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Flatness.original.rda")

summa.fit.flatness <- decideTests(fit)
summary(summa.fit.flatness)

##       (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down       606          0    87    0    0          0          0
## NotSig    22749      48525 48388 48525 48523      48525      48525
## Up        25170          0    50    0    2          0          0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig      48525      48525          0          0          0          0
## Up          0          0          0          0          0          0
##       Flatness.original   X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down          0 18540 16224 14047 12129 10471 10708 7176 7291 8163
## NotSig      48525 12702 19698 21934 25785 27074 28395 32428 33398 32420
## Up          0 17283 12603 12544 10611 10980 9422 8921 7836 7942
##       X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down     7838 8316 5592 5342 5604 4579 4298 2838 2672 2637
## NotSig  32645 33281 36281 36438 37275 39014 39929 41713 43501 43186
## Up        8042 6928 6652 6745 5646 4932 4298 3974 2352 2702

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/LeastAxisLength.original.rda")

summa.fit.leastAxis <- decideTests(fit)
summary(summa.fit.leastAxis)

##       (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down       580          0    68    0    0          0          0
## NotSig    22923      48525 48419 48525 48523      48525      48525
## Up        25022          0    38    0    2          0          0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig      48525      48525          0          0          0          0
## Up          0          0          0          0          0          0
##       LeastAxisLength.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down          0 18561 16207 14003 12204 10448 10671 6930 7270
## NotSig      48525 12691 19717 22008 25625 27104 28445 32808 33491

```

```

## Up
## X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
## Down 8133 7845 8316 5581 5317 5627 4645 4347 2835 2673 2610
## NotSig 32421 32677 33271 36288 36499 37220 38844 39838 41731 43448 43221
## Up 7971 8003 6938 6656 6709 5678 5036 4340 3959 2404 2694

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/MajorAxisLength.original.rda")

summa.fit.majorAxis <- decideTests(fit)
summary(summa.fit.majorAxis)

## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down 580 0 48 0 1 0 0
## NotSig 22782 48525 48443 48525 48522 48525 48525
## Up 25163 0 34 0 2 0 0
## dusty_exposeY history_asthmaY CoughNo chronic cough BMI Cr_wheezengY
## Down 0 0 0 0 0 0 0
## NotSig 48525 48525 48525 48525 48525 48525
## Up 0 0 0 0 0 0 0
## MajorAxisLength.original X1 X2 X3 X4 X5 X6 X7 X8
## Down 0 18406 16187 14057 12345 10543 10726 6985 7184
## NotSig 48525 12893 19711 21898 25231 26851 28320 32860 33563
## Up 0 17226 12627 12570 10949 11131 9479 8680 7778
## X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
## Down 8127 7798 8295 5575 5362 5604 4680 4332 2939 2652 2583
## NotSig 32475 32742 33312 36363 36429 37264 38721 39875 41581 43487 43227
## Up 7923 7985 6918 6587 6734 5657 5124 4318 4005 2386 2715

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Maximum2DDiameterColumn.original.rda")

summa.fit.2ddCol <- decideTests(fit)
summary(summa.fit.2ddCol)

## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down 565 0 53 0 0 0 0
## NotSig 22755 48525 48439 48525 48523 48525 48525
## Up 25205 0 33 0 2 0 0
## dusty_exposeY history_asthmaY CoughNo chronic cough BMI Cr_wheezengY
## Down 0 0 0 0 0 0 0
## NotSig 48525 48525 48525 48525 48525 48525
## Up 0 0 0 0 0 0 0
## Maximum2DDiameterColumn.original X1 X2 X3 X4 X5 X6
## Down 0 18555 16166 13981 12471 10515 10711
## NotSig 48525 12764 19831 22041 24983 26919 28254
## Up 0 17206 12528 12503 11071 11091 9560
## X7 X8 X9 X10 X11 X12 X13 X14 X15 X16 X17 X18
## Down 6706 7370 8065 7879 8325 5499 5432 5597 4588 4756 2893 2547
## NotSig 33300 33377 32565 32428 33381 36498 36353 37347 38895 39019 41589 43706
## Up 8519 7778 7895 8218 6819 6528 6740 5581 5042 4750 4043 2272
## X19
## Down 2556
## NotSig 43204
## Up 2765

```

```

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Maximum2DDiameterRow.original.rda")

summa.fit.2ddRow <- decideTests(fit)
summary(summa.fit.2ddRow)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           592          0     81      0     1       0          0
## NotSig        22690        48525 48402 48525 48522     48525        48525
## Up            25243          0    42      0     2       0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0          0
## NotSig        48525         48525         48525        48525        48525
## Up            0             0           0           0       0          0
##          Maximum2DDiameterRow.original   X1     X2     X3     X4     X5     X6     X7
## Down           0 18523 16188 14021 12381 10564 10716 7088
## NotSig        48525 12760 19772 21968 25195 26853 28329 32590
## Up            0 17242 12565 12536 10949 11108 9480 8847
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down        7270 8119 7833 8233 5571 5354 5537 4617 4327 2936 2708 2552
## NotSig      33472 32440 32730 33479 36310 36434 37433 38811 39896 41597 43391 43294
## Up          7783 7966 7962 6813 6644 6737 5555 5097 4302 3992 2426 2679

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Maximum2DDiameterSlice.original.rda")

summa.fit.2ddSlic <- decideTests(fit)
summary(summa.fit.2ddSlic)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           567          0     38      0     1       0          0
## NotSig        23001        48525 48455 48525 48522     48525        48525
## Up            24957          0    32      0     2       0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0          0
## NotSig        48525         48525         48525        48525        48525
## Up            0             0           0           0       0          0
##          Maximum2DDiameterSlice.original   X1     X2     X3     X4     X5     X6
## Down           0 18491 16203 14033 12319 10479 10710
## NotSig        48525 12786 19674 21966 25222 26967 28332
## Up            0 17248 12648 12526 10984 11079 9483
##          X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down        6963 7173 8117 7871 8270 5582 5355 5613 4708 4360 2971 2688
## NotSig      32904 33581 32503 32595 33410 36318 36443 37269 38630 39843 41500 43415
## Up          8658 7771 7905 8059 6845 6625 6727 5643 5187 4322 4054 2422
##          X19
## Down        2563
## NotSig     43274
## Up          2688

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Maximum3DDiameter.original.rda")

summa.fit.3ddDia <- decideTests(fit)

```

```

summary(summa.fit.3ddDia)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      573           0     55    0    0       0           0
## NotSig    22729        48525 48437 48525 48523     48525       48525
## Up       25223           0     33    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig     48525           48525           48525     48525       48525       48525
## Up            0           0           0           0       0       0           0
##          Maximum3DDiameter.original X1     X2     X3     X4     X5     X6     X7
## Down           0 18502 16192 13983 12467 10558 10732 6809
## NotSig        48525 12827 19732 22055 24995 26848 28232 33285
## Up            0 17196 12601 12487 11063 11119 9561 8431
##          X8     X9    X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down      7305 8070 7918 8364 5487 5426 5608 4690 4729 2849 2594 2607
## NotSig    33415 32634 32338 33376 36537 36361 37319 38670 39090 41687 43624 43143
## Up       7805 7821 8269 6785 6501 6738 5598 5165 4706 3989 2307 2775

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/MeshVolume.original.rda")

summa.fit.MeshVol <- decideTests(fit)
summary(summa.fit.MeshVol)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      587           0     62    0    0       0           0
## NotSig    22685        48525 48428 48525 48523     48525       48525
## Up       25253           0     35    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig     48525           48525           48525     48525       48525       48525
## Up            0           0           0           0       0       0           0
##          MeshVolume.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18515 16187 13928 12386 10569 10688 6677 7205
## NotSig        48525 12794 19795 22171 25162 26849 28376 33349 33553
## Up            0 17216 12543 12426 10977 11107 9461 8499 7767
##          X9     X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down      8121 7780 8272 5534 5356 5645 4661 4308 2904 2665 2632
## NotSig    32446 32791 33410 36415 36426 37214 38738 39932 41621 43453 43138
## Up       7958 7954 6843 6576 6743 5666 5126 4285 4000 2407 2755

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/MinorAxisLength.original.rda")

summa.fit.MinAxis <- decideTests(fit)
summary(summa.fit.MinAxis)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      571           0     74    0    0       0           0
## NotSig    22780        48525 48415 48525 48523     48525       48525
## Up       25174           0     36    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0

```

```

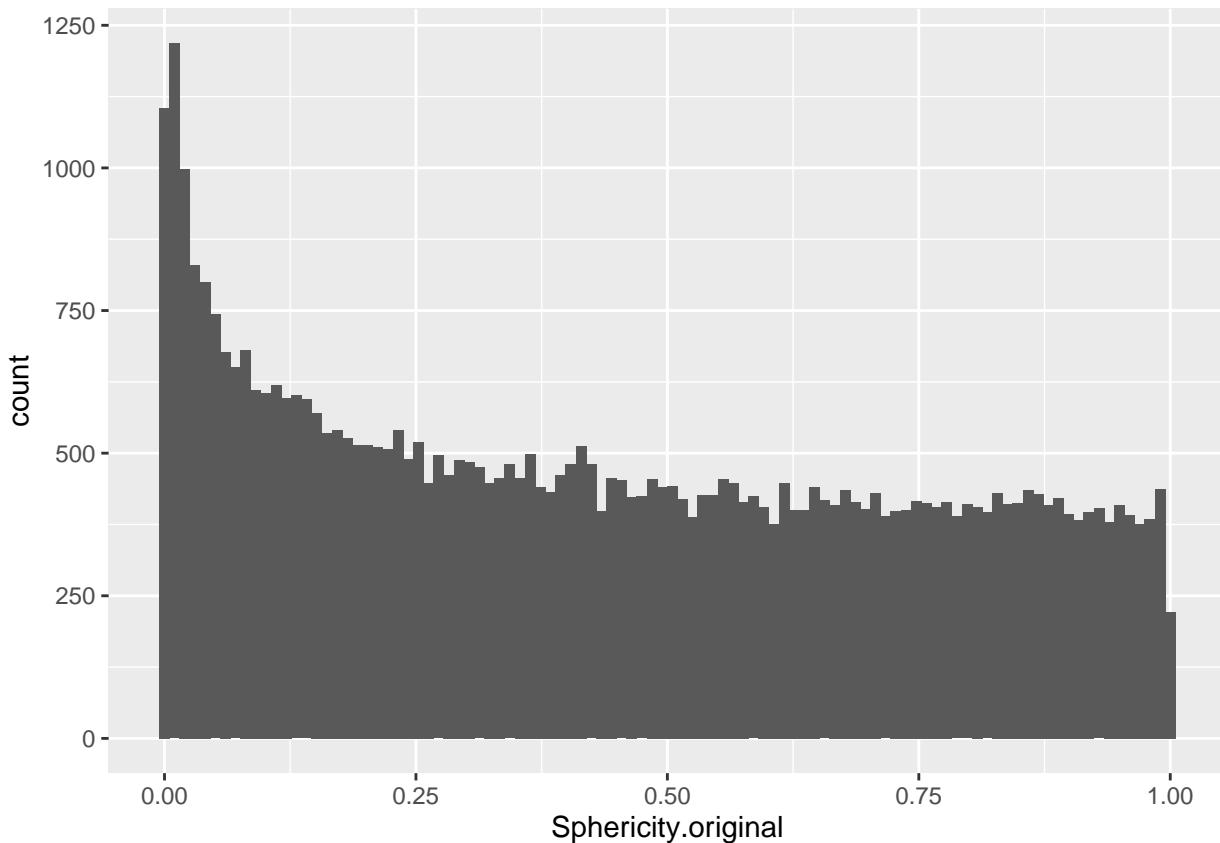
## NotSig          48525          48525          48525 48525          48525
## Up              0              0              0      0      0
## MinorAxisLength.original X1    X2    X3    X4    X5    X6    X7    X8
## Down             0 18580 16214 14034 12440 10541 10767 7103 7316
## NotSig          48525 12671 19722 21952 25012 26889 28194 32621 33457
## Up               0 17274 12589 12539 11073 11095 9564  8801 7752
## X9    X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down            8092 7828 8339 5558 5397 5624 4523 4730 2823 2611 2798
## NotSig         32600 32510 33403 36339 36407 37291 38961 39030 41766 43602 43115
## Up              7833 8187 6783 6628 6721 5610 5041 4765 3936 2312 2612

load("/Users/carlacasanovasanchez/Desktop/Radiomic features models
(indiv)/Sphericity.original.rda")

# Store: toptable, p.value, summary
summa.fit.sphe <- decideTests(fit)
toptable.sphericity <- topTable(fit, coef = "Sphericity.original", number =
dim(counts.ok)[1])
toptable.sphericity <- toptable.sphericity[order(toptable.sphericity$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Sphericity.original)) + geom_histogram(bins = 100)

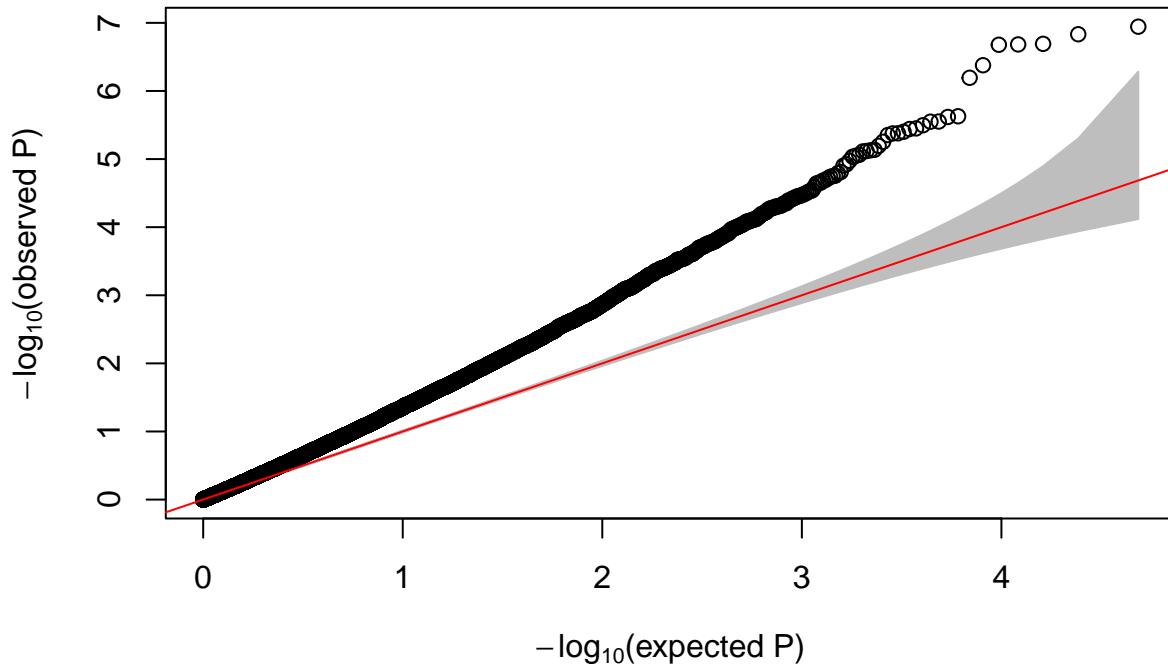
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Sphericity.original)

```



```
summary(summa.fit.sphe)
```

```
##          (Intercept) GroupSevere SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           500         0   130     0     0       0           0
## NotSig        23022      48525 48282 48525 48523     48525      48525
## Up            25003         0   113     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezeY
## Down           0           0           0           0       0       0           0
## NotSig        48525      48525           0       48525 48525      48525
## Up             0           0           0           0       0       0           0
##          Sphericity.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           86 18681 15874 14235 12480 10421 10540 6860 7272
## NotSig        48414 12567 20346 21614 25021 26716 28648 32886 33745
## Up            25 17277 12305 12676 11024 11388 9337 8779 7508
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19    X20
## Down          8143 8132 8371 5316 5138 5969 4365 3482 3769 2635 2796 1970
## NotSig       32580 31672 33332 36846 36642 36838 39232 41338 40182 43758 43165 44578
## Up            7802 8721 6822 6363 6745 5718 4928 3705 4574 2132 2564 1977
```

```
head(toptable.sphericity, 10)
```

```
##          logFC      AveExpr       t     P.Value adj.P.Val
## 1555057_at -0.18032328  0.85211268 -5.722587 1.138012e-07 0.002034577
## 233228_at   -0.12628292  4.49382735 -5.664443 1.470117e-07 0.002034577
## 221916_at   -0.19080840 -0.28687457 -5.590379 2.033555e-07 0.002034577
## 1561614_at  -0.18130158  0.64172140 -5.585920 2.073542e-07 0.002034577
## 1560222_at  -0.12313331  0.64394774 -5.583406 2.096421e-07 0.002034577
## 1557566_at  -0.23298881 -0.05812328 -5.423649 4.190543e-07 0.003389102
## 239013_at   -0.16685800  0.44993298 -5.324787 6.401800e-07 0.004437819
## 1570266_x_at 0.09218518  4.64450556  5.015030 2.354072e-06 0.011973303
## 215067_x_at  0.05211018  4.21705911  5.009535 2.408199e-06 0.011973303
## 244579_at   -0.13792111  4.39056355 -4.972056 2.811154e-06 0.011973303
##          B
```

```

## 1555057_at    7.194662
## 233228_at    7.191464
## 221916_at    6.396601
## 1561614_at    6.590057
## 1560222_at    6.603401
## 1557566_at    5.845504
## 239013_at    5.590874
## 1570266_x_at 4.592324
## 215067_x_at  4.574267
## 244579_at    4.405476

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SurfaceArea.original.rda")

summa.fit.surAr <- decideTests(fit)
summary(summa.fit.surAr)

##             (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           591          0    76    0    0      0          0
## NotSig        22773        48525 48403 48525 48523    48525        48525
## Up            25161          0    46    0    2      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           1            0          0          0          0          0
## NotSig        48524        48525          0        48525 48525        48525
## Up             0            0          0          0          0          0
##             SurfaceArea.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18548 16219 13907 12381 10567 10596 6790 7183
## NotSig        48525 12705 19622 22171 25112 26807 28572 33361 33597
## Up            0 17272 12684 12447 11032 11151 9357 8374 7745
##             X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         8048 7916 8262 5579 5356 5612 4706 4322 2860 2722 2642
## NotSig      32732 32317 33547 36361 36439 37258 38666 39909 41784 43397 43088
## Up           7745 8292 6716 6585 6730 5655 5153 4294 3881 2406 2795

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SurfaceVolumeRatio.original.rda")

summa.fit.surVol <- decideTests(fit)
summary(summa.fit.surVol)

##             (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           565          0    76    0    0      0          0
## NotSig        22786        48525 48405 48525 48523    48525        48525
## Up            25174          0    44    0    2      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0          0          0          0          0
## NotSig        48525        48525          0        48525 48525        48525
## Up             0            0          0          0          0          0
##             SurfaceVolumeRatio.original X1     X2     X3     X4     X5     X6     X7
## Down           0 18582 15977 14200 12400 10459 10640 7015
## NotSig        48525 12763 20135 21757 25162 26868 28424 32713
## Up            0 17180 12413 12568 10963 11198 9461 8797
##             X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7193 8056 7942 8260 5468 5162 5625 4585 3684 3345 2570 2580
## NotSig      33680 32720 32226 33550 36521 36670 37298 38885 41037 40893 43770 43488

```

```

## Up      7652  7749  8357  6715  6536  6693  5602  5055  3804  4287  2185  2457
load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/VoxelVolume.original.rda")

summa.fit.voxVol <- decideTests(fit)
summary(summa.fit.voxVol)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down            587           0    62     0     0       0           0
## NotSig         22686        48525 48428 48525 48523   48525       48525
## Up             25252           0   35     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0           0           0       0       0           0
## NotSig         48525        48525           48525 48525       48525
## Up             0           0           0       0       0           0
##          VoxelVolume.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down            0 18515 16187 13929 12386 10570 10691 6679 7205
## NotSig         48525 12794 19795 22170 25162 26848 28372 33348 33551
## Up             0 17216 12543 12426 10977 11107 9462 8498 7769
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down           8121  7780  8272  5534  5355  5645  4661  4308  2904  2666  2632
## NotSig        32446 32790 33411 36417 36427 37214 38738 39932 41621 43451 43137
## Up             7958  7955  6842  6574  6743  5666  5126  4285  4000  2408  2756

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/TotalEnergy.original.rda")

summa.fit.totEn <- decideTests(fit)
summary(summa.fit.totEn)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down            573           0    94     0     0       0           0
## NotSig         22882        48525 48365 48525 48523   48525       48525
## Up             25070           0   66     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0           0           0       0       0           0
## NotSig         48525        48525           48525 48525       48525
## Up             0           0           0       0       0           0
##          TotalEnergy.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down            0 18574 16147 14064 12374 10380 10553 7149 7284
## NotSig         48525 12669 19782 21911 25142 27199 28702 32542 33419
## Up             0 17282 12596 12550 11009 10946 9270 8834 7822
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down           8024  7887  8237  5602  5351  5626  4653  4267  2722  2709  2606
## NotSig        32579 32561 33456 36222 36452 37166 38678 40039 42047 43353 43155
## Up             7922  8077  6832  6701  6722  5733  5194  4219  3756  2463  2764

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Uniformity.original.rda")

summa.fit.unif <- decideTests(fit)
summary(summa.fit.unif)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
```

```

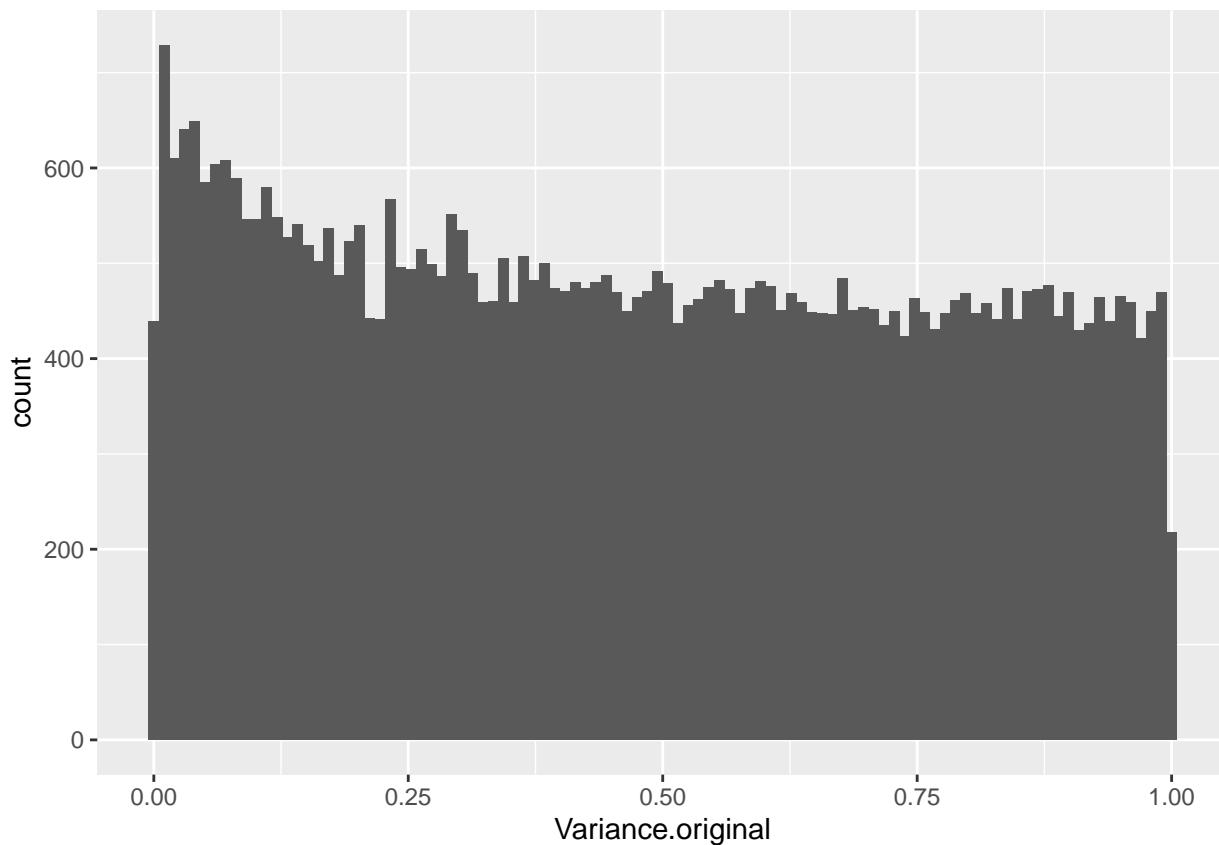
## Down      607      0     94      0      0      0      0
## NotSig   22618  48525  48365  48525  48524  48525  48525
## Up       25300      0     66      0      1      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig        48525        48525        48525        48525        48525
## Up            0          0          0          0          0          0
##      Uniformity.original X1     X2     X3     X4     X5     X6     X7     X8
## Down          0 18449 16231 13871 12294 10569 10674 7213 7277
## NotSig        48525 12794 19564 22308 25347 26862 28383 32572 33553
## Up            0 17282 12730 12346 10884 11094 9468 8740 7695
##      X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down      7930  7844  8232  5437  5271  5681  4552  4022  3211  2659  2551
## NotSig   32799 32551 33503 36562 36547 37452 38877 40427 41125 43505 43321
## Up       7796  8130  6790  6526  6707  5392  5096  4076  4189  2361  2653

load("/Users/carlacasanova/Downloads/Desktop/Radiomic features models
(indiv)/Variance.original.rda")

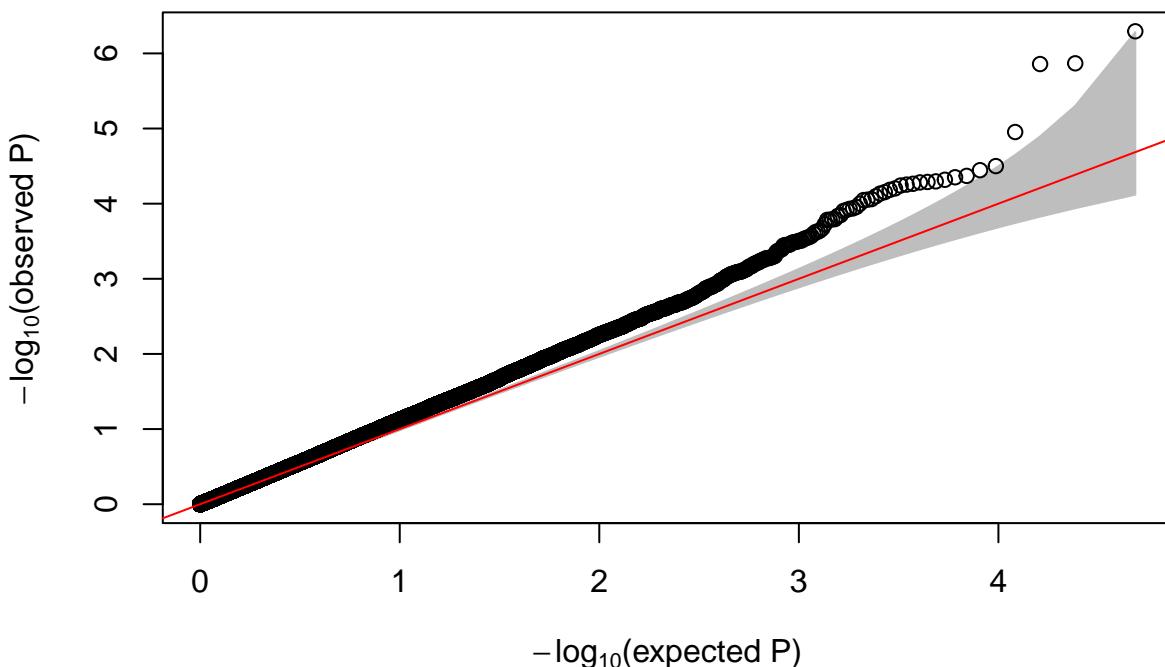
# Store toptable, p-value, summary
summa.fit.var <- decideTests(fit)
toptable.variance <- topTable(fit, coef = "Variance.original", number =
dim(counts.ok)[1])
toptable.variance <- toptable.variance[order(toptable.variance$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Variance.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Variance.original)
```



```
summary(summa.fit.var)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      581      0     93      0      0      0      0
## NotSig   22641    48525  48374  48525  48523   48525   48525
## Up       25303      0     58      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0          0          0          0          0          0          0
## NotSig   48525      48525      48525      48525      48525   48525
## Up       0          0          0          0          0          0          0
##      Variance.original   X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      0 18594 16125 13922 12288 10645 10712 7001 7320 8312
## NotSig   48522 12667 19907 22015 25311 26644 28474 32655 33596 31952
## Up       3 17264 12493 12588 10926 11236 9339 8869 7609 8261
##      X10    X11    X12    X13    X14    X15    X16    X17    X18    X19    X20
## Down    7980  8279  5459  5339  5808  4778  4459  2873  2826  2569  2484
## NotSig  32469 33183 36614 36413 36920 38429 39564 41754 43095 43577 43751
## Up      8076  7063  6452  6773  5797  5318  4502  3898  2604  2379  2290
head(toptable.variance, 10)

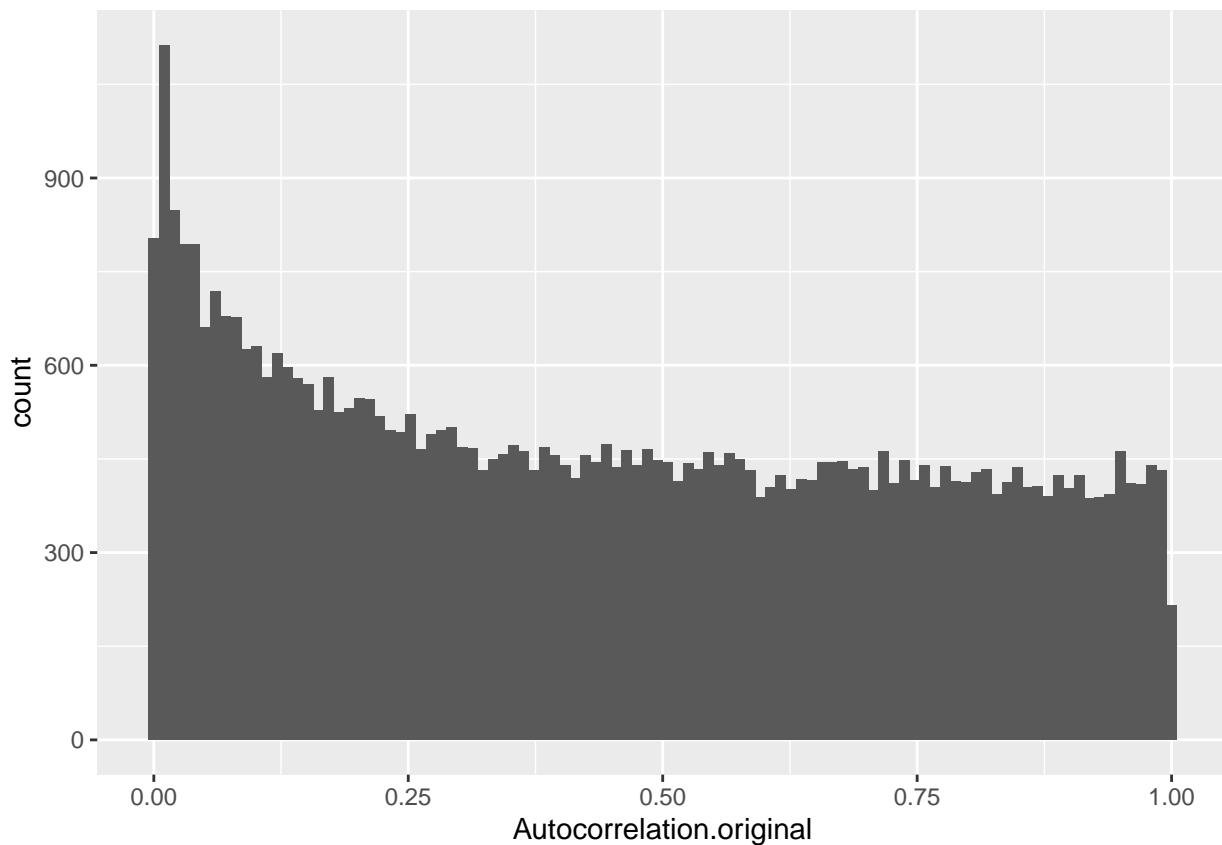
##              logFC     AveExpr        t    P.Value adj.P.Val        B
## 202814_s_at  0.6658893 5.2711632 5.378782 5.081299e-07 0.02241816 5.8538935
## 230825_at    1.2771613 1.0470995 5.147504 1.355389e-06 0.02241816 3.5878362
## 1561431_at   2.1071332 -1.1572903 5.142183 1.385976e-06 0.02241816 1.4751377
## 226699_at    0.8492466 0.8434641 4.631707 1.112736e-05 0.13498877 1.8331468
## 214695_at    0.5861018 4.6285243 4.363720 3.161172e-05 0.18558027 2.1360437
## 239956_at    1.2178626 -0.4591442 4.330883 3.583608e-05 0.18558027 0.2660508
## 242813_at    0.6891639 1.1519933 4.284791 4.269379e-05 0.18558027 1.1798952
## 224964_s_at  -0.6557059 6.4588815 -4.273537 4.455118e-05 0.18558027 1.9024151
## 1562112_at   1.1245873 0.1564666 4.253369 4.807603e-05 0.18558027 0.6249239
## 227981_at    0.5553706 3.4721749 4.240004 5.055810e-05 0.18558027 1.5584154

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Autocorrelation.original.rda")

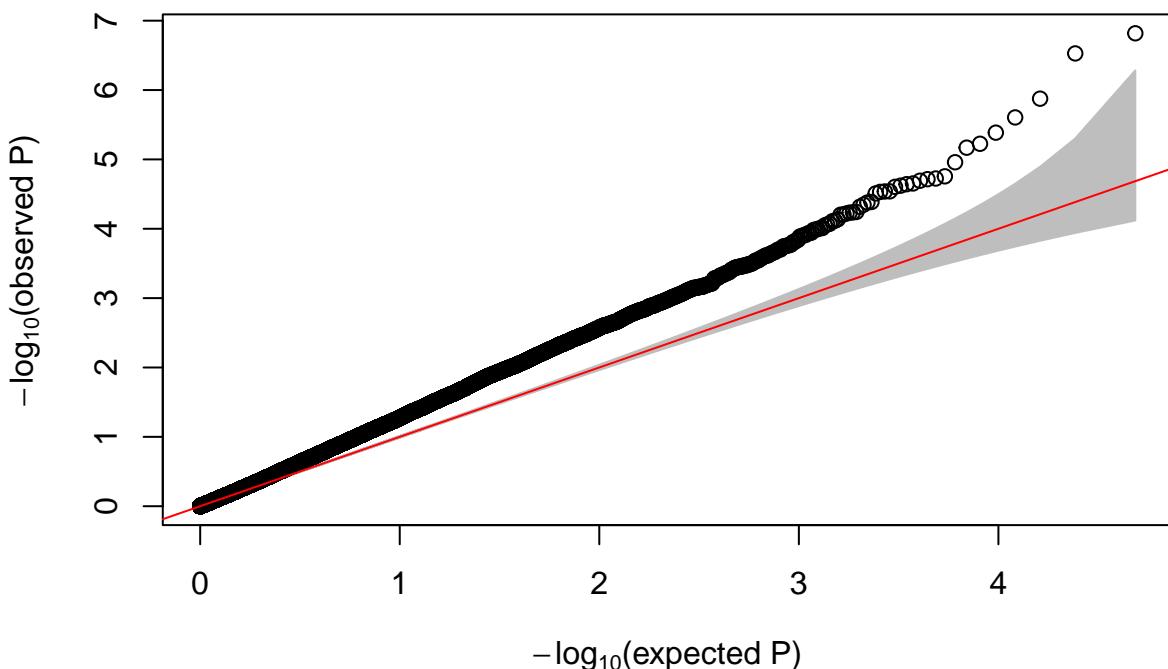
# Store toptable, p.value, summary
summa.fit.auto <- decideTests(fit)
toptable.autoc <- topTable(fit, coef = "Autocorrelation.original", number =
dim(counts.ok)[1])
toptable.autoc <- toptable.autoc[order(toptable.autoc$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Autocorrelation.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Autocorrelation.original)
```



```
summary(summa.fit.auto)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      655      0 134      0 0      0      0
## NotSig   22381    48525 48281 48525 48523    48525    48525
## Up       25489      0 110      0 2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0 0      0      0
## NotSig   48525      48525      48525 48525    48525    48525
## Up       0      0      0      0 0      0      0
##      Autocorrelation.original X1     X2     X3     X4     X5     X6     X7     X8
## Down      4 18449 16216 13769 12119 10405 9202 8846 7174
## NotSig   48518 12837 19852 22241 25530 26816 28801 32485 34509
## Up       3 17239 12457 12515 10876 11304 10522 7194 6842
##      X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7871 8319 6705 6469 6520 5524 4800 3768 3855 2140 2484
## NotSig  32528 32400 33888 36700 36944 37330 39295 41141 41712 43711 43571
## Up      8126 7806 7932 5356 5061 5671 4430 3616 2958 2674 2470
head(toptable.autoc, 10)

##          logFC AveExpr      t    P.Value adj.P.Val      B
## 212329_at  0.2140579 3.046026 5.652212 1.519904e-07 0.00719515 6.850449
## 227973_at -0.1569479 4.812141 -5.499370 2.965543e-07 0.00719515 6.501359
## 230036_at -0.2491051 5.626065 -5.148172 1.331450e-06 0.02153620 5.126485
## 212764_at -0.2346671 5.362327 -4.998864 2.482641e-06 0.03011754 4.549247
## 218986_s_at -0.2669902 5.501943 -4.876164 4.112468e-06 0.03991150 4.075728
## 212916_at  0.1046100 5.425691  4.785150 5.953396e-06 0.04695797 3.741335
## 221687_s_at 0.2593628 1.217924  4.753158 6.773947e-06 0.04695797 3.143012
## 239988_at -0.3690031 2.447993 -4.632331 1.098311e-05 0.06661941 3.075849
## 220238_s_at -0.1701855 3.591236 -4.513544 1.754084e-05 0.07504312 2.729188
## 228185_at -0.1254877 4.257772 -4.495131 1.884922e-05 0.07504312 2.687036

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ClusterProminence.original.rda")

summa.fit.clustPro <- decideTests(fit)
summary(summa.fit.clustPro)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      595      0 92 0 0      0      0
## NotSig   22639    48525 48365 48525 48524    48525    48525
## Up       25291      0 68 0 1      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0 0      0      0
## NotSig   48525      48525      48525 48525    48525    48525
## Up       0      0      0      0 0      0      0
##      ClusterProminence.original X1     X2     X3     X4     X5     X6     X7
## Down      0 18481 16176 13873 12364 10528 9427 8586
## NotSig   48525 12747 19725 22241 25249 26922 28481 32960
## Up       0 17297 12624 12411 10912 11075 10617 6979
##      X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7666 7944 8062 6956 6537 6723 5551 5092 3940 4197 2313 2653
## NotSig  33668 32557 32555 33257 36521 36572 37200 38791 40648 41079 43646 43366
## Up      7191 8024 7908 8312 5467 5230 5774 4642 3937 3249 2566 2506

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ClusterShade.original.rda")

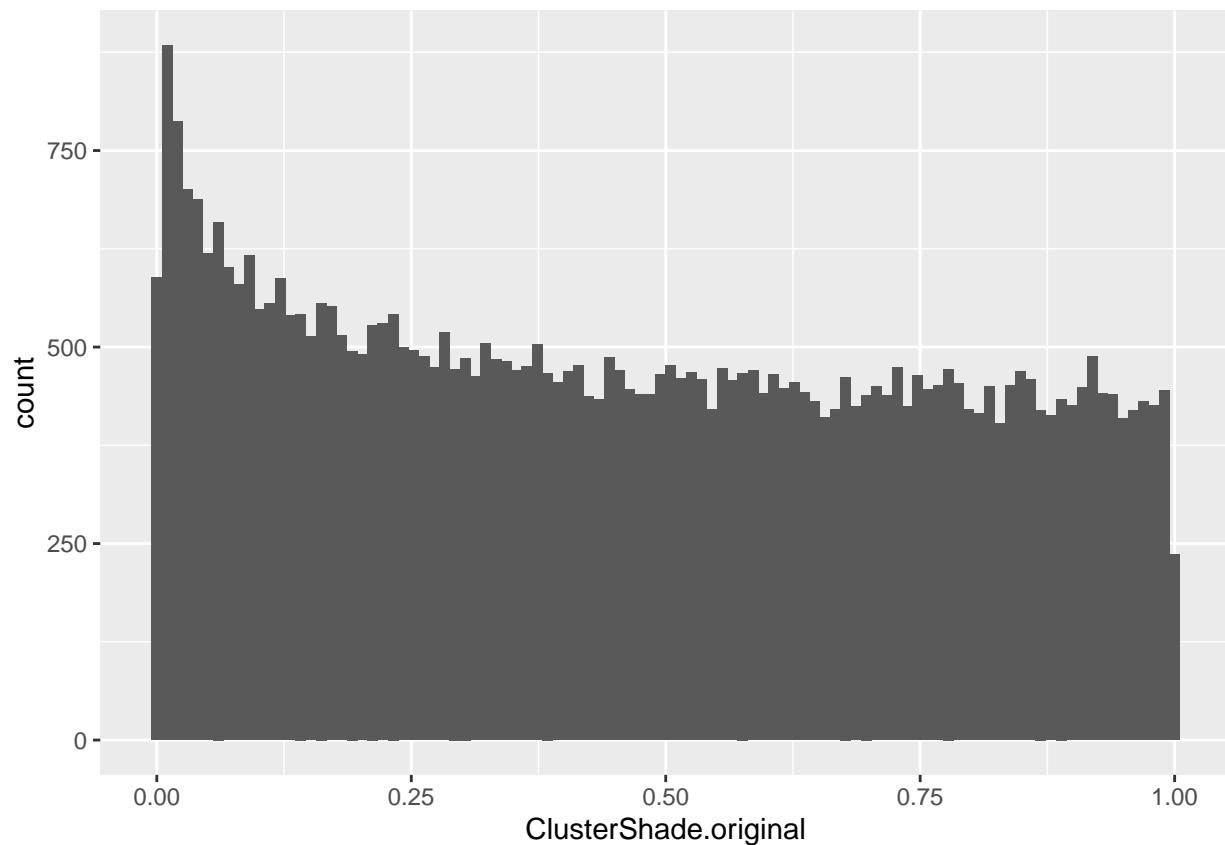
```

```

summa.fit.clustSh <- decideTests(fit)
toptable.clustSh <- topTable(fit, coef = "ClusterShade.original", number =
dim(counts.ok)[1])
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = ClusterShade.original)) + geom_histogram(bins = 100)

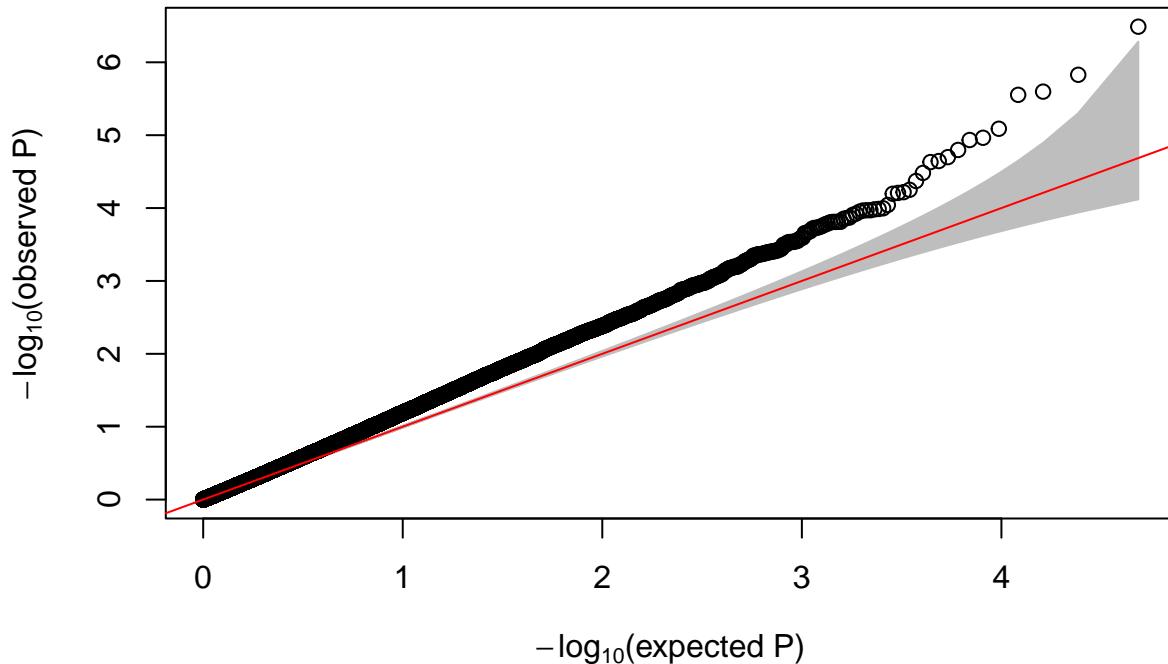
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$ClusterShade.original)

```



```
summary(summa.fit.clustSh)
```

```
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down           592         0   101    0    0      0        0
## NotSig        22818      48525 48341 48525 48523    48525      48525
## Up            25115         0    83    0    2      0        0
##          dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0           0           0       0      0        0        0
## NotSig        48525      48525           0    48525 48525      48525
## Up             0           0           0       0      0        0        0
##          ClusterShade.original X1   X2   X3   X4   X5   X6   X7   X8
## Down           2 18574 16044 13738 12291 10588 9076 8809 7484
## NotSig        48521 12688 20150 22431 25240 26588 29113 32992 33781
## Up            2 17263 12331 12356 10994 11349 10336 6724 7260
##          X9   X10  X11  X12  X13  X14  X15  X16  X17  X18  X19
## Down          7806 8462 6781 6468 6642 5556 5134 4077 4141 2482 2525
## NotSig       32697 32179 33679 36651 36496 37445 38763 40531 41197 43138 43224
## Up            8022 7884 8065 5406 5387 5524 4628 3917 3187 2905 2776
```

```
head(toptable.clustSh, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 214027_x_at	0.17161563	0.6872062	5.478815	3.246790e-07	0.01575505	5.643635
## 239081_at	-0.16362161	2.3837066	-5.122579	1.484159e-06	0.03393020	4.832180
## 204233_s_at	0.20349264	3.0075886	4.994830	2.527017e-06	0.03393020	4.427936
## 213564_x_at	0.09183282	6.5682690	4.706900	8.164235e-06	0.07923390	3.345018
## 201030_x_at	0.08763818	6.2130525	4.617732	1.164706e-05	0.08073908	3.045538
## 233092_s_at	-0.35824461	-0.5402662	-4.970275	2.796925e-06	0.03393020	3.013439
## 230774_at	-0.19153535	1.0816671	-4.635558	1.085185e-05	0.08073908	2.878926
## 210681_s_at	0.07254418	7.0264442	4.537919	1.595499e-05	0.09677700	2.662140
## 225855_at	-0.17640895	1.9816101	-4.480038	2.000575e-05	0.10315918	2.513144
## 218983_at	-0.09082771	5.8726308	-4.439856	2.338487e-05	0.10315918	2.425140

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ClusterTendency.original.rda")

summa.fit.clustTen <- decideTests(fit)
summary(summa.fit.clustTen)

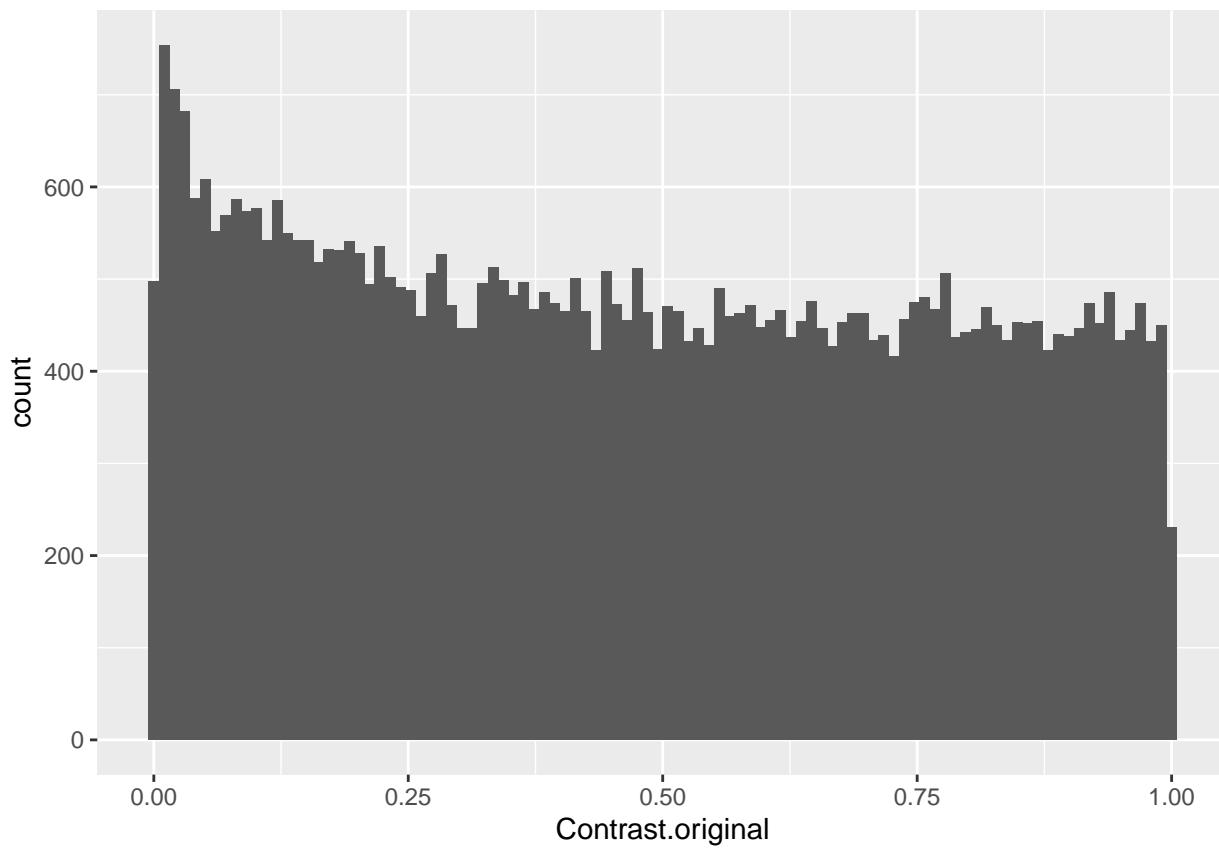
##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           598          0   99     0     0      0          0
## NotSig        22654        48525 48359 48525 48524    48525        48525
## Up            25273          0   67     0     1      0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0          0          0      0          0
## NotSig        48525         48525          0        48525 48525        48525
## Up             0             0          0          0      0          0
##          ClusterTendency.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18452 16230 13851 12265 10553 10670 7220 7250
## NotSig        48525 12794 19606 22325 25391 26901 28384 32551 33566
## Up             0 17279 12689 12349 10869 11071 9471 8754 7709
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down       7950 7860 8213 5460 5270 5631 4583 4042 3187 2675 2542
## NotSig    32745 32548 33534 36517 36548 37525 38821 40410 41180 43464 43347
## Up        7830 8117 6778 6548 6707 5369 5121 4073 4158 2386 2636

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Contrast.original.rda")

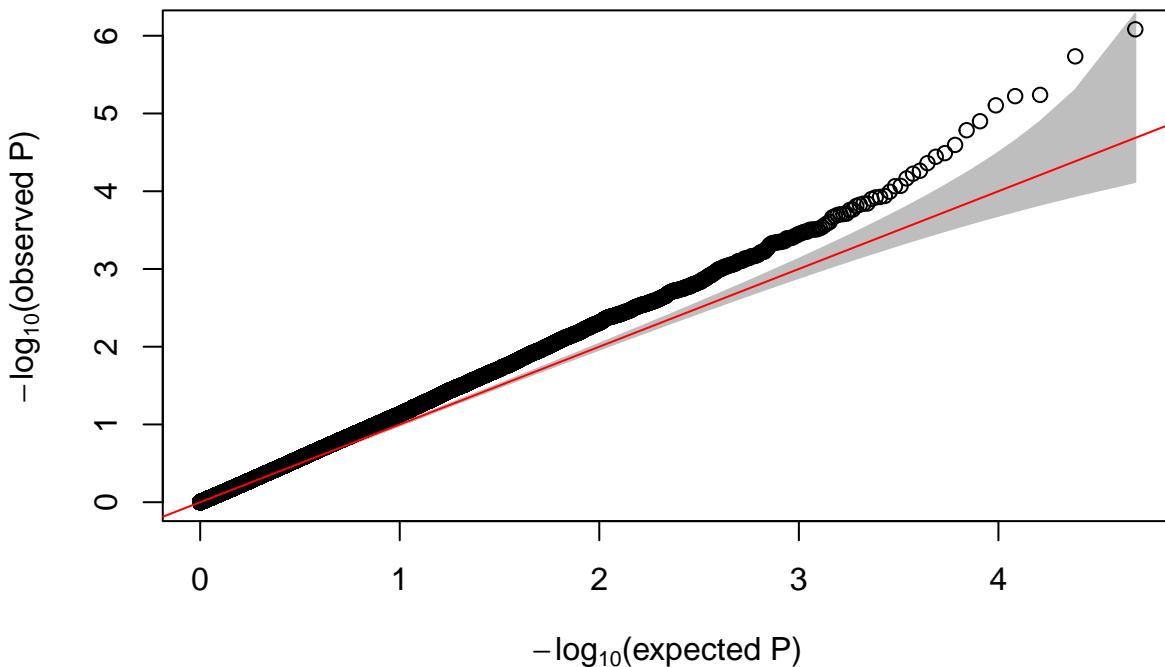
# Store toptable, p.value, summary
summa.fit.cont <- decideTests(fit)
toptable.cont <- topTable(fit, coef = "Contrast.original", number = dim(counts.ok)[1])
toptable.cont <- toptable.cont[order(toptable.cont$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Contrast.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Contrast.original)
```



```
summary(summa.fit.cont)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      601      0     89      0      0      0      0
## NotSig   22631    48525  48368  48525  48524    48525    48525
## Up       25293      0     68      0      1      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      Contrast.original   X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      1 18458 16255 13932 12369 10607 10670 7127 7268 7937
## NotSig   48523 12783 19492 22225 25214 26772 28368 32682 33558 32750
## Up       1 17284 12778 12368 10942 11146 9487 8716 7699 7838
##      X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7845  8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig  32626 33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up      8054  6853  6442  6712  5434  5070  4076  4204  2364  2674

head(toptable.cont, 10)

##          logFC     AveExpr        t     P.Value adj.P.Val       B
## 203893_at -0.10041678  5.0379308 -5.261247 8.262337e-07 0.04009299 5.554520
## 1554830_a_at  0.19493497  2.6289573  5.071015 1.840997e-06 0.04466720 4.581840
## 1555229_a_at  0.39799402  0.6820437  4.793267 5.765254e-06 0.07258511 3.111078
## 1562121_at   0.17768900  0.1193435  4.784088 5.983317e-06 0.07258511 2.725248
## 216922_x_at   0.20693649 -0.3358964  4.716413 7.857573e-06 0.07625775 2.217700
## 201645_at    0.26341444  1.8007395  4.598154 1.258368e-05 0.10177048 2.811716
## 219675_s_at   0.09225380  0.0965517  4.530517 1.642267e-05 0.11384429 2.813061
## 224785_at    -0.15288095  3.6686028 -4.418797 2.536640e-05 0.15386309 2.382161
## 217279_x_at   0.21058986  0.8980683  4.355435 3.236753e-05 0.17451493 1.784988
## 218315_s_at   -0.09320256  3.2742864 -4.327517 3.601302e-05 0.17475318 2.058275

load("/Users/carlacasanovasuzquez/Desktop/Radiomic features models
(indiv)/Maximum2DDiameterColumn.original.rda")

summa.fit.corr <- decideTests(fit)
summary(summa.fit.corr)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      565      0     53      0      0      0      0
## NotSig   22755    48525  48439  48525  48523    48525    48525
## Up       25205      0     33      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      Maximum2DDiameterColumn.original   X1     X2     X3     X4     X5     X6
## Down      0 18555 16166 13981 12471 10515 10711
## NotSig   48525 12764 19831 22041 24983 26919 28254
## Up       0 17206 12528 12503 11071 11091  9560
##      X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down    6706  7370  8065  7879  8325  5499  5432  5597  4588  4756  2893  2547
## NotSig  33300 33377 32565 32428 33381 36498 36353 37347 38895 39019 41589 43706
## Up      8519  7778  7895  8218  6819  6528  6740  5581  5042  4750  4043  2272
##      X19
## Down    2556
## NotSig 43204

```

```

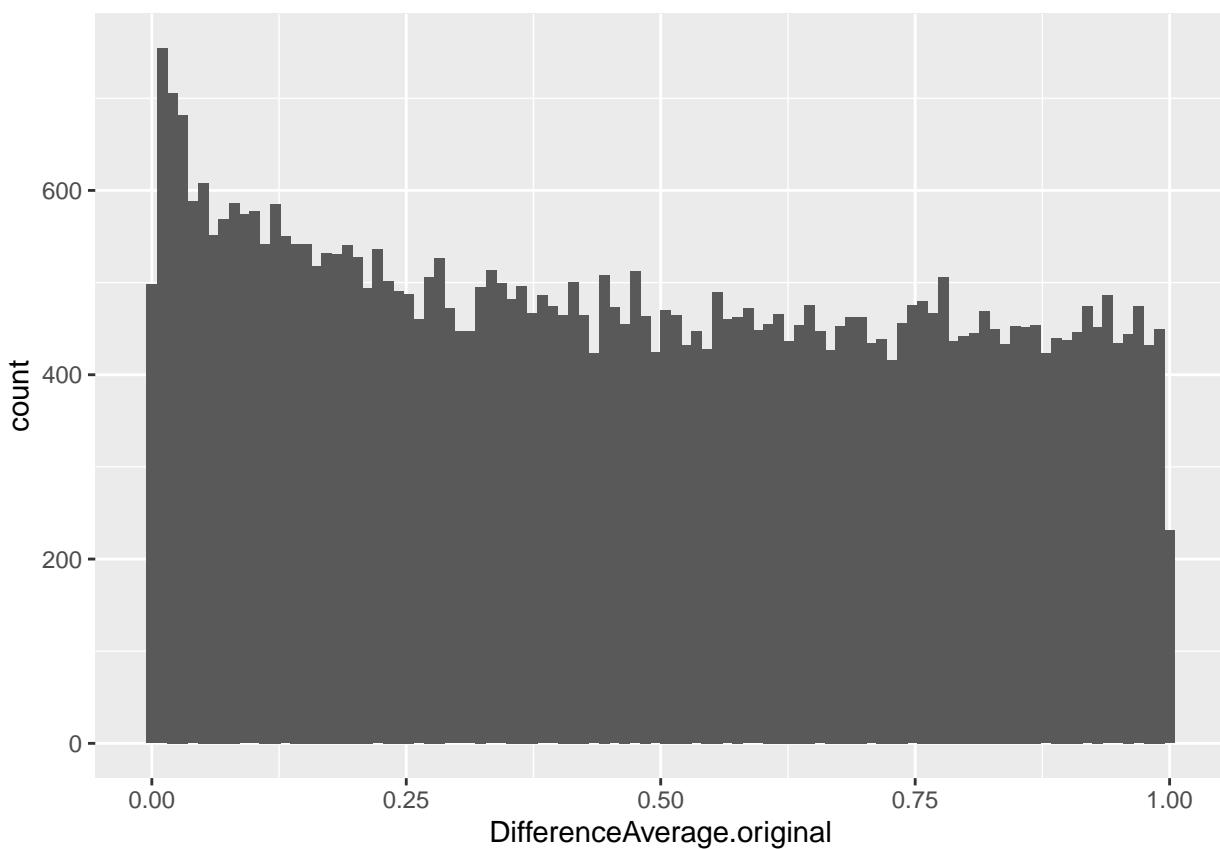
## Up      2765

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/DifferenceAverage.original.rda")

# Store toptable, p.value, summary
summa.fit.diffAv <- decideTests(fit)
toptable.diffAv <- topTable(fit, coef = "DifferenceAverage.original", number =
dim(counts.ok)[1])
toptable.diffAv <- toptable.diffAv[order(toptable.diffAv$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = DifferenceAverage.original)) + geom_histogram(bins =
100)

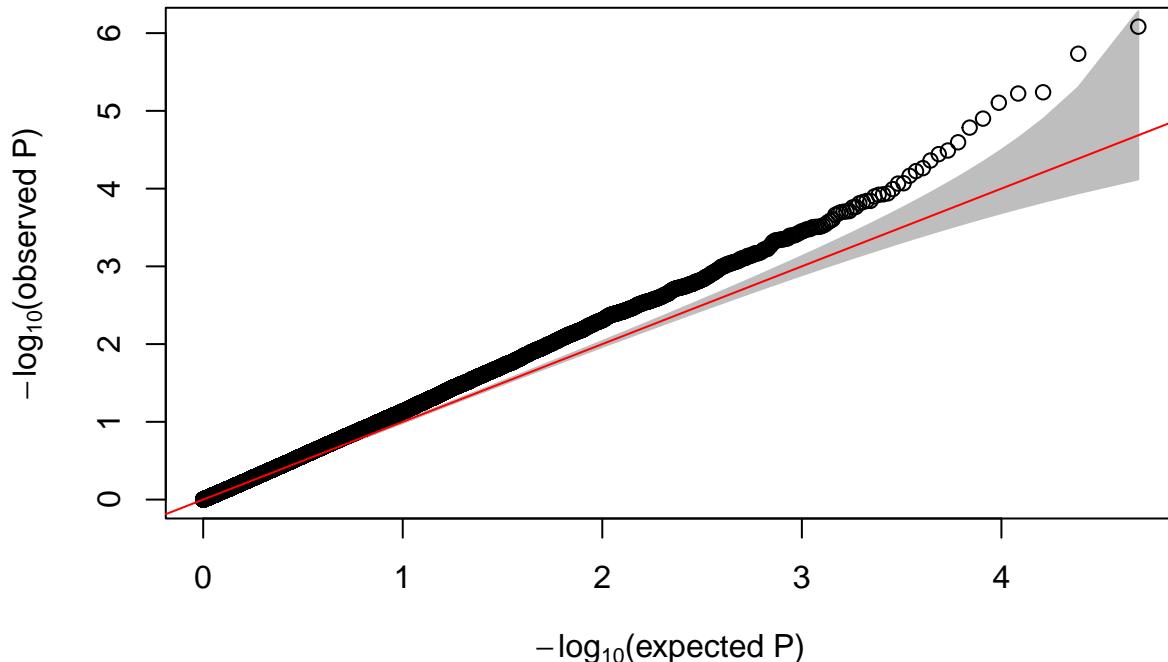
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$DifferenceAverage.original)

```



```
summary(summa.fit.diffAv)
```

```
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down       601        0     89    0    0      0        0
## NotSig    22631      48525 48368 48525 48524    48525      48525
## Up        25293        0     68    0    1      0        0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down        0            0           0         0      0        0        0
## NotSig    48525        48525           0      48525 48525      48525
## Up         0            0           0         0      0        0        0
##          DifferenceAverage.original X1     X2     X3     X4     X5     X6     X7
## Down           1 18458 16255 13932 12369 10607 10670 7127
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682
## Up            1 17284 12778 12368 10942 11146 9487 8716
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down      7268 7937 7845 8259 5401 5277 5729 4520 4006 3269 2649 2552
## NotSig  33558 32750 32626 33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up       7699 7838 8054 6853 6442 6712 5434 5070 4076 4204 2364 2674
```

```
head(toptable.diffAv, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 203893_at	-0.10041678	5.0379308	-5.261247	8.262337e-07	0.04009299	5.554520
## 1554830_a_at	0.19493497	2.6289573	5.071015	1.840997e-06	0.04466720	4.581840
## 1555229_a_at	0.39799402	0.6820437	4.793267	5.765254e-06	0.07258511	3.111078
## 1562121_at	0.17768900	0.1193435	4.784088	5.983317e-06	0.07258511	2.725248
## 216922_x_at	0.20693649	-0.3358964	4.716413	7.857573e-06	0.07625775	2.217700
## 201645_at	0.26341444	1.8007395	4.598154	1.258368e-05	0.10177048	2.811716
## 219675_s_at	0.09225380	5.0965517	4.530517	1.642267e-05	0.11384429	2.813061
## 224785_at	-0.15288095	3.6686028	-4.418797	2.536640e-05	0.15386309	2.382161
## 217279_x_at	0.21058986	0.8980683	4.355435	3.236753e-05	0.17451493	1.784988
## 218315_s_at	-0.09320256	3.2742864	-4.327517	3.601302e-05	0.17475318	2.058275

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/DifferenceEntropy.original.rda")

summa.fit.diffEnt <- decideTests(fit)
summary(summa.fit.diffEnt)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           600          0   89      0     0       0           0
## NotSig        22633        48525 48367 48525 48524     48525       48525
## Up            25292          0   69      0     1       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0           0
## NotSig        48525         48525           48525       48525       48525
## Up            0             0           0           0       0           0
##          DifferenceEntropy.original X1     X2     X3     X4     X5     X6     X7
## Down           0 18475 16251 13944 12398 10546 10653 6907
## NotSig        48525 12748 19558 22145 25175 26911 28418 32988
## Up            0 17302 12716 12436 10952 11068 9454 8630
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down        7258 8056 7883 8297 5419 5293 5682 4508 3924 3383 2647 2560
## NotSig      33524 32507 32643 33288 36666 36495 37383 38965 40591 40862 43494 43264
## Up          7743 7962 7999 6940 6440 6737 5460 5052 4010 4280 2384 2701

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/DifferenceVariance.original.rda")

summa.fit.diffVar <- decideTests(fit)
summary(summa.fit.diffVar)

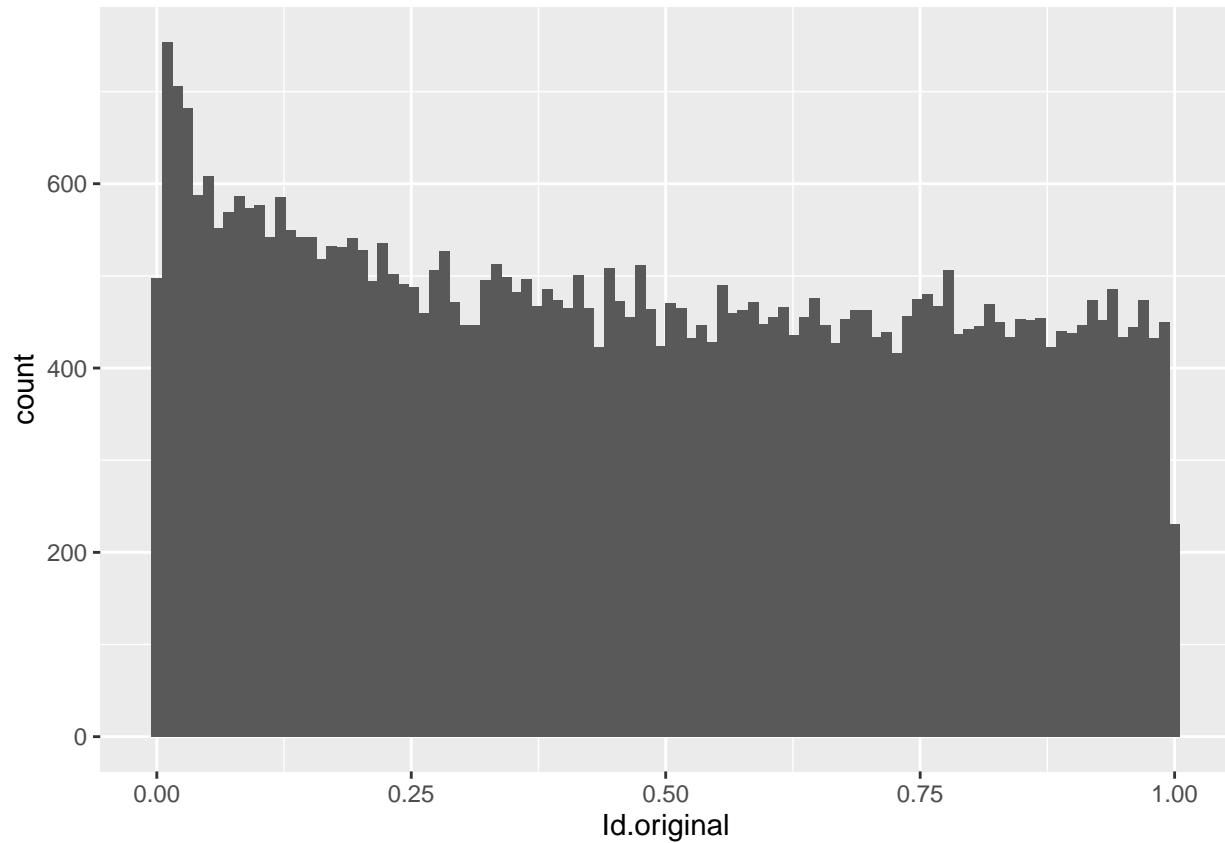
##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           604          0   90      0     0       0           0
## NotSig        22626        48525 48364 48525 48524     48525       48525
## Up            25295          0   71      0     1       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0           0
## NotSig        48525         48525           48525       48525       48525
## Up            0             0           0           0       0           0
##          DifferenceVariance.original X1     X2     X3     X4     X5     X6     X7
## Down           0 18475 16251 13943 12375 10603 10661 7001
## NotSig        48525 12755 19526 22183 25206 26802 28384 32887
## Up            0 17295 12748 12399 10944 11120 9480 8637
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down        7271 7998 7848 8261 5389 5270 5734 4521 3939 3354 2646 2537
## NotSig      33563 32644 32643 33359 36707 36537 37329 38946 40566 40924 43517 43308
## Up          7691 7883 8034 6905 6429 6718 5462 5058 4020 4247 2362 2680

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Id.original.rda")

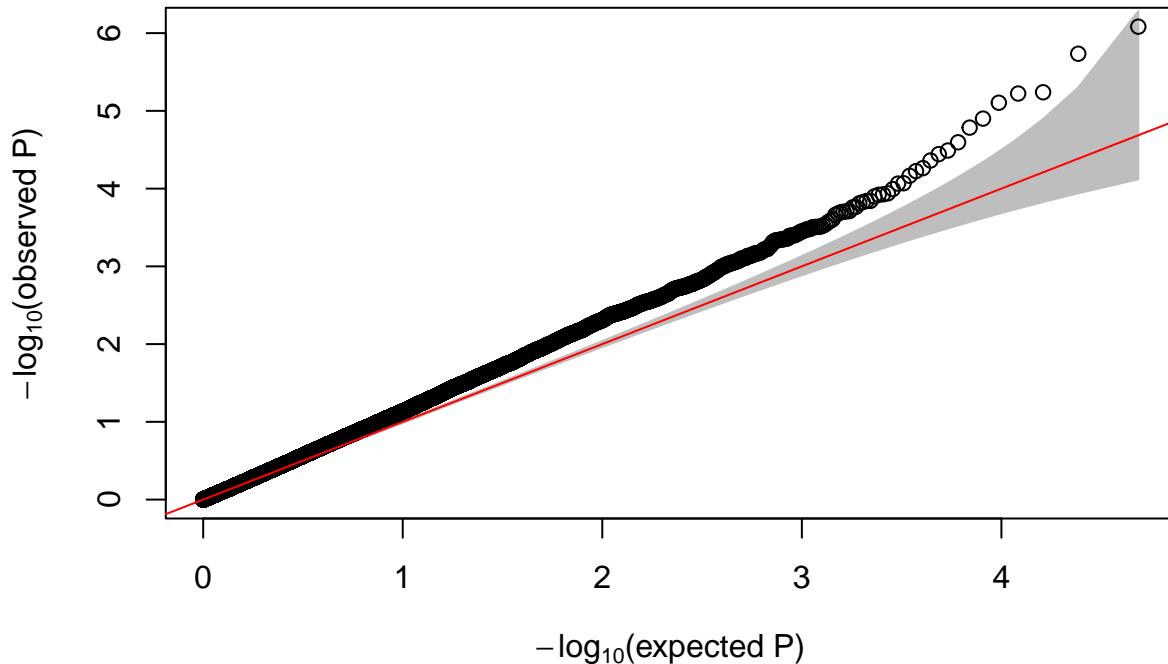
# Store toptable, p.value, summary
summa.fit.id0 <- decideTests(fit)
toptable.id0 <- topTable(fit, coef = "Id.original", number = dim(counts.ok)[1])
toptable.id0 <- toptable.id0[order(toptable.id0$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

```

```
# P-value distribution of results computed by limma  
ggplot(data = p.val.voom, aes(x = Id.original)) + geom_histogram(bins = 100)
```



```
# QQplot plot for p-values computed by limma  
GWASTools::qqPlot(p.val.voom$Id.original)
```



```
summary(summa.fit.id0)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    89      0      0      0          0
## NotSig        22631        48525 48368 48525 48524 48525        48525
## Up            25293          0    68      0      1      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0              0          0      0      0          0
## NotSig        48525        48525          48525 48525 48525        48525
## Up             0            0              0          0      0      0          0
##             Id.original   X1      X2      X3      X4      X5      X6      X7      X8      X9      X10
## Down           1 18458 16255 13932 12369 10607 10670 7127 7268 7937 7845
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682 33558 32750 32626
## Up            1 17284 12778 12368 10942 11146 9487 8716 7699 7838 8054
##             X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down          8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig       33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up            6853  6442  6712  5434  5070  4076  4204  2364  2674
```

```
head(toptable.id0, 10)
```

```
##                  logFC     AveExpr         t     P.Value adj.P.Val       B
## 203893_at     0.10041678  5.0379308  5.261247 8.262333e-07 0.04009297 5.554521
## 1554830_a_at -0.19493497  2.6289573 -5.071015 1.840998e-06 0.04466722 4.581839
## 1555229_a_at -0.39799402  0.6820437 -4.793267 5.765255e-06 0.07258511 3.111078
## 1562121_at    -0.17768899  0.1193435 -4.784088 5.983317e-06 0.07258511 2.725248
## 216922_x_at   -0.20693649 -0.3358964 -4.716413 7.857575e-06 0.07625776 2.217700
## 201645_at     -0.26341443  1.8007395 -4.598154 1.258368e-05 0.10177053 2.811715
## 219675_s_at   -0.09225380  5.0965517 -4.530517 1.642267e-05 0.11384431 2.813060
## 224785_at     0.15288095  3.6686028  4.418797 2.536641e-05 0.15386312 2.382161
## 217279_x_at   -0.21058986  0.8980683 -4.355435 3.236753e-05 0.17451491 1.784988
## 218315_s_at   0.09320257  3.2742864  4.327517 3.601304e-05 0.17475327 2.058275
```

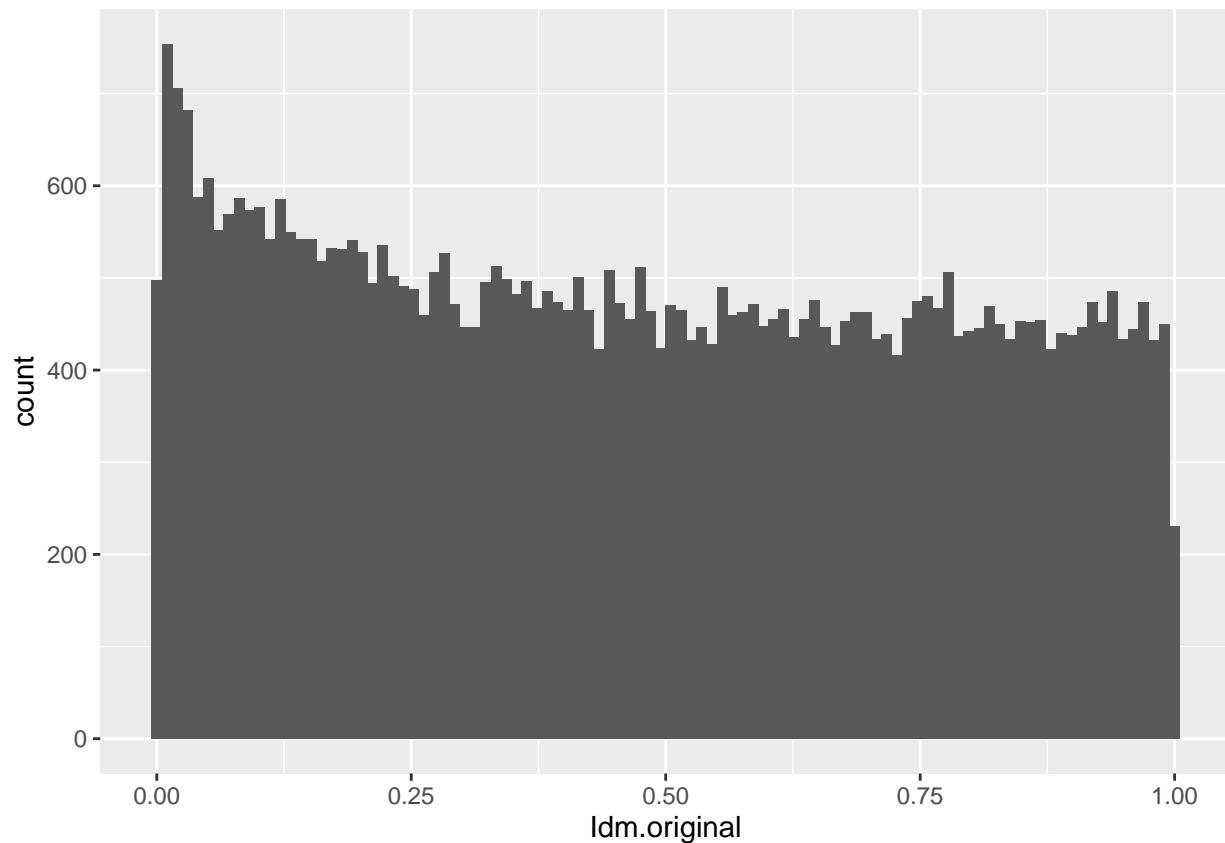
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Idm.original.rda")

# Store toptable, p.value, summary
summa.fit.idm0 <- decideTests(fit)
toptable.idm0 <- topTable(fit, coef = "Idm.original", number = dim(counts.ok)[1])
toptable.idm0 <- toptable.idm0[order(toptable.idm0$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Idm.original)) + geom_histogram(bins = 100)

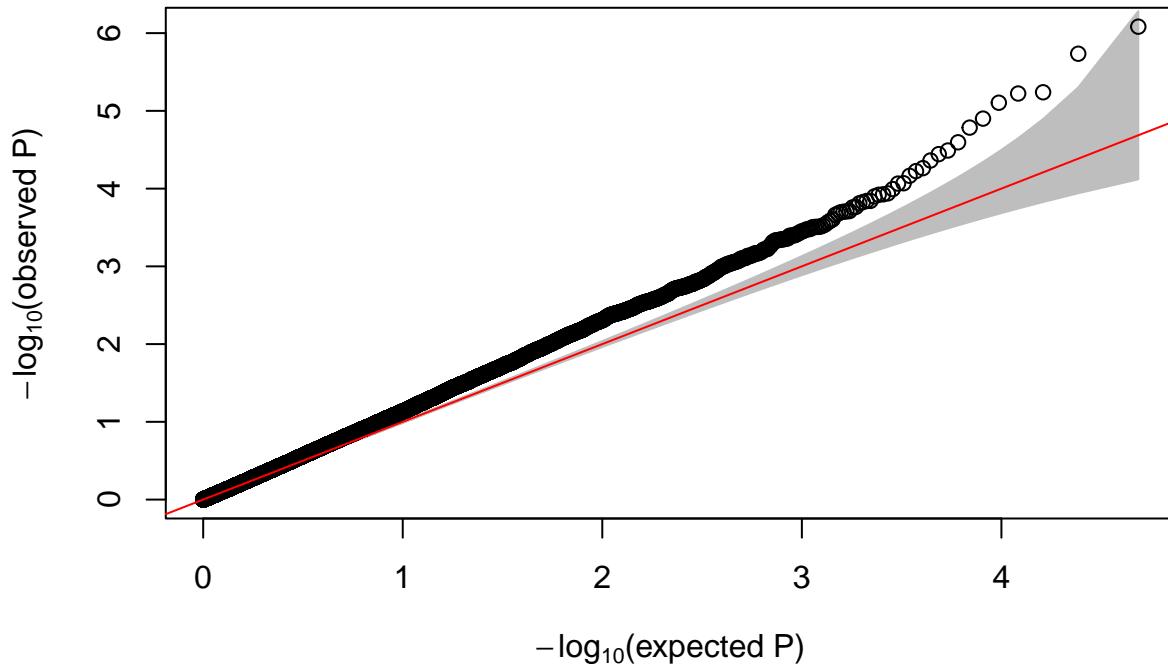
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Idm.original)

```



```
summary(summa.fit.idm0)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    89      0      0      0          0
## NotSig        22631        48525 48368 48525 48524 48525        48525
## Up            25293          0    68      0      1      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0              0          0      0      0          0
## NotSig        48525        48525          48525 48525 48525        48525
## Up             0            0              0          0      0      0          0
##             Idm.original X1      X2      X3      X4      X5      X6      X7      X8      X9      X10
## Down           1 18458 16255 13932 12369 10607 10670 7127 7268 7937 7845
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682 33558 32750 32626
## Up             1 17284 12778 12368 10942 11146 9487 8716 7699 7838 8054
##             X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down          8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig       33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up            6853  6442  6712  5434  5070  4076  4204  2364  2674
```

```
head(toptable.idm0, 10)
```

```
##                logFC     AveExpr         t     P.Value adj.P.Val      B
## 203893_at     0.10041678  5.0379308  5.261247 8.262333e-07 0.04009297 5.554521
## 1554830_a_at -0.19493497  2.6289573 -5.071015 1.840998e-06 0.04466722 4.581839
## 1555229_a_at -0.39799402  0.6820437 -4.793267 5.765255e-06 0.07258511 3.111078
## 1562121_at    -0.17768899  0.1193435 -4.784088 5.983317e-06 0.07258511 2.725248
## 216922_x_at   -0.20693649 -0.3358964 -4.716413 7.857575e-06 0.07625776 2.217700
## 201645_at     -0.26341443  1.8007395 -4.598154 1.258368e-05 0.10177053 2.811715
## 219675_s_at   -0.09225380  5.0965517 -4.530517 1.642267e-05 0.11384431 2.813060
## 224785_at     0.15288095  3.6686028  4.418797 2.536641e-05 0.15386312 2.382161
## 217279_x_at   -0.21058986  0.8980683 -4.355435 3.236753e-05 0.17451491 1.784988
## 218315_s_at   0.09320257  3.2742864  4.327517 3.601304e-05 0.17475327 2.058275
```

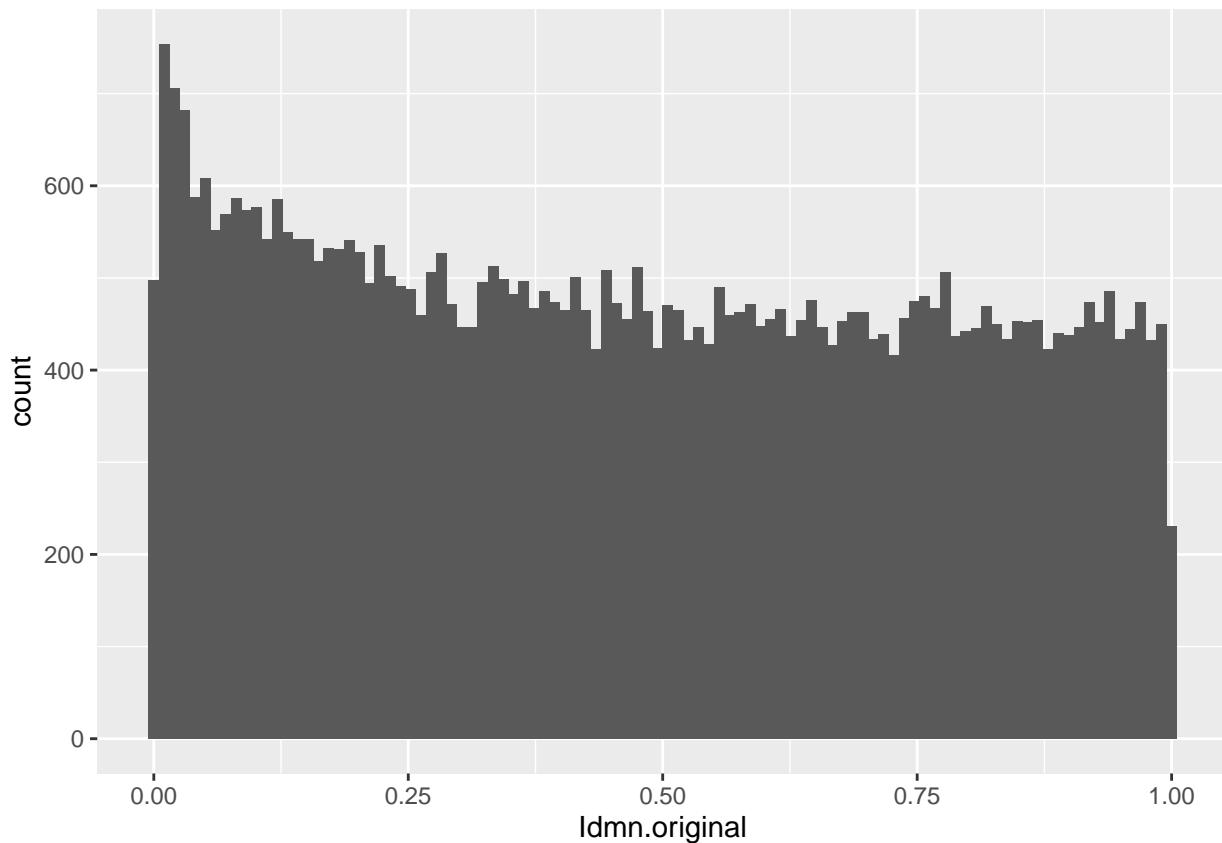
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Idmn.original.rda")

# Store toptable, p.value, summary
summa.fit.idmn0 <- decideTests(fit)
toptable.idmn0 <- topTable(fit, coef = "Idmn.original", number = dim(counts.ok)[1])
toptable.idmn0 <- toptable.idmn0[order(toptable.idmn0$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Idmn.original)) + geom_histogram(bins = 100)

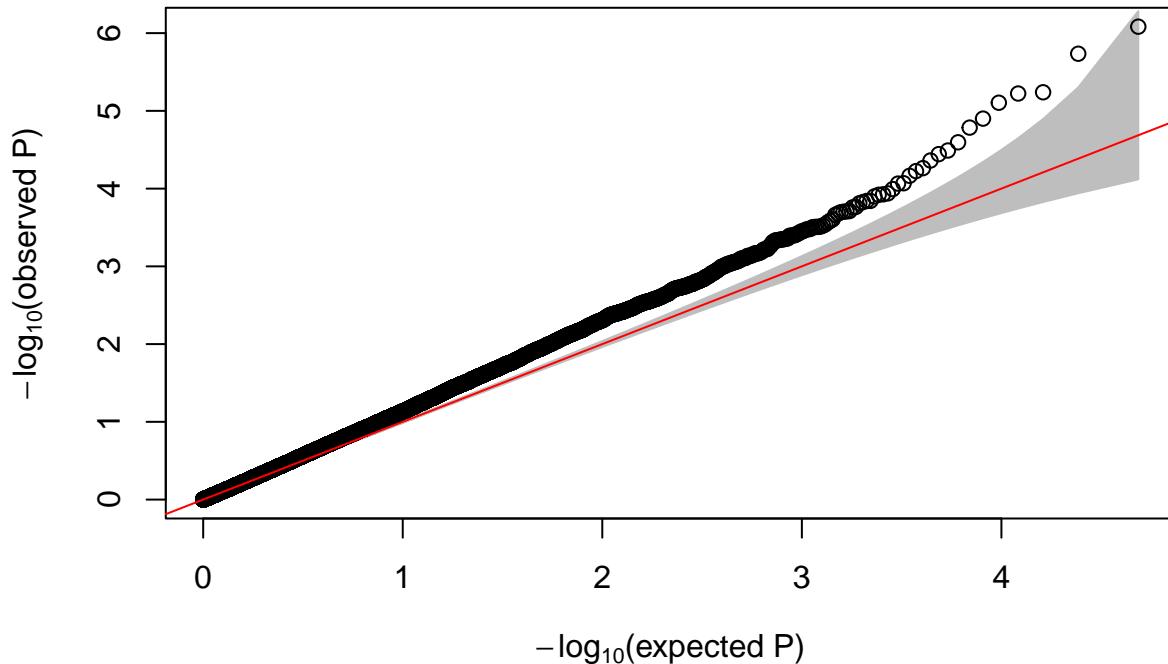
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Idmn.original)

```



```
summary(summa.fit.idmn0)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0      89      0      0      0          0
## NotSig        22631        48525 48368 48525 48524    48525        48525
## Up            25293          0      68      0      1      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0              0          0      0      0          0
## NotSig        48525        48525          48525    48525 48525        48525
## Up             0            0              0          0      0      0          0
##             Idmn.original   X1      X2      X3      X4      X5      X6      X7      X8      X9
## Down           1 18458 16255 13932 12369 10607 10670 7127 7268 7937
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682 33558 32750
## Up             1 17284 12778 12368 10942 11146 9487 8716 7699 7838
##             X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down         7845  8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig       32626 33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up           8054  6853  6442  6712  5434  5070  4076  4204  2364  2674
```

```
head(toptable.idmn0, 10)
```

```
##                  logFC     AveExpr         t     P.Value adj.P.Val       B
## 203893_at     0.10041678  5.0379308  5.261247 8.262337e-07 0.04009299 5.554520
## 1554830_a_at -0.19493497  2.6289573 -5.071015 1.840997e-06 0.04466720 4.581840
## 1555229_a_at -0.39799402  0.6820437 -4.793267 5.765254e-06 0.07258511 3.111078
## 1562121_at    -0.17768900  0.1193435 -4.784088 5.983317e-06 0.07258511 2.725248
## 216922_x_at   -0.20693649 -0.3358964 -4.716413 7.857573e-06 0.07625775 2.217700
## 201645_at     -0.26341444  1.8007395 -4.598154 1.258368e-05 0.10177048 2.811716
## 219675_s_at   -0.09225380  5.0965517 -4.530517 1.642267e-05 0.11384429 2.813061
## 224785_at     0.15288095  3.6686028  4.418797 2.536640e-05 0.15386309 2.382161
## 217279_x_at   -0.21058986  0.8980683 -4.355435 3.236753e-05 0.17451493 1.784988
## 218315_s_at   0.09320256  3.2742864  4.327517 3.601302e-05 0.17475318 2.058275
```

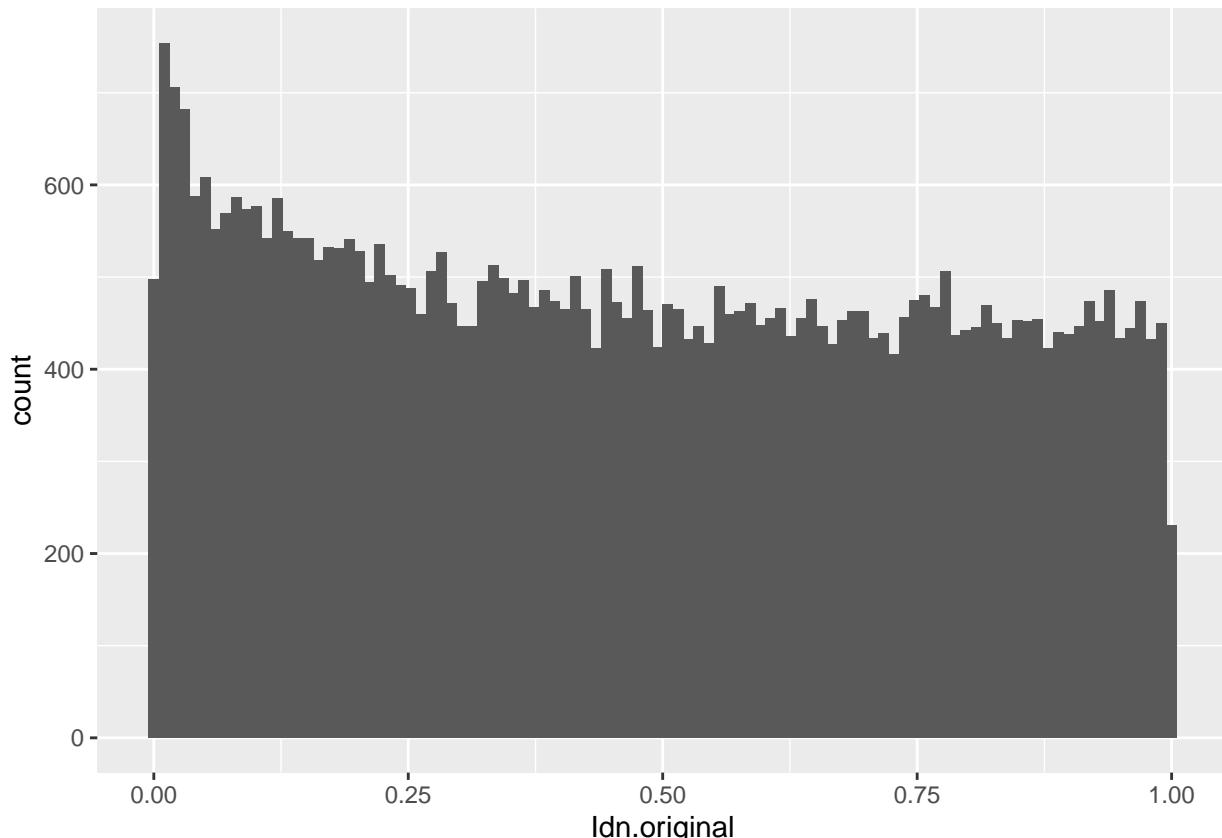
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Idn.original.rda")

summa.fit.idn0 <- decideTests(fit)
toptable.idn0 <- topTable(fit, coef = "Idn.original", number = dim(counts.ok)[1])
toptable.idn0 <- toptable.idn0[order(toptable.idn0$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Idn.original)) + geom_histogram(bins = 100)

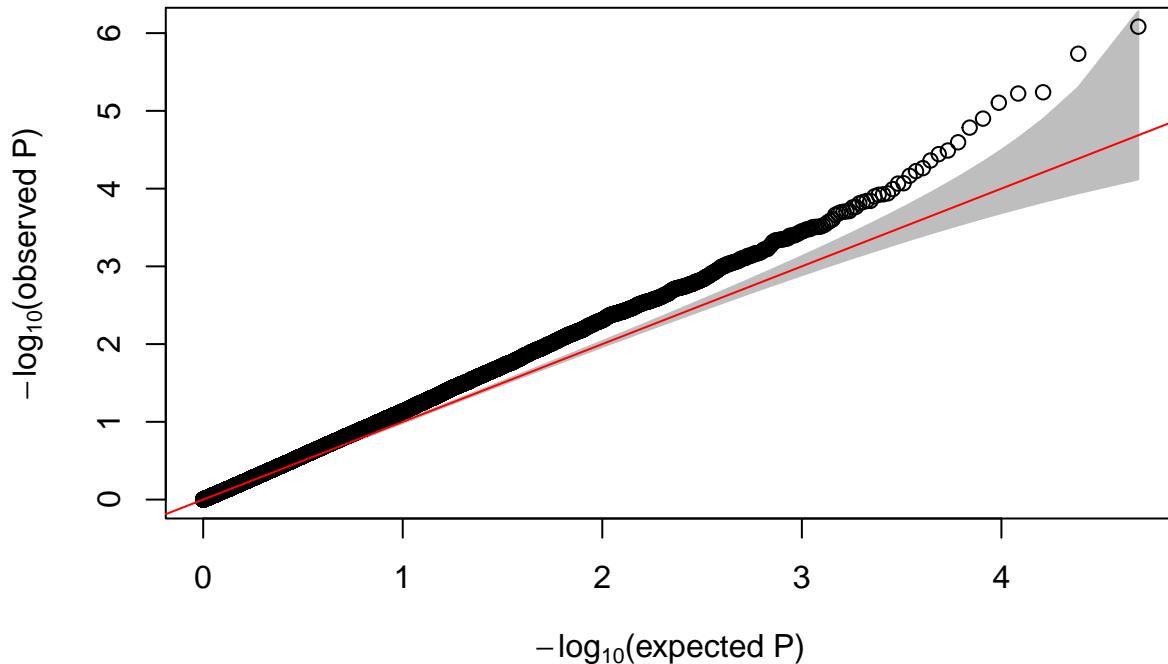
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Idn.original)

```



```
summary(summa.fit.idn0)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    89      0      0      0          0
## NotSig        22631        48525 48368 48525 48524    48525        48525
## Up            25293          0    68      0      1      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0              0          0      0      0          0
## NotSig        48525        48525          48525 48525 48525        48525
## Up             0            0              0          0      0      0          0
##             Idn.original X1      X2      X3      X4      X5      X6      X7      X8      X9      X10
## Down           1 18458 16255 13932 12369 10607 10670 7127 7268 7937 7845
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682 33558 32750 32626
## Up             1 17284 12778 12368 10942 11146 9487 8716 7699 7838 8054
##             X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down          8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig       33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up            6853  6442  6712  5434  5070  4076  4204  2364  2674
```

```
head(toptable.idn0, 10)
```

```
##                  logFC     AveExpr         t     P.Value adj.P.Val       B
## 203893_at     0.10041678  5.0379308  5.261247 8.262335e-07 0.04009298 5.554521
## 1554830_a_at -0.19493497  2.6289573 -5.071015 1.840998e-06 0.04466721 4.581839
## 1555229_a_at -0.39799402  0.6820437 -4.793267 5.765255e-06 0.07258511 3.111078
## 1562121_at    -0.17768900  0.1193435 -4.784088 5.983317e-06 0.07258511 2.725248
## 216922_x_at   -0.20693649 -0.3358964 -4.716413 7.857574e-06 0.07625776 2.217700
## 201645_at     -0.26341443  1.8007395 -4.598154 1.258368e-05 0.10177050 2.811715
## 219675_s_at   -0.09225380  5.0965517 -4.530517 1.642267e-05 0.11384430 2.813060
## 224785_at     0.15288095  3.6686028  4.418797 2.536641e-05 0.15386311 2.382161
## 217279_x_at   -0.21058986  0.8980683 -4.355435 3.236753e-05 0.17451492 1.784988
## 218315_s_at   0.09320256  3.2742864  4.327517 3.601303e-05 0.17475323 2.058275
```

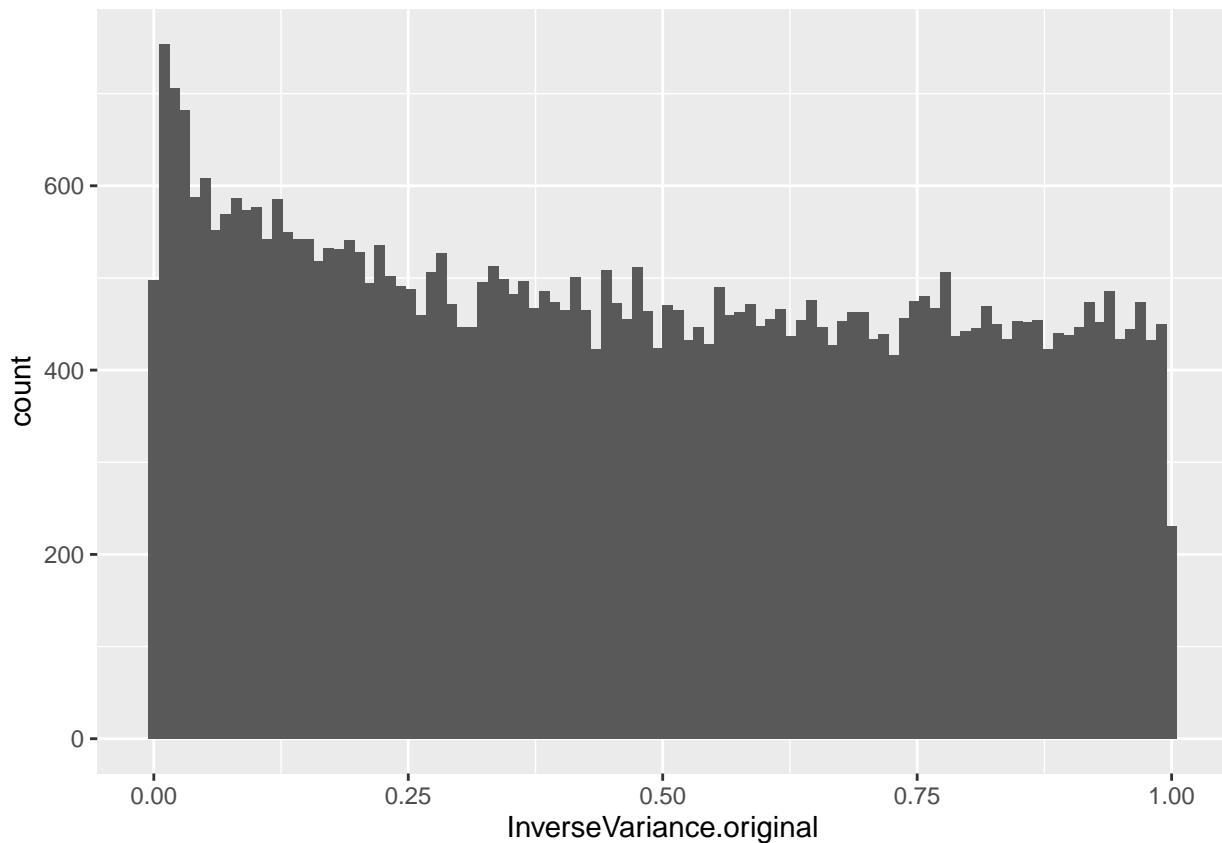
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/InverseVariance.original.rda")

summa.fit.invV <- decideTests(fit)
toptable.invV <- topTable(fit, coef = "InverseVariance.original", number =
dim(counts.ok)[1])
toptable.invV <- toptable.invV[order(toptable.invV$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = InverseVariance.original)) + geom_histogram(bins = 100)

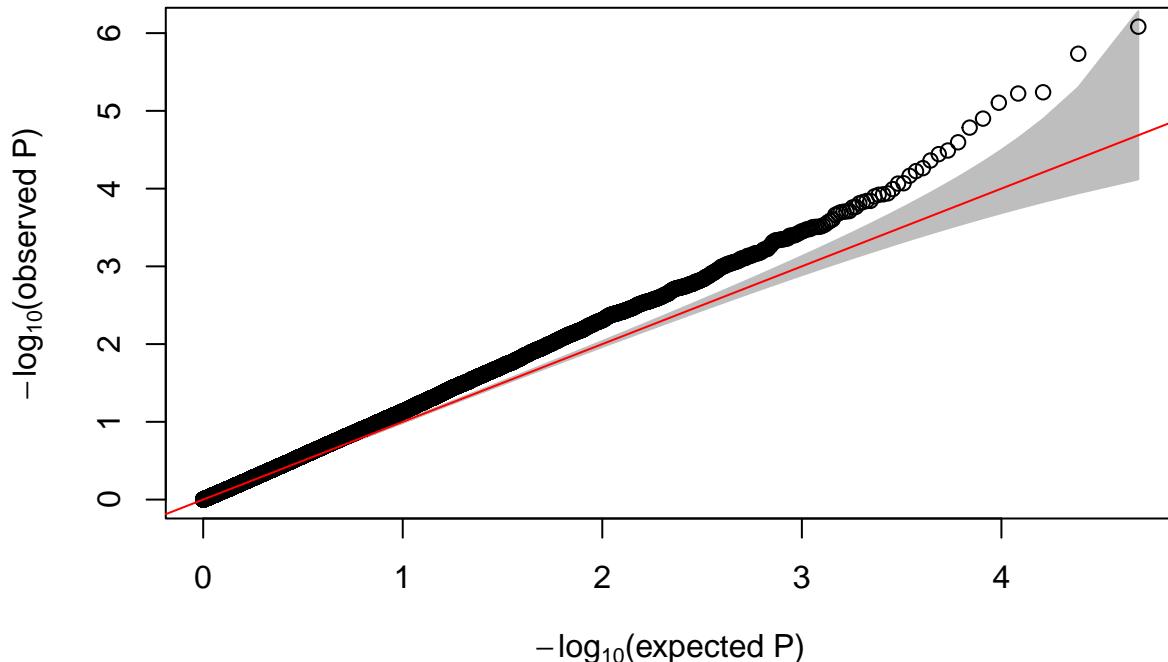
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$InverseVariance.original)

```



```
summary(summa.fit.invV)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    89      0      0      0          0
## NotSig        22631        48525 48368 48525 48524    48525        48525
## Up            25293          0    68      0      1      0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0              0          0      0      0          0
## NotSig        48525        48525          48525 48525 48525        48525
## Up             0            0              0          0      0      0          0
##             InverseVariance.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           1 18458 16255 13932 12369 10607 10670 7127 7268
## NotSig        48523 12783 19492 22225 25214 26772 28368 32682 33558
## Up             1 17284 12778 12368 10942 11146 9487 8716 7699
##             X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7937  7845  8259  5401  5277  5729  4520  4006  3269  2649  2552
## NotSig      32750 32626 33413 36682 36536 37362 38935 40443 41052 43512 43299
## Up           7838  8054  6853  6442  6712  5434  5070  4076  4204  2364  2674
```

```
head(toptable.invV, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 203893_at	-0.10041678	5.0379308	-5.261247	8.262337e-07	0.04009299	5.554520
## 1554830_a_at	0.19493497	2.6289573	5.071015	1.840997e-06	0.04466720	4.581840
## 1555229_a_at	0.39799402	0.6820437	4.793267	5.765254e-06	0.07258511	3.111078
## 1562121_at	0.17768900	0.1193435	4.784088	5.983317e-06	0.07258511	2.725248
## 216922_x_at	0.20693649	-0.3358964	4.716413	7.857573e-06	0.07625775	2.217700
## 201645_at	0.26341444	1.8007395	4.598154	1.258368e-05	0.10177048	2.811716
## 219675_s_at	0.09225380	5.0965517	4.530517	1.642267e-05	0.11384429	2.813061
## 224785_at	-0.15288095	3.6686028	-4.418797	2.536640e-05	0.15386309	2.382161
## 217279_x_at	0.21058986	0.8980683	4.355435	3.236753e-05	0.17451493	1.784988
## 218315_s_at	-0.09320256	3.2742864	-4.327517	3.601302e-05	0.17475318	2.058275

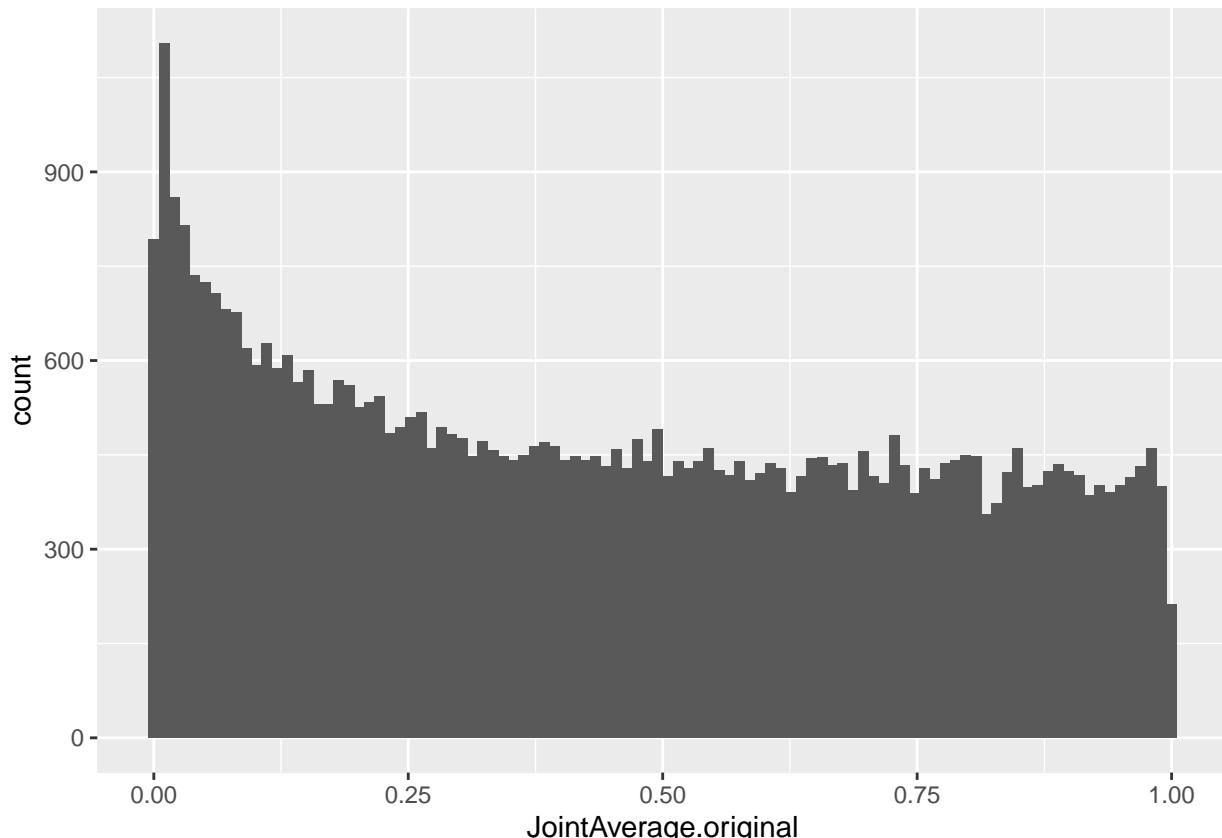
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/JointAverage.original.rda")

summa.fit.jAv <- decideTests(fit)
toptable.jAv <- topTable(fit, coef = "JointAverage.original", number = dim(counts.ok)[1])
toptable.jAv <- toptable.jAv[order(toptable.jAv$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = JointAverage.original)) + geom_histogram(bins = 100)

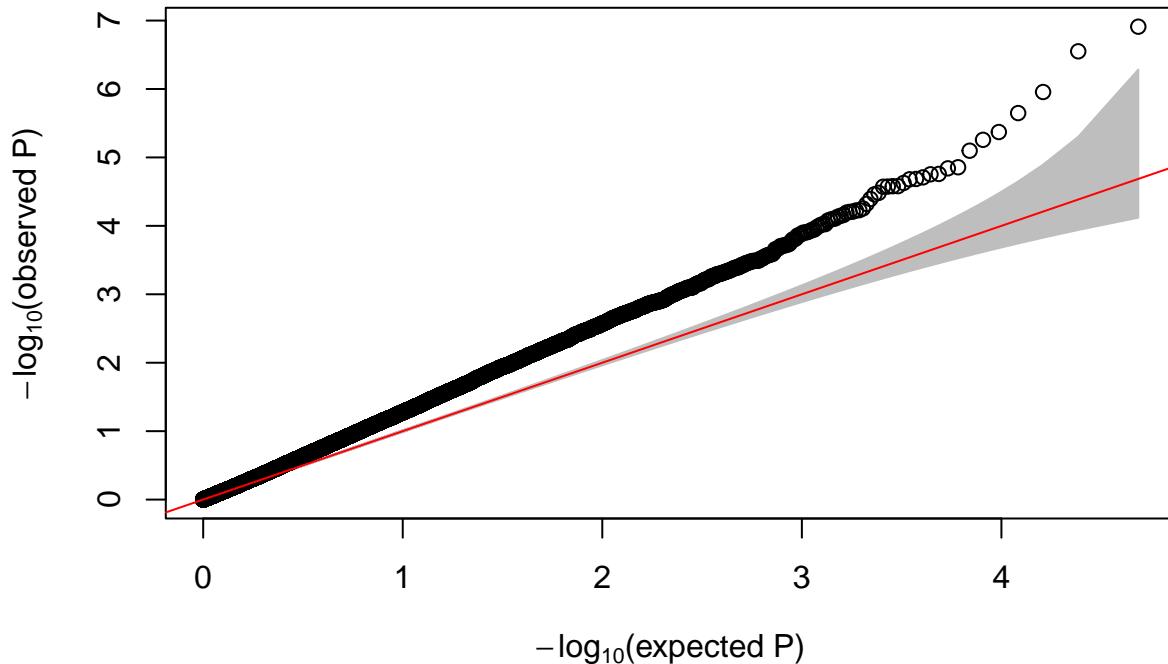
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$JointAverage.original)

```



```
summary(summa.fit.jAv)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           652          0    133      0      0        0          0
## NotSig        22384        48525  48287  48525  48523      48525        48525
## Up            25489          0   105      0      2        0          0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0            0            0        0        0          0
## NotSig        48525        48525          0        48525  48525        48525
## Up             0            0            0            0        0        0          0
##             JointAverage.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down           4 18442 16220 13776 12136 10395  9204  8860  7171
## NotSig        48519 12846 19867 22227 25503 26837 28794 32469 34517
## Up            2 17237 12438 12522 10886 11293 10527  7196  6837
##             X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7878  8295  6707  6483  6533  5517  4799  3766  3870  2125  2492
## NotSig       32481 32429 33893 36673 36908 37372 39297 41135 41683 43741 43570
## Up           8166  7801  7925  5369  5084  5636  4429  3624  2972  2659  2463
```

```
head(toptable.jAv, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 212329_at	0.2195191	3.0460263	5.700501	1.228358e-07	0.005960606	7.048836
## 227973_at	-0.1597969	4.8121414	-5.511355	2.814911e-07	0.006829677	6.552754
## 230036_at	-0.2558527	5.6260651	-5.192128	1.106285e-06	0.017894160	5.298819
## 212764_at	-0.2404495	5.3623273	-5.022728	2.248735e-06	0.027279965	4.640577
## 218986_s_at	-0.2717643	5.5019428	-4.867899	4.253549e-06	0.041280692	4.042695
## 212916_at	0.1069686	5.4256914	4.803493	5.527292e-06	0.044701976	3.809334
## 221687_s_at	0.2632330	1.2179241	4.712505	7.976086e-06	0.055291364	3.021021
## 239988_at	-0.3715954	2.4479933	-4.572309	1.392629e-05	0.068527057	2.875294
## 230146_s_at	-0.2414716	0.3778259	-4.563086	1.444150e-05	0.068527057	2.445160
## 220238_s_at	-0.1720925	3.5912361	-4.515235	1.742494e-05	0.068527057	2.738133

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/JointEnergy.original.rda")

summa.fit.jEn <- decideTests(fit)
summary(summa.fit.jEn)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           606          0    92     0     0      0          0          0
## NotSig        22617        48525  48365  48525  48524    48525        48525
## Up            25302          0    68     0     1      0          0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0          0          0          0          0          0
## NotSig        48525          48525        48525        48525    48525        48525
## Up            0             0          0          0          0          0          0
##          JointEnergy.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18444 16251 13895 12315 10572 10671 7151 7283
## NotSig        48525 12802 19536 22267 25315 26837 28376 32639 33532
## Up            0 17279 12738 12363 10895 11116 9478 8735 7710
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7926  7830  8235  5423  5281  5679  4536  3994  3259  2674  2529
## NotSig      32779 32608 33497 36606 36529 37450 38900 40469 41049 43478 43352
## Up           7820  8087  6793  6496  6715  5396  5089  4062  4217  2373  2644

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/JointEntropy.original.rda")

summa.fit.jEnt <- decideTests(fit)
summary(summa.fit.jEnt)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           605          0    91     0     0      0          0          0
## NotSig        22627        48525  48366  48525  48524    48525        48525
## Up            25293          0    68     0     1      0          0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0          0          0          0          0          0
## NotSig        48525          48525        48525        48525    48525        48525
## Up            0             0          0          0          0          0          0
##          JointEntropy.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18452 16251 13908 12356 10576 10666 7100 7280
## NotSig        48525 12783 19543 22243 25254 26856 28373 32734 33528
## Up            0 17290 12731 12374 10915 11093 9486 8691 7717
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7964  7862  8261  5425  5263  5691  4529  3972  3299  2676  2545
## NotSig      32699 32584 33418 36603 36542 37423 38927 40507 40997 43468 43320
## Up           7862  8079  6846  6497  6720  5411  5069  4046  4229  2381  2660

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/MCC.original.rda")

summa.fit.mcc <- decideTests(fit)
summary(summa.fit.mcc)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           645          0   132     0     0      0          0          0

```

```

## NotSig      22465      48525 48286 48525 48523      48525      48525
## Up          25415           0   107    0    2           0           0
##       dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down          0           0           0           0           0           0
## NotSig      48525      48525           0           0           0           0
## Up          0           0           0           0           0           0
##       MCC.original   X1     X2     X3     X4     X5     X6     X7     X8     X9     X10
## Down          0 18499 16154 14087 12105 10549 10609 6942 7052 8238 7862
## NotSig      48525 12696 19850 21845 25609 26686 28609 32789 33942 32311 32522
## Up          0 17330 12521 12593 10811 11290 9307 8794 7531 7976 8141
##       X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down     8107  5355  5173  5712  4534  3692  3136  2702  2511
## NotSig    33685 36732 36704 37205 38943 41050 41272 43663 43545
## Up        6733  6438  6648  5608  5048  3783  4117  2160  2469

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/MaximumProbability.original.rda")

summa.fit.maxProb <- decideTests(fit)
summary(summa.fit.maxProb)

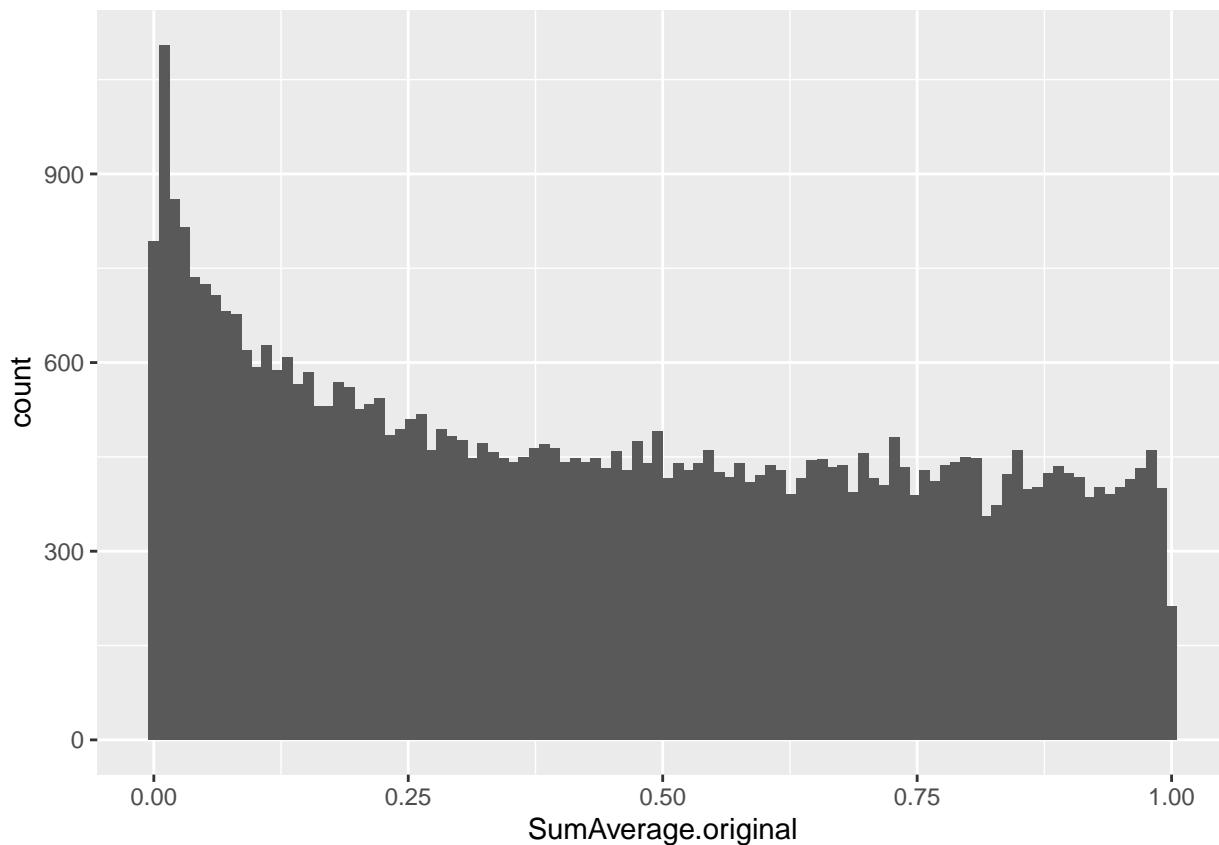
##       (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down          600           0   95    0    0           0           0
## NotSig      22656      48525 48368 48525 48524      48525      48525
## Up          25269           0   62    0    1           0           0
##       dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down          0           0           0           0           0           0
## NotSig      48525      48525           0           0           0           0
## Up          0           0           0           0           0           0
##       MaximumProbability.original   X1     X2     X3     X4     X5     X6     X7
## Down          0 18481 16250 13886 12271 10591 10688 7243
## NotSig      48525 12765 19554 22271 25361 26848 28380 32495
## Up          0 17279 12721 12368 10893 11086 9457 8787
##       X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down     7279  7970  7856  8144  5464  5268  5632  4610  4109  3118  2668  2560
## NotSig    33524 32748 32576 33657 36510 36538 37530 38803 40275 41287 43493 43314
## Up        7722  7807  8093  6724  6551  6719  5363  5112  4141  4120  2364  2651

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SumAverage.original.rda")

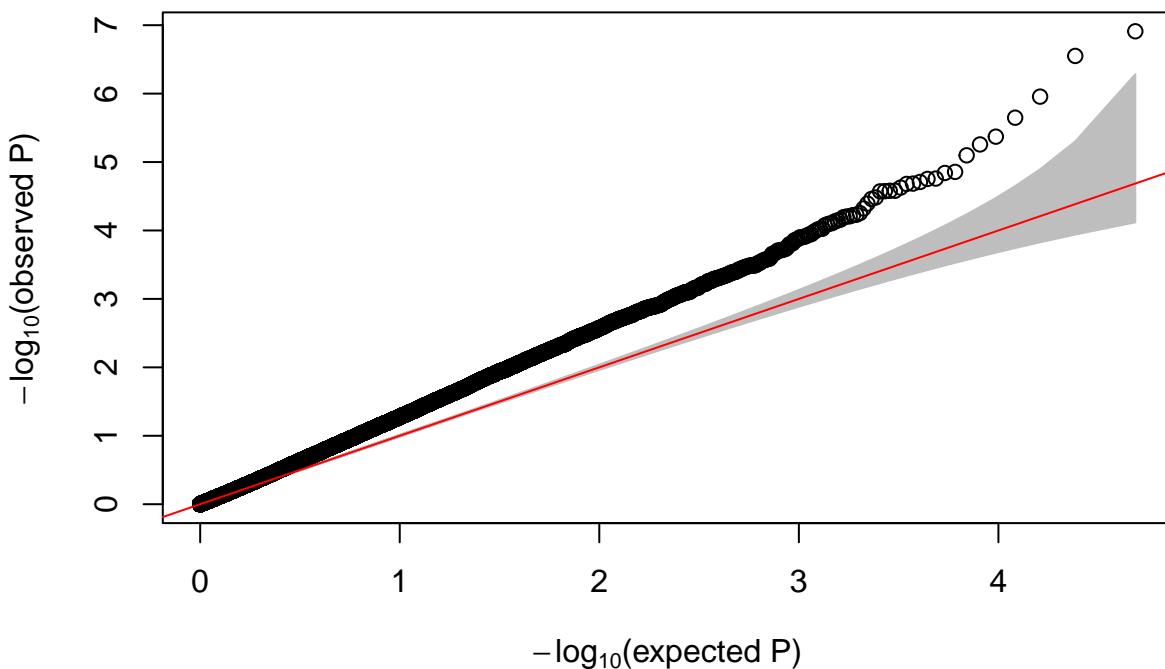
summa.fit.sumAv <- decideTests(fit)
toptable.sumAv <- topTable(fit, coef = "SumAverage.original", number = dim(counts.ok)[1])
toptable.sumAv <- toptable.sumAv[order(toptable.sumAv$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = SumAverage.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$SumAverage.original)
```



```
summary(summa.fit.sumAv)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      652      0 133 0 0 0 0
## NotSig   22384 48525 48287 48525 48523 48525 48525
## Up       25489 0 105 0 2 0 0
## dusty_exposeY history_asthmaY CoughNo chronic cough BMI Cr_wheezengY
## Down      0 0 0 0 0 0 0
## NotSig   48525 48525 48525 48525 48525 48525 48525
## Up       0 0 0 0 0 0 0
## SumAverage.original X1 X2 X3 X4 X5 X6 X7 X8
## Down      4 18442 16220 13776 12136 10395 9204 8860 7171
## NotSig   48519 12846 19867 22227 25503 26837 28794 32469 34517
## Up       2 17237 12438 12522 10886 11293 10527 7196 6837
## X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
## Down    7878 8295 6707 6483 6533 5517 4799 3766 3870 2125 2492
## NotSig  32481 32429 33893 36673 36908 37372 39297 41135 41683 43741 43570
## Up     8166 7801 7925 5369 5084 5636 4429 3624 2972 2659 2463
head(toptable.sumAv, 10)

## logFC AveExpr t P.Value adj.P.Val B
## 212329_at 0.2195191 3.0460263 5.700501 1.228358e-07 0.005960606 7.048836
## 227973_at -0.1597969 4.8121414 -5.511355 2.814911e-07 0.006829677 6.552754
## 230036_at -0.2558527 5.6260651 -5.192128 1.106285e-06 0.017894160 5.298819
## 212764_at -0.2404495 5.3623273 -5.022728 2.248735e-06 0.027279965 4.640577
## 218986_s_at -0.2717643 5.5019428 -4.867899 4.253549e-06 0.041280692 4.042695
## 212916_at 0.1069686 5.4256914 4.803493 5.527292e-06 0.044701976 3.809334
## 221687_s_at 0.2632330 1.2179241 4.712505 7.976086e-06 0.055291364 3.021021
## 239988_at -0.3715954 2.4479933 -4.572309 1.392629e-05 0.068527057 2.875294
## 230146_s_at -0.2414716 0.3778259 -4.563086 1.444150e-05 0.068527057 2.445160
## 220238_s_at -0.1720925 3.5912361 -4.515235 1.742494e-05 0.068527057 2.738133

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SumEntropy.original.rda")

summa.fit.sumEnt <- decideTests(fit)
summary(summa.fit.sumEnt)

## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      603 0 95 0 0 0 0
## NotSig   22634 48525 48361 48525 48524 48525 48525
## Up       25288 0 69 0 1 0 0
## dusty_exposeY history_asthmaY CoughNo chronic cough BMI Cr_wheezengY
## Down      0 0 0 0 0 0 0
## NotSig   48525 48525 48525 48525 48525 48525 48525
## Up       0 0 0 0 0 0 0
## SumEntropy.original X1 X2 X3 X4 X5 X6 X7 X8
## Down      0 18455 16250 13898 12344 10570 10671 7095 7270
## NotSig   48525 12775 19550 22247 25269 26877 28369 32736 33530
## Up       0 17295 12725 12380 10912 11078 9485 8694 7725
## X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
## Down    7983 7862 8252 5432 5263 5695 4528 3978 3286 2674 2542
## NotSig  32670 32582 33425 36595 36539 37418 38924 40512 41011 43478 43337
## Up     7872 8081 6848 6498 6723 5412 5073 4035 4228 2373 2646

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SumSquares.original.rda")

```

```

summa.fit.sumSq <- decideTests(fit)
summary(summa.fit.sumSq)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down       606           0    97     0     0        0            0
## NotSig    22627        48525 48362 48525 48524    48525        48525
## Up        25292           0   66     0     1        0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down       0           0            0            0            0            0
## NotSig    48525           48525        48525        48525        48525
## Up         0           0            0            0            0            0
##          SumSquares.original   X1      X2      X3      X4      X5      X6      X7      X8
## Down        0 18451 16240 13889 12290 10563 10681 7204 7283
## NotSig     48525 12792 19549 22283 25346 26860 28369 32570 33537
## Up         0 17282 12736 12353 10889 11102 9475 8751 7705
##          X9      X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down      7933  7850  8215  5430  5275  5670  4558  4020  3208  2689  2555
## NotSig   32781 32558 33523 36585 36541 37465 38848 40432 41127 43450 43315
## Up        7811  8117  6787  6510  6709  5390  5119  4073  4190  2386  2655

load("/Users/carlacasanova/Downloads/Radiomic features models (indiv)/GrayLevelNonUniformity.original.rda")

summa.fit.g1NU <- decideTests(fit)
summary(summa.fit.g1NU)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down       598           0    82     0     0        0            0
## NotSig    22663        48525 48384 48525 48524    48525        48525
## Up        25264           0   59     0     1        0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down       0           0            0            0            0            0
## NotSig    48525           48525        48525        48525        48525
## Up         0           0            0            0            0            0
##          GrayLevelNonUniformity.original   X1      X2      X3      X4      X5      X6
## Down        0 18511 16224 14022 12376 10561 10664
## NotSig     48525 12729 19691 21981 25167 26857 28431
## Up         0 17285 12610 12522 10982 11107 9430
##          X7      X8      X9      X10     X11     X12     X13     X14     X15     X16     X17     X18
## Down      7195  7270  8089  7751  8110  5477  5291  5590  4621  3976  3154  2605
## NotSig   32396 33464 32458 32916 33540 36514 36484 37539 38792 40545 41234 43602
## Up        8934  7791  7978  7858  6875  6534  6750  5396  5112  4004  4137  2318
##          X19
## Down      2596
## NotSig   43231
## Up        2698

load("/Users/carlacasanova/Downloads/Radiomic features models (indiv)/GrayLevelNonUniformityNormalized.original.rda")

summa.fit.g1NU <- decideTests(fit)
summary(summa.fit.g1NU)

```

```

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           603            0   98     0     0       0             0
## NotSig        22751        48525 48359 48525 48523     48525         48525
## Up            25171            0   68     0     2       0             0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0             0             0       0             0
## NotSig        48525            48525             48525 48525         48525
## Up            0            0             0             0       0             0
##          GrayLevelNonUniformityNormalized.original   X1      X2      X3      X4      X5
## Down           0 18505 16202 14055 12387 10462
## NotSig        48525 12723 19734 21897 25154 27032
## Up            0 17297 12589 12573 10984 11031
##          X6      X7      X8      X9      X10     X11     X12     X13     X14     X15     X16     X17
## Down 10665 6795 7288 8207 7849 8284 5529 5335 5619 4575 4094 3086
## NotSig 28427 33097 33386 32216 32757 33272 36432 36494 37195 38904 40334 41322
## Up    9433 8633 7851 8102 7919 6969 6564 6696 5711 5046 4097 4117
##          X18     X19
## Down 2661 2586
## NotSig 43501 43221
## Up    2363 2718

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/GrayLevelVariance.original.rda")

summa.fit.glVar <- decideTests(fit)
summary(summa.fit.glVar)

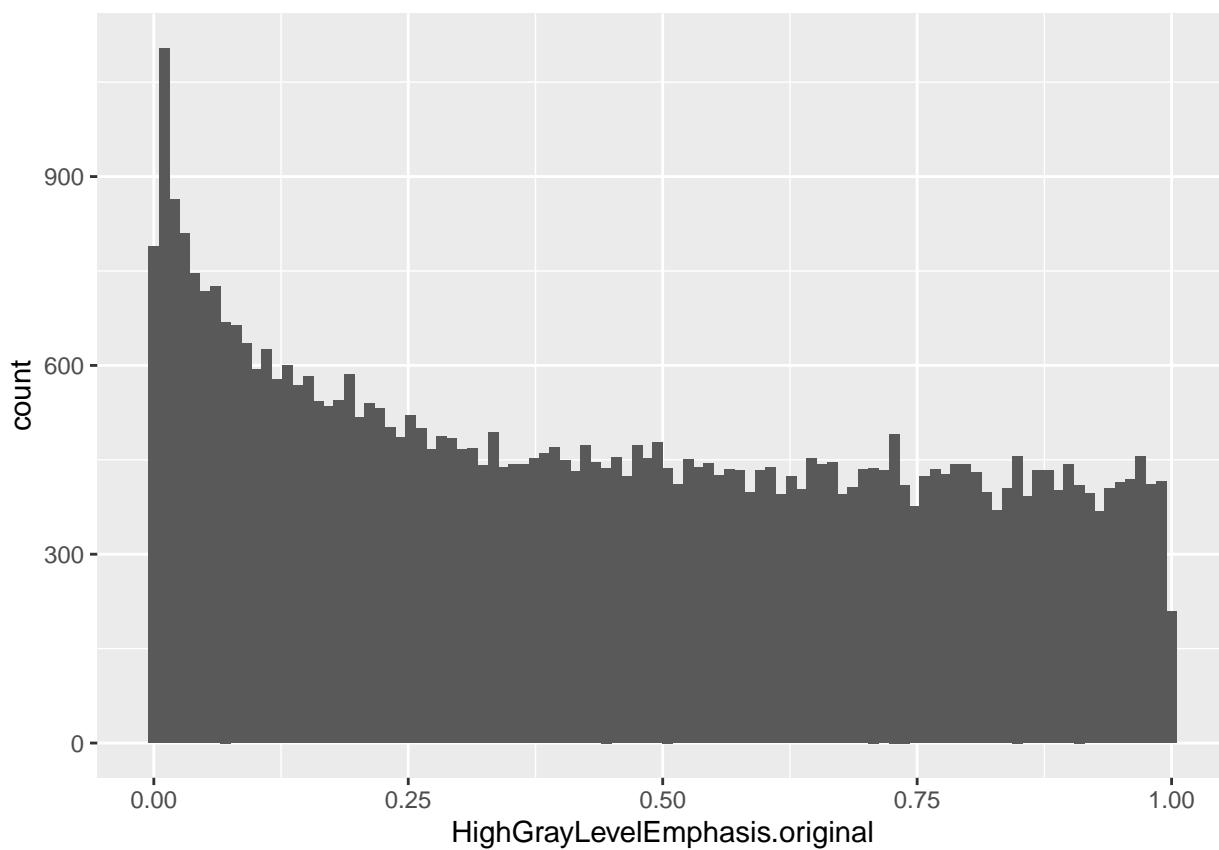
##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           603            0   98     0     0       0             0
## NotSig        22751        48525 48359 48525 48523     48525         48525
## Up            25171            0   68     0     2       0             0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0             0             0       0             0
## NotSig        48525            48525             48525 48525         48525
## Up            0            0             0             0       0             0
##          GrayLevelVariance.original   X1      X2      X3      X4      X5      X6      X7
## Down           0 18505 16202 14055 12387 10462 10665 6795
## NotSig        48525 12723 19734 21897 25154 27032 28427 33097
## Up            0 17297 12589 12573 10984 11031 9433 8633
##          X8      X9      X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down 7288 8207 7849 8284 5529 5335 5619 4575 4094 3086 2661 2586
## NotSig 33386 32216 32757 33272 36432 36494 37195 38904 40334 41322 43501 43221
## Up    7851 8102 7919 6969 6564 6696 5711 5046 4097 4117 2363 2718

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/HighGrayLevelEmphasis.original.rda")

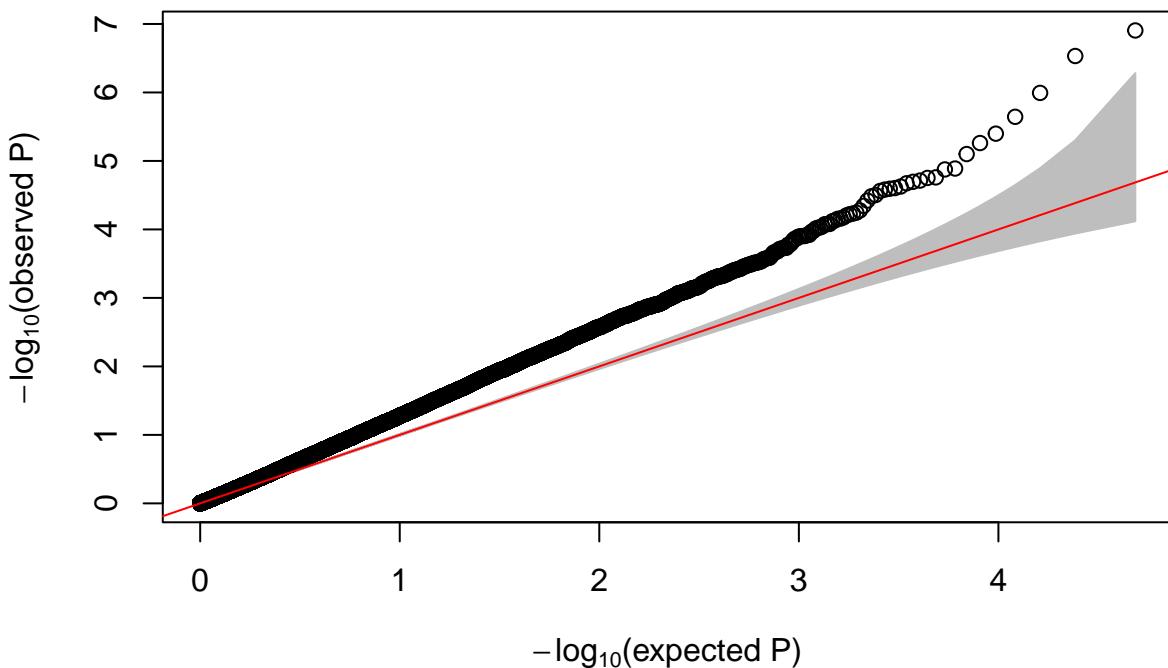
summa.fit.hglEm <- decideTests(fit)
toptable.hglEm <- topTable(fit, coef = "HighGrayLevelEmphasis.original", number =
dim(counts.ok)[1])
toptable.hglEm <- toptable.hglEm[order(toptable.hglEm$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = HighGrayLevelEmphasis.original)) + geom_histogram(bins
= 100)

```



```
# QQplot plot for p-values computed by limma  
GWASTools::qqPlot(p.val.voom$HighGrayLevelEmphasis.original)
```



```

summary(summa.fit.hg1Em)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           654          0   134      0     0       0           0
## NotSig        22384        48525 48286 48525 48523     48525       48525
## Up            25487          0   105      0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0       0           0
## NotSig        48525          48525          48525       48525       48525       48525
## Up            0             0           0           0       0       0           0
##          HighGrayLevelEmphasis.original   X1     X2     X3     X4     X5     X6     X7
## Down           4 18444 16217 13780 12132 10396 9210 8864
## NotSig        48519 12844 19869 22210 25503 26832 28789 32481
## Up            2 17237 12439 12535 10890 11297 10526 7180
##          X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7172 7879 8292 6709 6491 6531 5520 4800 3768 3865 2127 2490
## NotSig      34515 32460 32440 33894 36661 36913 37365 39294 41127 41695 43732 43575
## Up          6838 8186 7793 7922 5373 5081 5640 4431 3630 2965 2666 2460

head(toptable.hg1Em, 10)

##          logFC    AveExpr      t    P.Value adj.P.Val      B
## 212329_at  0.2196732 3.0460263 5.697704 1.243631e-07 0.006034721 7.040103
## 227973_at -0.1595674 4.8121414 -5.501652 2.936198e-07 0.007123949 6.514425
## 230036_at -0.2571485 5.6260651 -5.212540 1.014825e-06 0.016414800 5.379352
## 212764_at -0.2406094 5.3623273 -5.020708 2.267672e-06 0.027509696 4.632637
## 218986_s_at -0.2728846 5.5019428 -4.883333 3.993645e-06 0.038758321 4.101052
## 212916_at  0.1071366 5.4256914  4.805750 5.476957e-06 0.044294886 3.817662
## 221687_s_at  0.2637242 1.2179241  4.713958 7.929777e-06 0.054970347 3.027325
## 239988_at -0.3733070 2.4479933 -4.591606 1.290532e-05 0.070061359 2.943295
## 230146_s_at -0.2424403 0.3778259 -4.583726 1.331315e-05 0.070061359 2.514680
## 203238_s_at -0.3927748 2.0908241 -4.515877 1.738117e-05 0.070061359 2.648608

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/LongRunEmphasis.original.rda")

summa.fit.lrEm <- decideTests(fit)
summary(summa.fit.lrEm)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           581          0   92      0     0       0           0
## NotSig        22790        48525 48369 48525 48523     48525       48525
## Up            25154          0   64      0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0       0           0
## NotSig        48525          48525          48525       48525       48525       48525
## Up            0             0           0           0       0       0           0
##          LongRunEmphasis.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18517 16207 14031 12419 10458 10671 6821 7314
## NotSig        48525 12703 19714 21925 25097 27068 28419 33115 33396
## Up            0 17305 12604 12569 11009 10999 9435 8589 7815
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         8196 7824 8265 5534 5334 5637 4634 4168 3022 2653 2693
## NotSig      32281 32864 33270 36421 36502 37191 38770 40203 41475 43538 43280

```

```

## Up      8048  7837  6990  6570  6689  5697  5121  4154  4028  2334  2552
load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/LongRunHighGrayLevelEmphasis.original.rda")

summa.fit.lrHem <- decideTests(fit)
summary(summa.fit.lrHem)

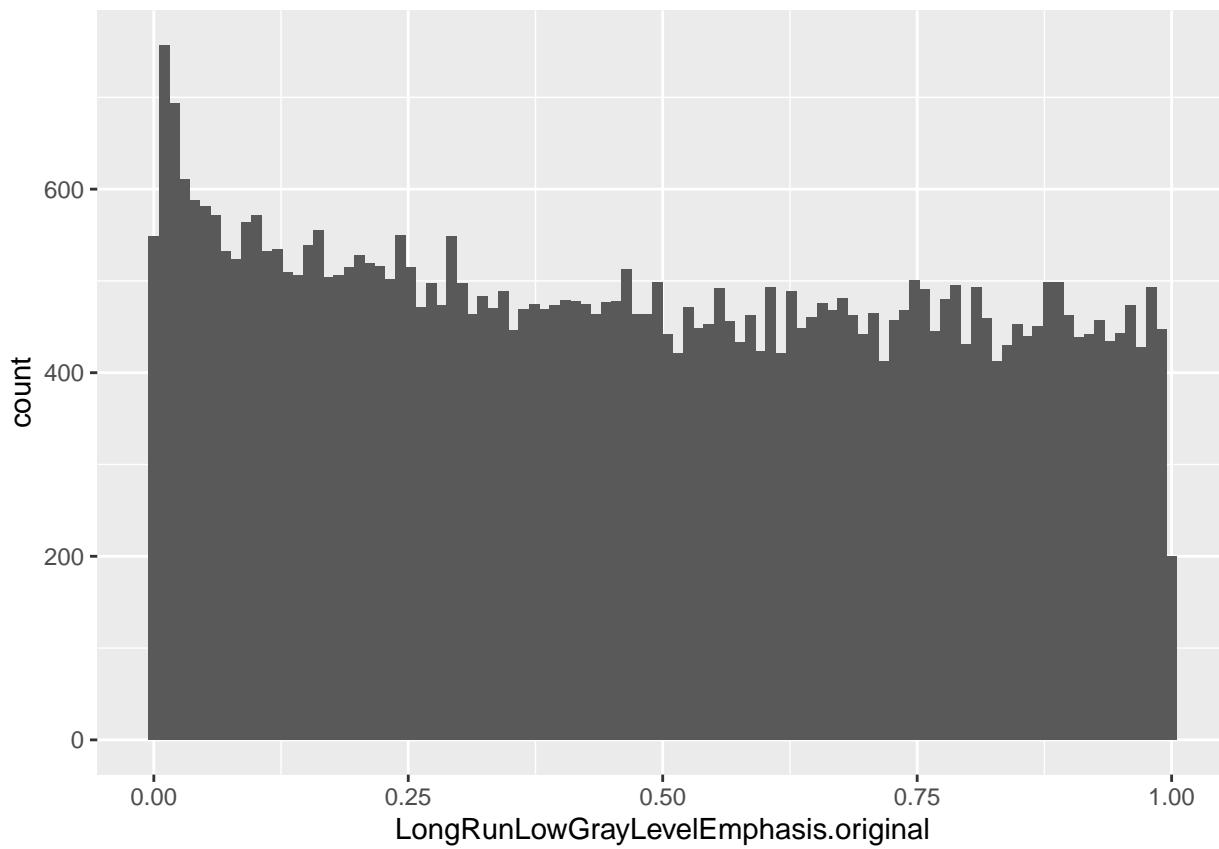
##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down            592           0    89     0     0       0           0
## NotSig         22768        48525 48381 48525 48523    48525        48525
## Up             25165           0    55     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0           0           0           0       0           0
## NotSig         48525        48525           48525 48525 48525        48525
## Up              0           0           0           0       0           0
##          LongRunHighGrayLevelEmphasis.original   X1     X2     X3     X4     X5
## Down            0 18563 16146 14048 12379 10535
## NotSig         48525 12693 19824 21925 25187 26897
## Up              0 17269 12555 12552 10959 11093
##          X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down          10734  6943  7269  8163  7874  8222  5524  5355  5622  4605  4306  2847
## NotSig        28304 33004 33440 32366 32631 33395 36477 36426 37299 38809 39942 41747
## Up            9487  8578  7816  7996  8020  6908  6524  6744  5604  5111  4277  3931
##          X18     X19
## Down          2568  2550
## NotSig        43671 43268
## Up            2286  2707

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/LongRunLowGrayLevelEmphasis.original.rda")

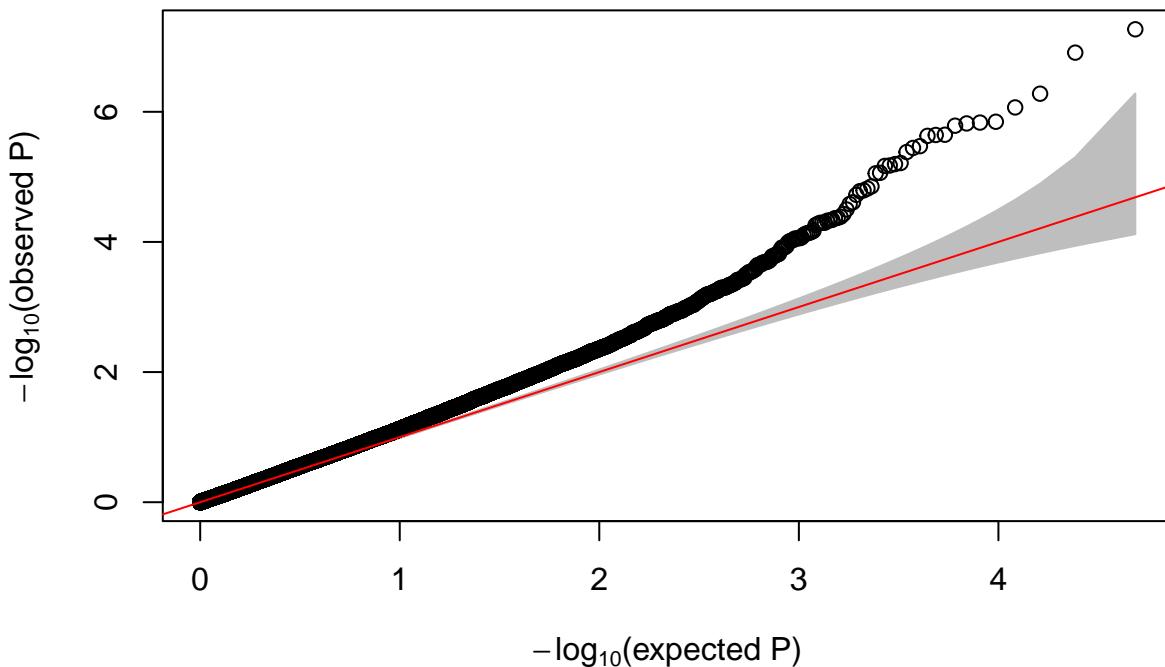
summa.fit.lrLem <- decideTests(fit)
toptable.lrLEM <- topTable(fit, coef = "LongRunLowGrayLevelEmphasis.original", number =
dim(counts.ok)[1])
toptable.lrLEM <- toptable.lrLEM[order(toptable.lrLEM$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LongRunLowGrayLevelEmphasis.original)) +
geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LongRunLowGrayLevelEmphasis.original)
```



```
summary(summa.fit.lrLem)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      568      0   100      0      0      0      0
## NotSig   22783  48525 48361 48525 48521  48525  48525
## Up       25174      0    64      0     4      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525 48525 48525  48525
## Up       0      0      0      0      0      0      0
##      LongRunLowGrayLevelEmphasis.original   X1     X2     X3     X4     X5     X6
## Down      2 18390 16115 13941 12445 10167 10533
## NotSig   48498 12762 19893 22047 25114 27314 28677
## Up       25 17373 12517 12537 10966 11044  9315
##      X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down   6799 7247 8236 7789 7962 5539 5335 5658 4621 4103 2892 2638
## NotSig 33070 33610 32104 32866 33768 36473 36518 37105 38742 40143 41775 43510
## Up     8656 7668 8185 7870 6795 6513 6672 5762 5162 4279 3858 2377
##      X19
## Down   1962
## NotSig 44676
## Up     1887
head(toptable.lrLEM, 10)

```

```

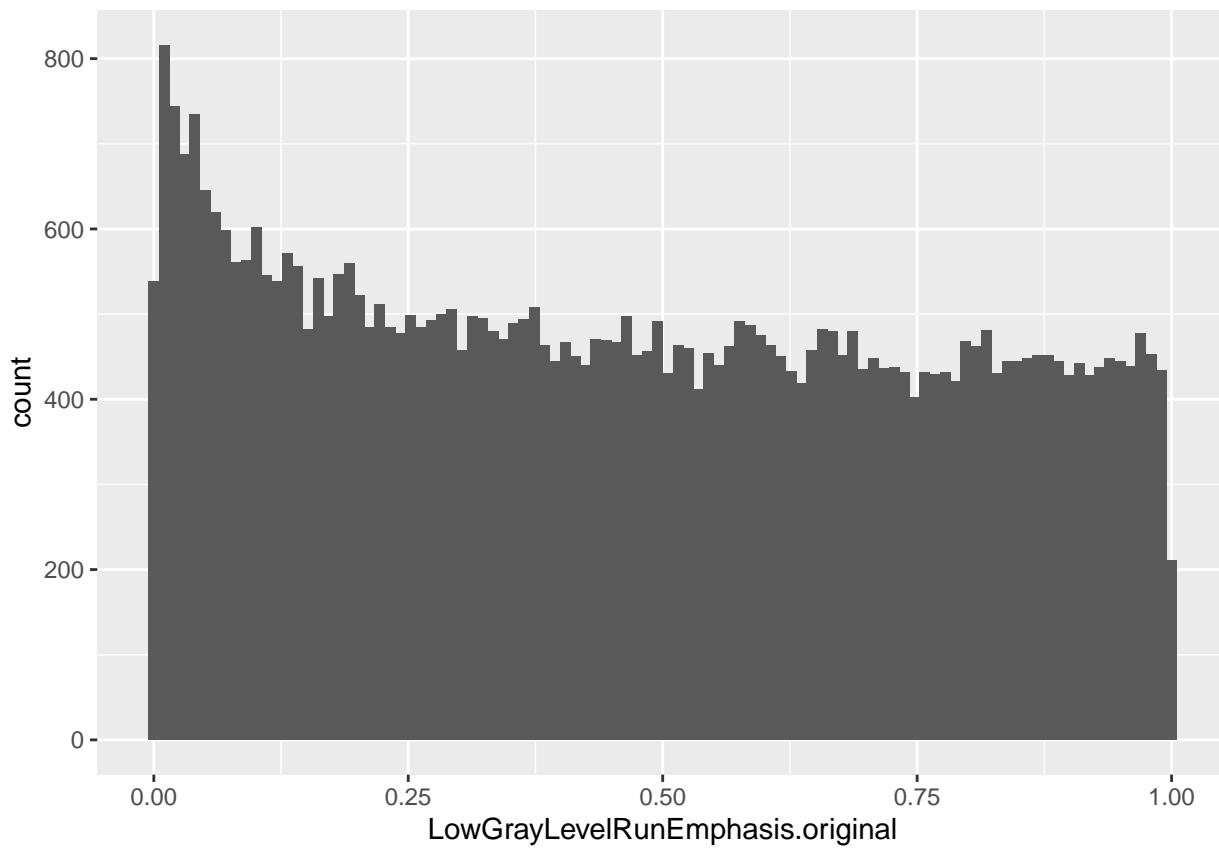
##          logFC AveExpr      t     P.Value adj.P.Val      B
## 221816_s_at 0.12774320 6.663139 5.885750 5.396119e-08 0.002618467 8.119250
## 203610_s_at 0.11783840 5.433915 5.700220 1.231877e-07 0.002988842 7.355332
## 208436_s_at 0.16661079 5.092808 5.366532 5.270703e-07 0.008525361 5.992282
## 203567_s_at 0.10588114 5.983397 5.252799 8.566394e-07 0.009918120 5.521922
## 202145_at   0.29135696 3.641079 5.132813 1.421808e-06 0.009918120 5.025263
## 221622_s_at 0.07202188 6.095018 5.125906 1.463620e-06 0.009918120 5.021955
## 214059_at   0.43303799 3.679703 5.118620 1.509025e-06 0.009918120 4.985502
## 228617_at   0.27153207 5.754949 5.099453 1.635136e-06 0.009918120 4.906834
## 204747_at   0.30693328 5.588170 5.022798 2.250488e-06 0.010336031 4.615017
## 212203_x_at 0.09147248 8.127608 5.020738 2.269808e-06 0.010336031 4.379757

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/LowGrayLevelRunEmphasis.original.rda")

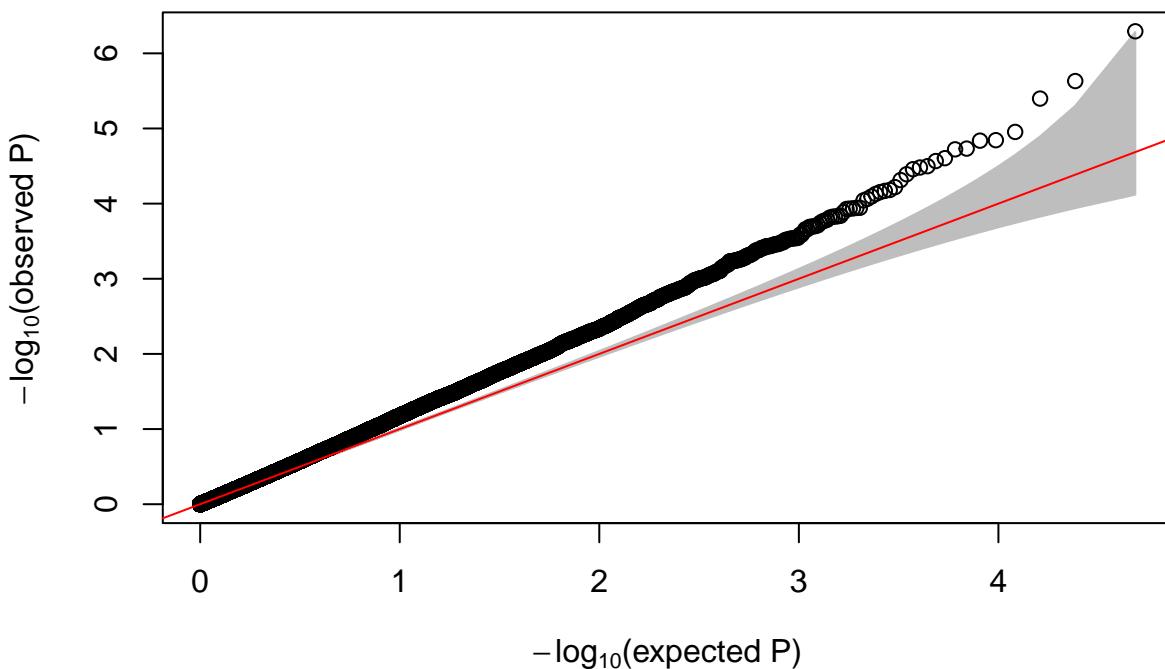
summa.fit.lowGLRem <- decideTests(fit)
toptable.lowGLRem <- topTable(fit, coef = "LowGrayLevelRunEmphasis.original", number =
dim(counts.ok)[1])
toptable.lowGLRem <- toptable.lowGLRem[order(toptable.lowGLRem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LowGrayLevelRunEmphasis.original)) +
geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LowGrayLevelRunEmphasis.original)
```



```
summary(summa.fit.lowGLRem)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      617      0   115      0      0      0      0
## NotSig   22650    48525 48320 48525 48523    48525    48525
## Up       25258      0   90      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##      LowGrayLevelRunEmphasis.original   X1     X2     X3     X4     X5     X6
## Down      0 18492 16048 14100 12264 10448 10566
## NotSig   48524 12709 20084 21850 25403 26787 28695
## Up       1 17324 12393 12575 10858 11290 9264
##      X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down   6759 7088 8231 7875 8035 5359 5188 5670 4507 3752 3050 2731
## NotSig 33150 33979 32335 32389 33822 36827 36626 37193 38966 40870 41364 43596
## Up     8616 7458 7959 8261 6668 6339 6711 5662 5052 3903 4111 2198
##      X19
## Down   2259
## NotSig 44086
## Up     2180

```

```
head(toptable.lowGLRem, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 239988_at	0.29153851	2.4479933	5.374462	5.090753e-07	0.02470288	5.838132
## 230036_at	0.17733877	5.6260651	5.013367	2.339017e-06	0.05675041	4.586602
## 241514_at	-0.40961125	-0.7748055	-4.883115	3.999111e-06	0.06468562	2.382877
## 218986_s_at	0.18204571	5.5019428	4.629470	1.111286e-05	0.11497359	3.132002
## 226130_at	-0.15498912	4.2551221	-4.565501	1.431036e-05	0.11497359	2.938669
## 238453_at	-0.23061480	1.0245559	-4.561747	1.452339e-05	0.11497359	2.583608
## 228077_at	-0.14854086	3.5670907	-4.499613	1.852879e-05	0.11497359	2.691687
## 233127_at	-0.31237659	1.0540609	-4.493787	1.895494e-05	0.11497359	2.331430
## 1563051_at	-0.16786385	3.5601254	-4.424154	2.484116e-05	0.13010649	2.419399
## 212579_at	0.09259941	6.9622936	4.401279	2.713437e-05	0.13010649	2.161734

```
load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/RunEntropy.original.rda")
```

```
summa.fit.runEnt <- decideTests(fit)
summary(summa.fit.runEnt)
```

	(Intercept)	GroupSevere	SexM	Age	Dwalk	FEV1PSPC	fume_exposeY			
## Down	603	0	85	0	0	0	0			
## NotSig	22674	48525	48380	48525	48524	48525	48525			
## Up	25248	0	60	0	1	0	0			
## dusty_exposeY history_asthmaY CoughNo chronic cough BMI Cr_wheezengY										
## Down	0	0	0	0	0	0	0			
## NotSig	48525	48525	48525	48525	48525	48525	48525			
## Up	0	0	0	0	0	0	0			
## RunEntropy.original X1 X2 X3 X4 X5 X6 X7 X8										
## Down	0	18513	16216	14024	12400	10519	10650	6764 7257		
## NotSig	48525	12704	19669	21959	25158	26997	28432	33165 33497		
## Up	0	17308	12640	12542	10967	11009	9443	8596 7771		
## X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19										
## Down	8157	7842	8292	5448	5351	5648	4547	4021	3229	2625 2589
## NotSig	32342	32781	33231	36568	36424	37295	38928	40434	41108	43566 43224

```

## Up      8026 7902 7002 6509 6750 5582 5050 4070 4188 2334 2712
load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/RunLengthNonUniformity.original.rda")

summa.fit.rlNU <- decideTests(fit)
summary(summa.fit.rlNU)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down            597           0    76     0     0       0           0
## NotSig         22681        48525 48393 48525 48524     48525       48525
## Up             25247           0    56     0     1       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0           0           0           0       0           0
## NotSig         48525        48525           48525 48525 48525       48525
## Up              0           0           0           0       0           0
##          RunLengthNonUniformity.original   X1     X2     X3     X4     X5     X6
## Down            0 18527 16212 14023 12387 10574 10679
## NotSig         48525 12707 19703 21983 25148 26820 28405
## Up              0 17291 12610 12519 10990 11131 9441
##          X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down          7178 7286 8111 7753 8163 5466 5320 5580 4639 4000 3144 2625
## NotSig        32431 33447 32429 32889 33470 36529 36457 37521 38759 40506 41248 43570
## Up            8916 7792 7985 7883 6892 6530 6748 5424 5127 4019 4133 2330
##          X19
## Down          2618
## NotSig        43188
## Up            2719

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/RunLengthNonUniformityNormalized.original.rda")

summa.fit.rlNU <- decideTests(fit)
summary(summa.fit.rlNU)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down            609           0    80     0     0       0           0
## NotSig         22646        48525 48384 48525 48524     48525       48525
## Up             25270           0    61     0     1       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0           0           0           0       0           0
## NotSig         48525        48525           48525 48525 48525       48525
## Up              0           0           0           0       0           0
##          RunLengthNonUniformityNormalized.original   X1     X2     X3     X4     X5
## Down            0 18510 16205 14021 12406 10509
## NotSig         48525 12706 19685 21953 25151 27011
## Up              0 17309 12635 12551 10968 11005
##          X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down          10670 6789 7258 8166 7845 8325 5406 5339 5661 4556 3952 3289
## NotSig        28415 33085 33490 32327 32763 33205 36639 36453 37301 38902 40526 41026
## Up            9440 8651 7777 8032 7917 6995 6480 6733 5563 5067 4047 4210
##          X18     X19
## Down          2652 2589
## NotSig        43517 43233
## Up            2356 2703

```

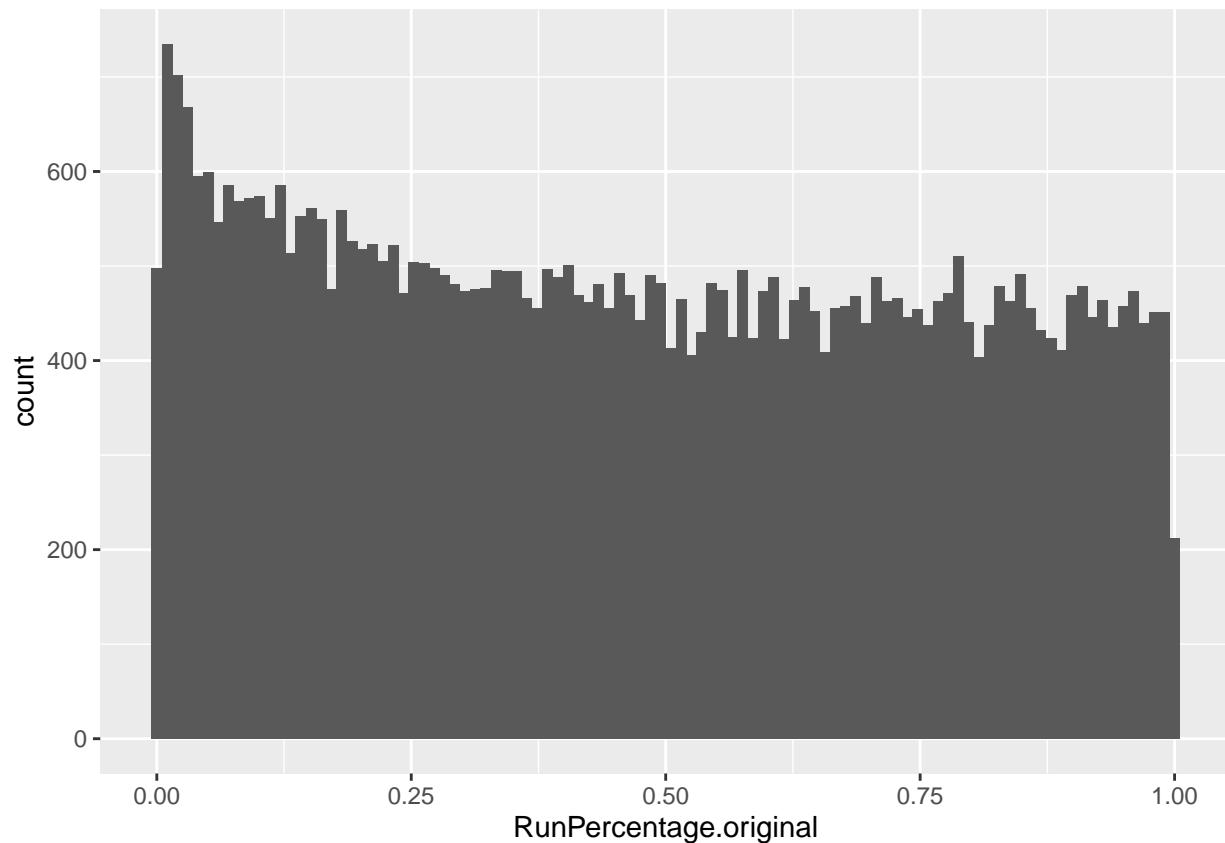
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/RunPercentage.original.rda")

summa.fit.rPer <- decideTests(fit)
toptable.rPer <- topTable(fit, coef = "RunPercentage.original", number =
dim(counts.ok)[1])
toptable.rPer <- toptable.rPer[order(toptable.rPer$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = RunPercentage.original)) + geom_histogram(bins = 100)

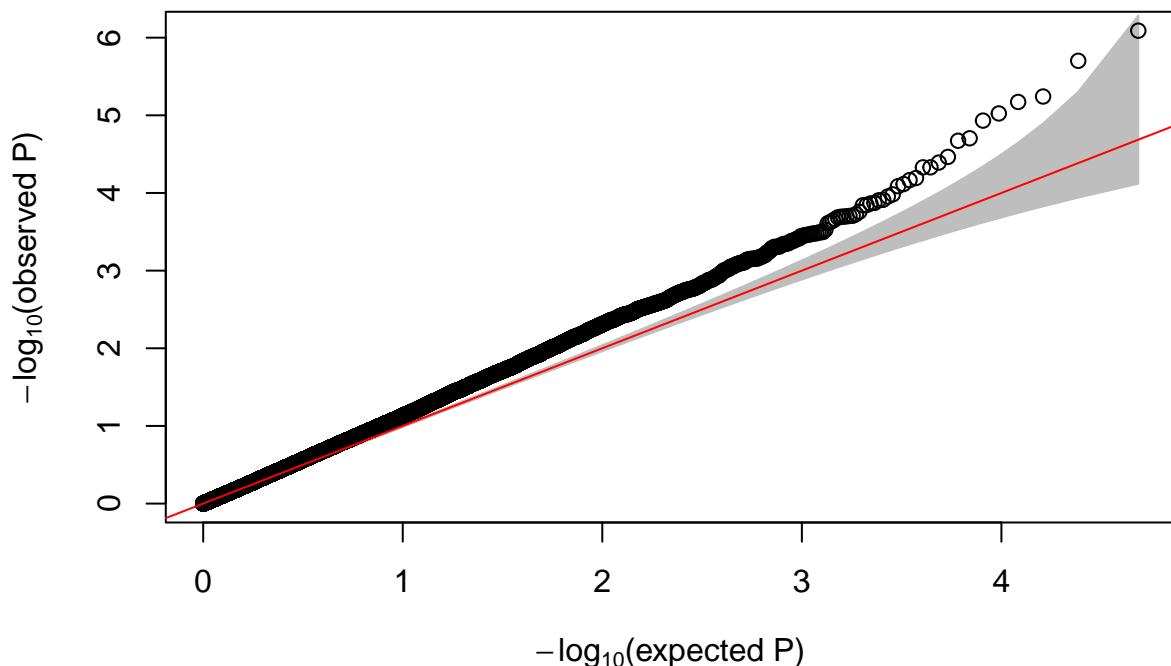
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$RunPercentage.original)

```



```
summary(summa.fit.rPer)
```

```
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down       603         0    89   0    0      0        0
## NotSig    22623     48525 48369 48525 48524    48525    48525
## Up        25299         0   67   0    1      0        0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down       0           0            0        0      0        0        0
## NotSig    48525     48525           0    48525 48525    48525
## Up         0           0            0        0      0        0        0
##          RunPercentage.original X1   X2   X3   X4   X5   X6   X7   X8
## Down           1 18465 16258 13930 12364 10610 10673 7118 7269
## NotSig        48523 12775 19495 22226 25217 26768 28360 32699 33562
## Up            1 17285 12772 12369 10944 11147 9492 8708 7694
##          X9   X10  X11  X12  X13  X14  X15  X16  X17  X18  X19
## Down      7936 7846 8248 5398 5294 5708 4529 4009 3254 2653 2545
## NotSig  32745 32624 33434 36685 36501 37397 38919 40442 41078 43509 43308
## Up        7844 8055 6843 6442 6730 5420 5077 4074 4193 2363 2672
```

```
head(toptable.rPer, 10)
```

```
##          logFC     AveExpr      t     P.Value adj.P.Val      B
## 203893_at -0.10110173 5.0379308 -5.265039 8.130249e-07 0.03945204 5.564559
## 1554830_a_at 0.19610034 2.6289573 5.052871 1.985626e-06 0.04817625 4.497213
## 1555229_a_at 0.40029739 0.6820437 4.794857 5.728299e-06 0.08165790 3.084803
## 1562121_at  0.17767386 0.1193435 4.754906 6.731202e-06 0.08165790 2.598570
## 216922_x_at  0.20640961 -0.3358964 4.669918 9.463463e-06 0.09184291 2.040448
## 201645_at   0.26581933 1.8007395 4.616600 1.169779e-05 0.09460586 2.854891
## 219675_s_at  0.09199390 5.0965517 4.483312 1.974977e-05 0.12892525 2.645362
## 224785_at   -0.15500844 3.6686028 -4.464435 2.125506e-05 0.12892525 2.531718
## 217279_x_at  0.21105056 0.8980683 4.340107 3.432266e-05 0.18505633 1.716275
## 218315_s_at -0.09311102 3.2742864 -4.295988 4.060615e-05 0.18918227 1.946197
```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/RunVariance.original.rda")

summa.fit.rVar <- decideTests(fit)
summary(summa.fit.rVar)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           597          0    90     0     0      0          0
## NotSig        22719        48525 48376 48525 48523    48525        48525
## Up            25209          0    59     0     2      0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0           0           0
## NotSig        48525          48525          48525        48525        48525
## Up            0             0           0           0           0           0
##          RunVariance.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18539 16216 14027 12415 10484 10707 6676 7274
## NotSig        48525 12690 19670 21926 25112 27043 28369 33399 33494
## Up            0 17296 12639 12572 10998 10998 9449 8450 7757
##          X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         8181 7831 8254 5557 5347 5621 4607 4136 3075 2654 2579
## NotSig      32310 32816 33289 36392 36450 37284 38804 40255 41342 43528 43246
## Up           8034 7878 6982 6576 6728 5620 5114 4134 4108 2343 2700

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ShortRunEmphasis.original.rda")

summa.fit.shREM <- decideTests(fit)
summary(summa.fit.shREM)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           596          0    85     0     0      0          0
## NotSig        22721        48525 48381 48525 48523    48525        48525
## Up            25208          0    59     0     2      0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0           0           0
## NotSig        48525          48525          48525        48525        48525
## Up            0             0           0           0           0           0
##          ShortRunEmphasis.original X1     X2     X3     X4     X5     X6     X7
## Down           0 18516 16182 14030 12391 10490 10656 6849
## NotSig        48525 12693 19766 21927 25175 27015 28431 33012
## Up            0 17316 12577 12568 10959 11020 9438 8664
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down         7284 8158 7848 8263 5486 5341 5612 4581 4098 3089 2630 2590
## NotSig      33433 32319 32799 33296 36526 36456 37247 38874 40320 41350 43551 43223
## Up           7808 8048 7878 6966 6513 6728 5666 5070 4107 4086 2344 2712

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ShortRunHighGrayLevelEmphasis.original.rda")

summa.fit.shRH <- decideTests(fit)
summary(summa.fit.shRH)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           591          0    87     0     0      0          0

```

```

## NotSig      22637      48525 48372 48525 48525      48525      48525
## Up         25297          0    66    0    0          0          0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig      48525      48525          0          0          0          0
## Up          0          0          0          0          0          0
##       ShortRunHighGrayLevelEmphasis.original   X1     X2     X3     X4     X5
## Down          0    18496 16153 13832 12408 10440
## NotSig      48525 12686 19739 22339 25198 27145
## Up          0    17343 12633 12354 10919 10940
##       X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down    10586 6958 7214 7853 7914 8531 5505 5323 5719 4500 3838 3364
## NotSig    28571 32905 33576 32965 32571 33046 36489 36482 37175 39083 40792 40933
## Up       9368 8662 7735 7707 8040 6948 6531 6720 5631 4942 3895 4228
##       X18    X19
## Down    2608 2442
## NotSig  43611 43412
## Up       2306 2671

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/ShortRunLowGrayLevelEmphasis.original.rda")

summa.fit.shRL <- decideTests(fit)
summary(summa.fit.shRL)

##       (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down        591          0 100    0    0        0        0
## NotSig     22684      48525 48357 48525 48523      48525      48525
## Up         25250          0  68    0    2        0        0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0
## NotSig      48525      48525          0          0          0          0
## Up          0          0          0          0          0          0
##       ShortRunLowGrayLevelEmphasis.original   X1     X2     X3     X4     X5
## Down          0    18556 16189 13836 12316 10583
## NotSig      48525 12642 19815 22190 25333 26815
## Up          0    17327 12521 12499 10876 11127
##       X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down    10804 6875 7267 8210 7924 8342 5316 5399 5757 4821 4036 3208
## NotSig  28118 32899 33562 32224 32623 33093 36808 36355 37049 38412 40352 41077
## Up       9603 8751 7696 8091 7978 7090 6401 6771 5719 5292 4137 4240
##       X18    X19    X20
## Down    2791 2801 2281
## NotSig  43258 43075 43977
## Up       2476 2649 2267

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/HighGrayLevelZoneEmphasis.original.rda")

summa.fit.hglZEM <- decideTests(fit)
summary(summa.fit.hglZEM)

##       (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down        608          0 142    0    0        0        0
## NotSig     22700      48525 48256 48525 48523      48525      48525

```

```

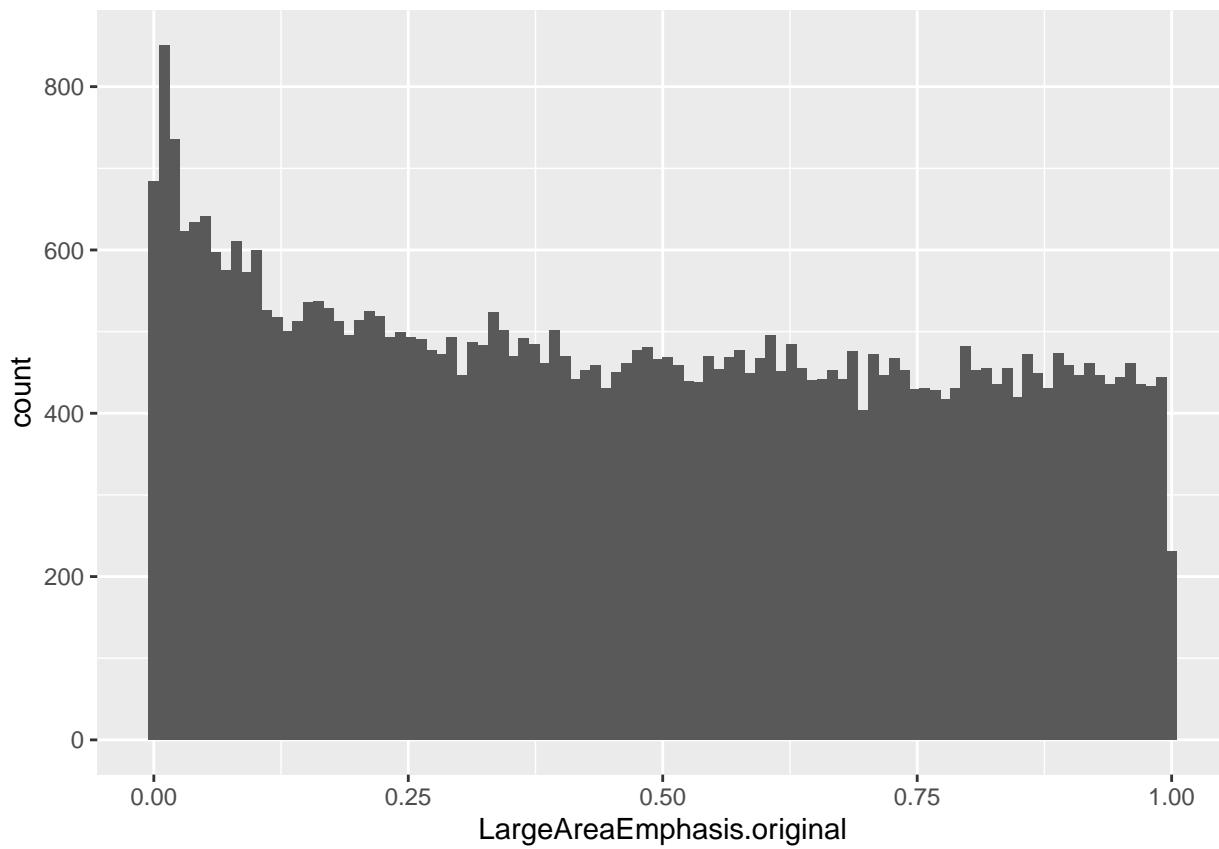
## Up          25217      0   127      0     2      0      0
##       dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0     0     0      0
## NotSig        48525      48525      48525 48525      48525
## Up           0          0          0     0     0      0
##       HighGrayLevelZoneEmphasis.original   X1     X2     X3     X4     X5     X6
## Down          0 18644 16012 13595 11473 9819 9163
## NotSig        48525 12577 20315 22542 24151 27897 29036
## Up           0 17304 12198 12388 12901 10809 10326
##       X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down     8992 6977 7396 8761 6706 6444 6406 5835 4957 4120 3683 3125
## NotSig  32503 34494 33387 31601 33500 36563 36704 37124 39149 40211 41896 43069
## Up        7030 7054 7742 8163 8319 5518 5415 5566 4419 4194 2946 2331
##       X19    X20
## Down     2079 2845
## NotSig  43741 43198
## Up        2705 2482

load("/Users/carlacasanova.suarez/Desktop/Radiomic features models
(indiv)/LargeAreaEmphasis.original.rda")

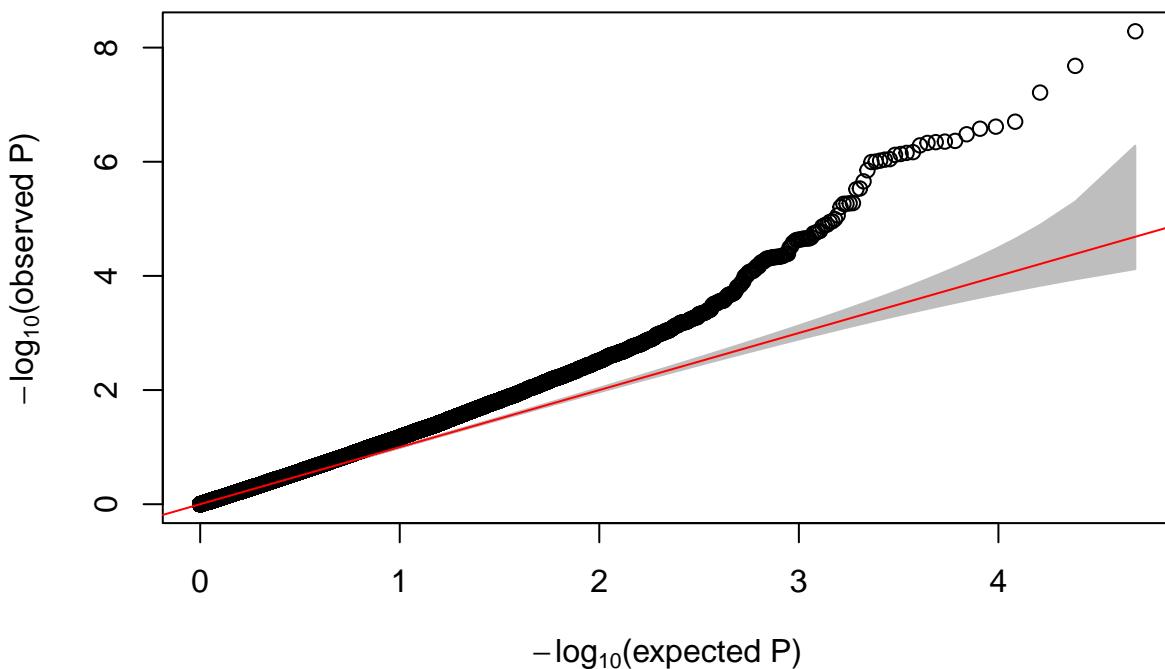
summa.fit.larAEm <- decideTests(fit)
toptable.larAEm <- topTable(fit, coef = "LargeAreaEmphasis.original", number =
dim(counts.ok)[1])
toptable.larAEm <- toptable.larAEm[order(toptable.larAEm$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LargeAreaEmphasis.original)) + geom_histogram(bins =
100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LargeAreaEmphasis.original)
```



```
summary(summa.fit.larAEm)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      590      0   110      0     1      0      0
## NotSig   22743  48525 48325 48525 48519  48525  48525
## Up       25192      0    90      0     5      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525 48525 48525  48525
## Up       0      0      0      0      0      0      0
##      LargeAreaEmphasis.original X1     X2     X3     X4     X5     X6     X7
## Down      8 18446 16006 14101 12365 10183  9282  8518
## NotSig   48438 12711 20082 21886 25190 27176 28732 33378
## Up       79 17368 12437 12538 10970 11166 10511 6629
##      X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7523 7977 8279 6584 6497 6640 5644 5029 3962 4215 2287 1933
## NotSig 33787 32366 32322 34228 36455 36604 37307 38998 40816 41076 43571 44454
## Up     7215 8182 7924 7713 5573 5281 5574 4498 3747 3234 2667 2138
head(toptable.larAEm, 10)

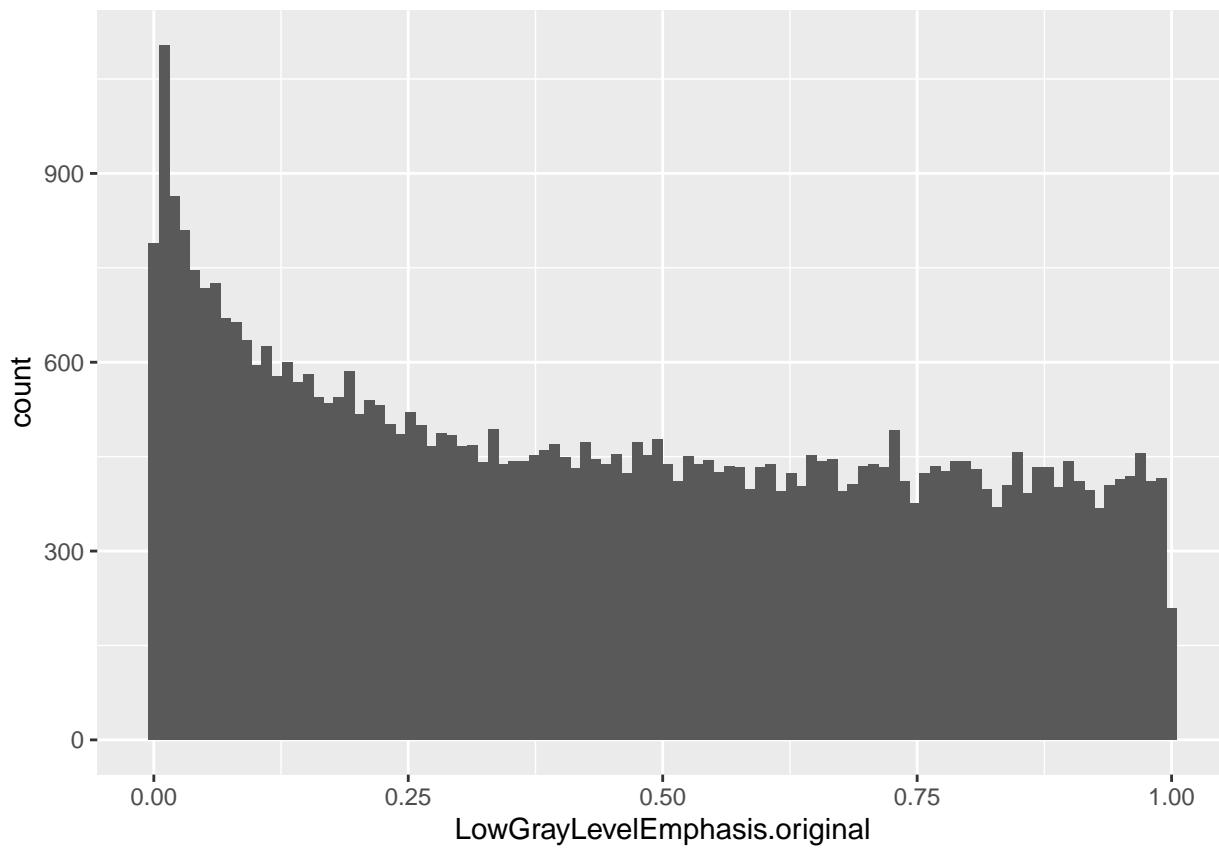
##          logFC AveExpr      t    P.Value    adj.P.Val      B
## 230036_at  0.20563742 5.626065 6.399638 5.178948e-09 0.0002513085 10.358990
## 222986_s_at 0.05655418 7.893641 6.095749 2.090387e-08 0.0005071800 8.847290
## 239988_at  0.28344604 2.447993 5.856891 6.137996e-08 0.0009928209 7.910719
## 204747_at  0.27452096 5.588170 5.591531 1.986236e-07 0.0020620811 6.850120
## 228617_at  0.24109252 5.754949 5.545631 2.427412e-07 0.0020620811 6.645829
## 218986_s_at 0.19645239 5.501943 5.526582 2.637527e-07 0.0020620811 6.608164
## 206133_at  0.23002381 5.082622 5.475041 3.299511e-07 0.0020620811 6.404180
## 203568_s_at 0.11150882 4.180112 5.413383 4.307413e-07 0.0020620811 6.181011
## 221816_s_at 0.10094490 6.663139 5.406529 4.436560e-07 0.0020620811 6.034845
## 214059_at  0.37567108 3.679703 5.401473 4.534260e-07 0.0020620811 6.132976

load("/Users/carlacasanovasuzarez/Desktop/Radiomic features models
(indiv)/LowGrayLevelEmphasis.original.rda")

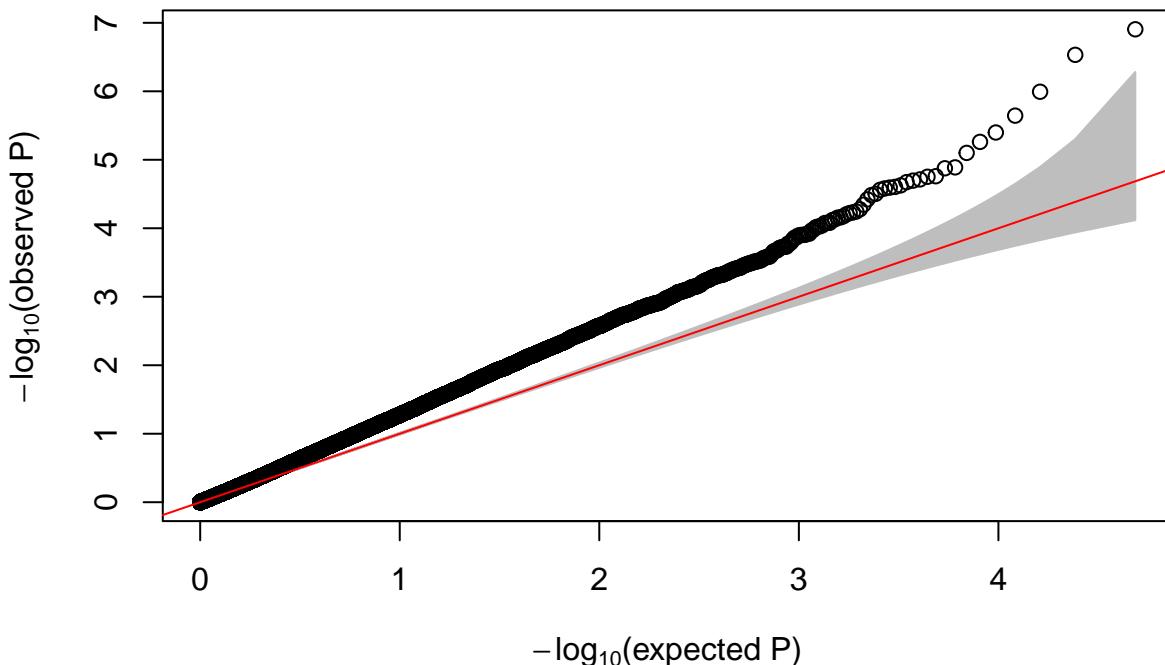
summa.fit.lowGLem <- decideTests(fit)
toptable.lowGLem <- topTable(fit, coef = "LowGrayLevelEmphasis.original", number =
dim(counts.ok)[1])
toptable.lowGLem <- toptable.lowGLem[order(toptable.lowGLem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LowGrayLevelEmphasis.original)) + geom_histogram(bins =
100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LowGrayLevelEmphasis.original)
```



```
summary(summa.fit.lowGLem)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      654      0   134      0      0      0      0
## NotSig  22384  48525 48286 48525 48523  48525 48525
## Up       25487      0   105      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig  48525      48525      48525 48525 48525 48525
## Up       0      0      0      0      0      0      0
##      LowGrayLevelEmphasis.original X1     X2     X3     X4     X5     X6     X7
## Down      2 18444 16217 13780 12132 10396 9210 8864
## NotSig  48519 12844 19869 22210 25503 26832 28789 32481
## Up       4 17237 12439 12535 10890 11297 10526 7180
##      X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7172 7879 8292 6709 6491 6531 5520 4800 3768 3865 2127 2490
## NotSig 34515 32460 32440 33894 36661 36913 37365 39294 41127 41695 43732 43575
## Up     6838 8186 7793 7922 5373 5081 5640 4431 3630 2965 2666 2460
head(toptable.lowGLem, 10)

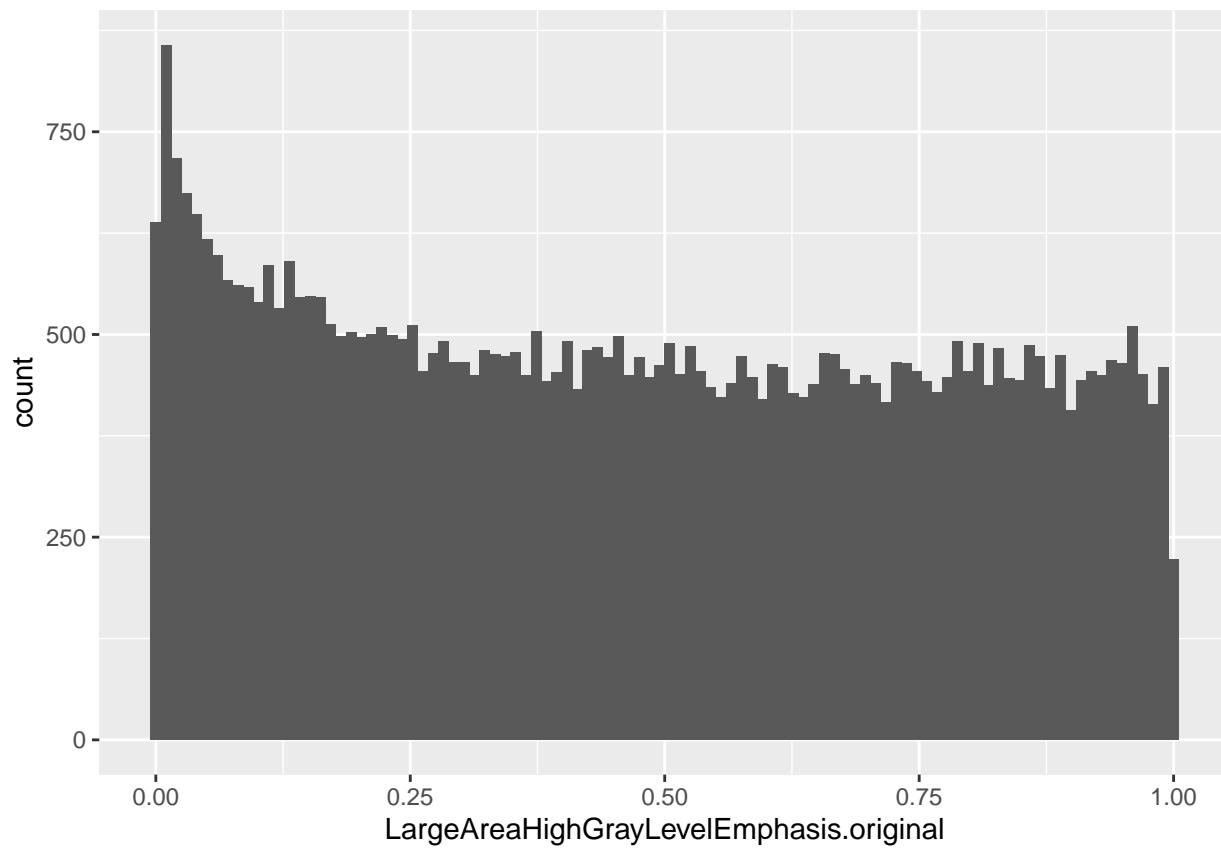
##          logFC    AveExpr        t    P.Value   adj.P.Val       B
## 212329_at -0.2196732 3.0460263 -5.697704 1.243631e-07 0.006034721 7.040103
## 227973_at  0.1595674 4.8121414  5.501652 2.936197e-07 0.007123948 6.514425
## 230036_at  0.2571485 5.6260651  5.212541 1.014825e-06 0.016414796 5.379352
## 212764_at  0.2406094 5.3623273  5.020708 2.267672e-06 0.027509698 4.632637
## 218986_s_at 0.2728846 5.5019428  4.883333 3.993644e-06 0.038758314 4.101052
## 212916_at -0.1071366 5.4256914 -4.805750 5.476957e-06 0.044294886 3.817662
## 221687_s_at -0.2637242 1.2179241 -4.713958 7.929778e-06 0.054970353 3.027325
## 239988_at  0.3733070 2.4479933  4.591606 1.290531e-05 0.070061351 2.943295
## 230146_s_at 0.2424403 0.3778259  4.583726 1.331315e-05 0.070061351 2.514679
## 203238_s_at 0.3927748 2.0908241  4.515877 1.738118e-05 0.070061351 2.648608

load("/Users/carlacasanovasuzarez/Desktop/Radiomic features models
(indiv)/LargeAreaHighGrayLevelEmphasis.original.rda")

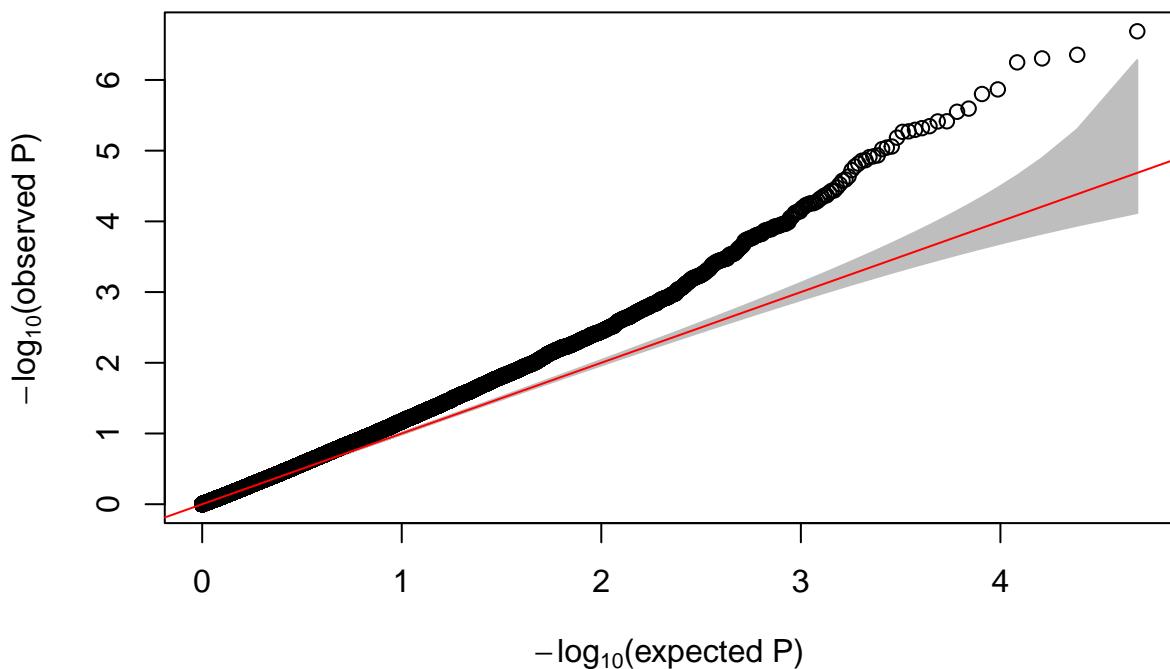
summa.fit.larAHigh <- decideTests(fit)
toptable.larAHigh <- topTable(fit, coef = "LargeAreaHighGrayLevelEmphasis.original",
  number = dim(counts.ok)[1])
toptable.larAHigh <- toptable.larAHigh[order(toptable.larAHigh$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LargeAreaHighGrayLevelEmphasis.original)) +
  geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LargeAreaHighGrayLevelEmphasis.original)
```



```
summary(summa.fit.larAHig)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      585      0   116      0      0      0      0
## NotSig   22900    48525 48297 48525 48523    48525    48525
## Up       25040      0   112      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##      LargeAreaHighGrayLevelEmphasis.original   X1     X2     X3     X4     X5
## Down          4 18385 16108 14044 12308 10219
## NotSig        48494 12787 19892 21911 25242 27280
## Up        27 17353 12525 12570 10975 11026
##      X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down    9342  8617  7556  7960  8253  6650  6423  6527  5593  5090  3600  4625
## NotSig  28651 33140 33623 32373 32414 34112 36668 36678 37388 38814 41539 40124
## Up      10532 6768  7346  8192  7858  7763  5434  5320  5544  4621  3386  3776
##      X18    X19
## Down    2342  2129
## NotSig 43503 44105
## Up      2680  2291

head(toptable.larAHigh, 10)

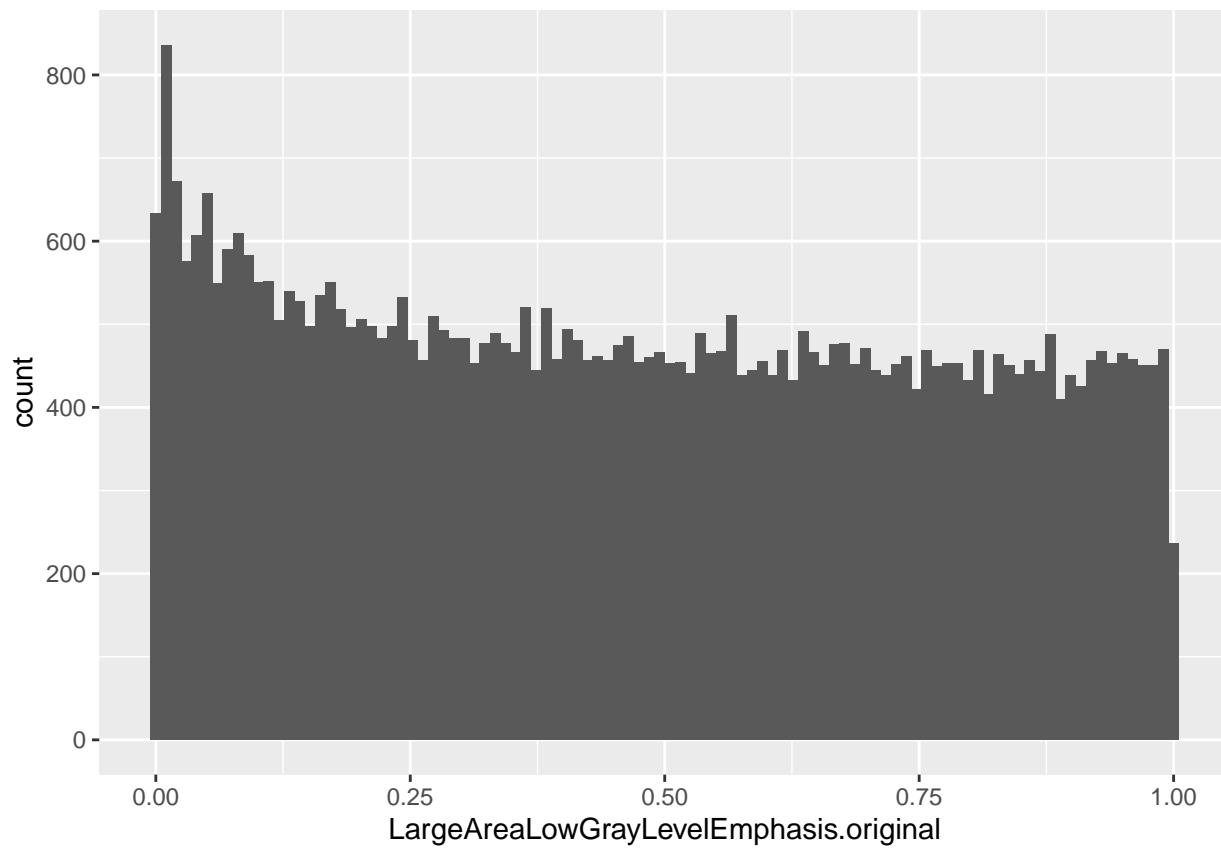
##              logFC    AveExpr         t    P.Value   adj.P.Val      B
## 230036_at    0.20920585 5.6260651  5.584157 2.051083e-07 0.006841793 6.874963
## 1563431_x_at -0.08343605 7.6428042 -5.408125 4.405553e-07 0.006841793 6.041527
## 222816_s_at    0.18314213 4.6986392  5.380549 4.960758e-07 0.006841793 6.044920
## 229354_at     0.54715261 0.6668949  5.350664 5.639809e-07 0.006841793 5.540182
## 239887_at     0.41407150 0.1790370  5.143335 1.359882e-06 0.012788765 4.617850
## 228617_at     0.27290624 5.7549490  5.107373 1.581300e-06 0.012788765 4.930849
## 236156_at     0.36210130 3.3538067  4.993351 2.541791e-06 0.017080917 4.510562
## 206133_at     0.25297810 5.0826216  4.968556 2.816019e-06 0.017080917 4.422292
## 214059_at     0.42034549 3.6797030  4.892809 3.844441e-06 0.017516030 4.136214
## 242057_at     0.36945631 1.9120105  4.891825 3.859954e-06 0.017516030 3.978593

load("/Users/carlacasanovasanchez/Desktop/Radiomic features models
(indiv)/LargeAreaLowGrayLevelEmphasis.original.rda")

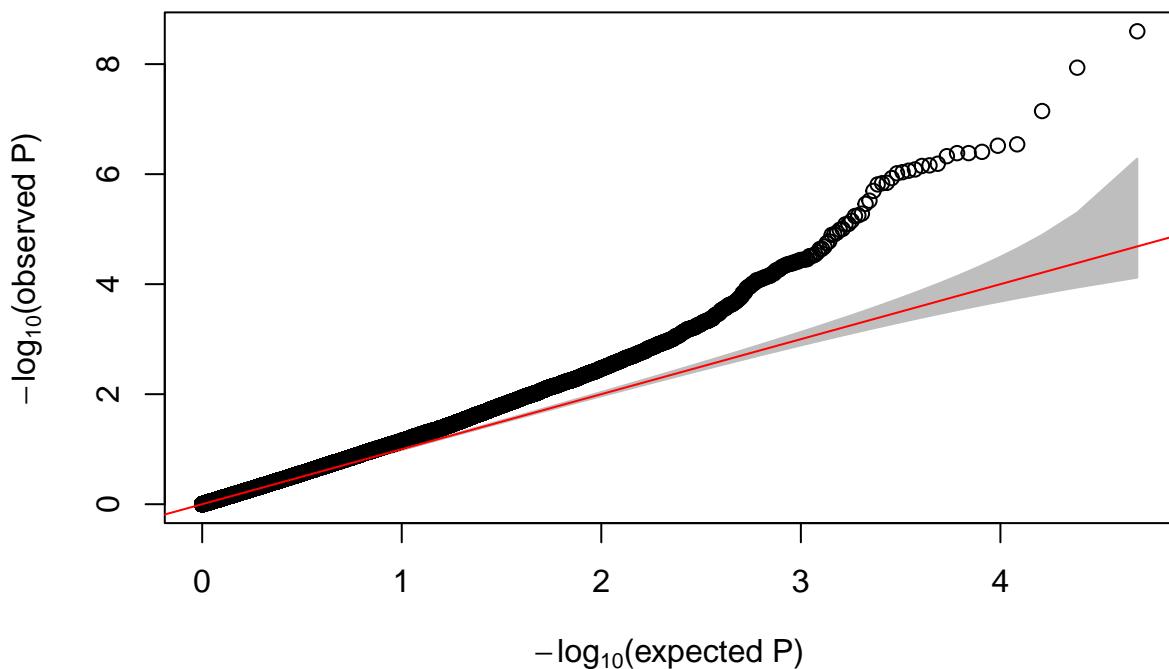
summa.fit.larALow <- decideTests(fit)
toptable.larALow <- topTable(fit, coef = "LargeAreaLowGrayLevelEmphasis.original",
  number = dim(counts.ok)[1])
toptable.larALow <- toptable.larALow[order(toptable.larALow$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LargeAreaLowGrayLevelEmphasis.original)) +
  geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LargeAreaLowGrayLevelEmphasis.original)
```



```
summary(summa.fit.larALow)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      585      0 106  0   1      0      0
## NotSig   22765    48525 48338 48525 48520    48525    48525
## Up       25175      0  81  0   4      0      0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525    48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##          LargeAreaLowGrayLevelEmphasis.original   X1   X2   X3   X4   X5
## Down      4 18466 16019 14080 12388 10166
## NotSig   48451 12698 20063 21902 25155 27205
## Up       70 17361 12443 12543 10982 11154
##          X6   X7   X8   X9   X10  X11  X12  X13  X14  X15  X16  X17
## Down   10546 6649 7208 8206 7886 7779 5599 5257 5613 4529 3912 2957
## NotSig 28695 33407 33735 32316 32420 34182 36433 36550 37241 38919 40514 41590
## Up     9284 8469 7582 8003 8219 6564 6493 6718 5671 5077 4099 3978
##          X18  X19
## Down   2679 2090
## NotSig 43570 44537
## Up     2276 1898

head(toptable.larALow)

##          logFC AveExpr      t     P.Value adj.P.Val      B
## 222986_s_at 0.05851532 7.893641 6.553491 2.531362e-09 0.0001228344 10.913376
## 230036_at   0.19976717 5.626065 6.224828 1.159703e-08 0.0002813728 9.590333
## 239988_at   0.27602778 2.447993 5.823270 7.133678e-08 0.0011538725 7.760237
## 208436_s_at 0.13612935 5.092808 5.507022 2.872284e-07 0.0025188102 6.548899
## 204747_at   0.26873749 5.588170 5.493822 3.041811e-07 0.0025188102 6.451316
## 218986_s_at 0.19093654 5.501943 5.434486 3.933100e-07 0.0025188102 6.234535

load("/Users/carlacasanovasuzarez/Desktop/Radiomic features models
(indiv)/LowGrayLevelZoneEmphasis.original.rda")

summa.fit.lowGLZem <- decideTests(fit)
summary(summa.fit.lowGLZem)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      608      0 142  0   0      0      0
## NotSig   22700    48525 48256 48525 48523    48525    48525
## Up       25217      0 127  0   2      0      0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525    48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##          LowGrayLevelZoneEmphasis.original   X1   X2   X3   X4   X5   X6
## Down      0 18644 16012 13595 11473 9819 9163
## NotSig   48525 12577 20315 22542 24151 27897 29036
## Up       0 17304 12198 12388 12901 10809 10326
##          X7   X8   X9   X10  X11  X12  X13  X14  X15  X16  X17  X18
## Down   8992 6977 7396 8761 6706 6444 6406 5835 4957 4120 3683 3125
## NotSig 32503 34494 33387 31601 33500 36563 36704 37124 39149 40211 41896 43069
## Up     7030 7054 7742 8163 8319 5518 5415 5566 4419 4194 2946 2331
##          X19  X20
## Down   2079 2845
## NotSig 43741 43198

```

```

## Up      2705  2482

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SizeZoneNonUniformity.original.rda")

summa.fit.sizZNU <- decideTests(fit)
summary(summa.fit.sizZNU)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           580          0     87     0     0       0           0
## NotSig        22880        48525  48377  48525  48523     48525        48525
## Up            25065          0     61     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0           0
## NotSig        48525         48525           48525        48525        48525
## Up            0             0           0           0       0           0
##          SizeZoneNonUniformity.original   X1     X2     X3     X4     X5     X6     X7
## Down           0 18526 16146 13766 12029 10493 10492 7187
## NotSig        48525 12724 19881 22350 25789 26918 28775 32451
## Up            0 17275 12498 12409 10707 11114 9258 8887
##          X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down        7333  8086  7822  8121  5570  5081  5620  4631  4255  2945  2642  2585
## NotSig      33380 32501 32736 33533 36303 37054 37278 38783 40011 41590 43526 43228
## Up          7812  7938  7967  6871  6652  6390  5627  5111  4259  3990  2357  2712

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SizeZoneNonUniformityNormalized.original.rda")

summa.fit.sizZNU <- decideTests(fit)
summary(summa.fit.sizZNU)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           592          0     112     0     0       0           0
## NotSig        22659        48525  48335  48525  48523     48525        48525
## Up            25274          0     78     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0           0
## NotSig        48525         48525           48525        48525        48525
## Up            0             0           0           0       0           0
##          SizeZoneNonUniformityNormalized.original   X1     X2     X3     X4     X5
## Down           0 18421 16241 14068 12344 10436
## NotSig        48525 12781 19701 21868 25181 26973
## Up            0 17323 12583 12589 11000 11116
##          X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down        10685  6995  7327  8181  7874  8155  5558  5318  5627  4533  4249  2900
## NotSig      28448 32710 33317 32307 32635 33504 36359 36539 37180 38935 40013 41752
## Up          9392  8820  7881  8037  8016  6866  6608  6668  5718  5057  4263  3873
##          X18    X19
## Down        2607  2659
## NotSig     43578 43361
## Up          2340  2505

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SmallAreaEmphasis.original.rda")

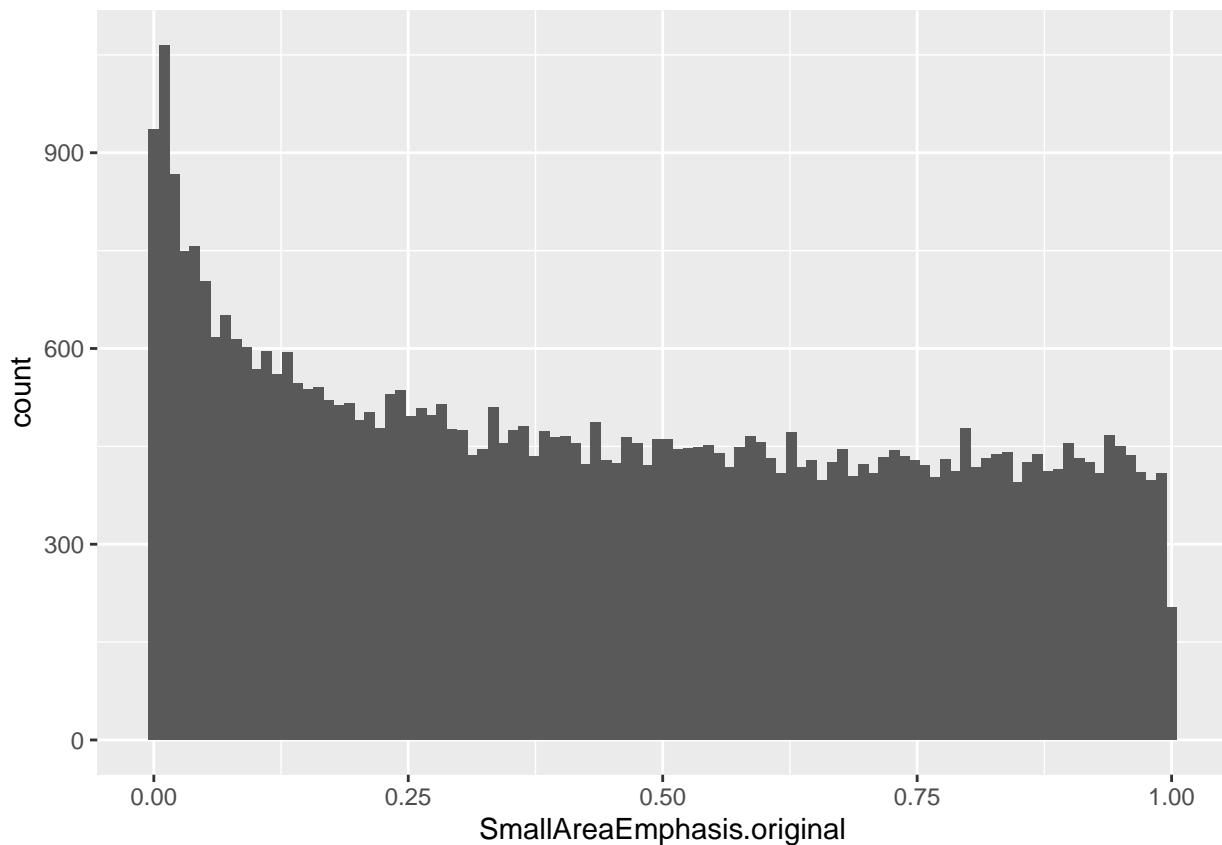
```

```

summa.fit.smAem <- decideTests(fit)
toptable.smAem <- topTable(fit, coef = "SmallAreaEmphasis.original", number =
dim(counts.ok)[1])
toptable.smAem <- toptable.smAem[order(toptable.smAem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = SmallAreaEmphasis.original)) + geom_histogram(bins =
100)

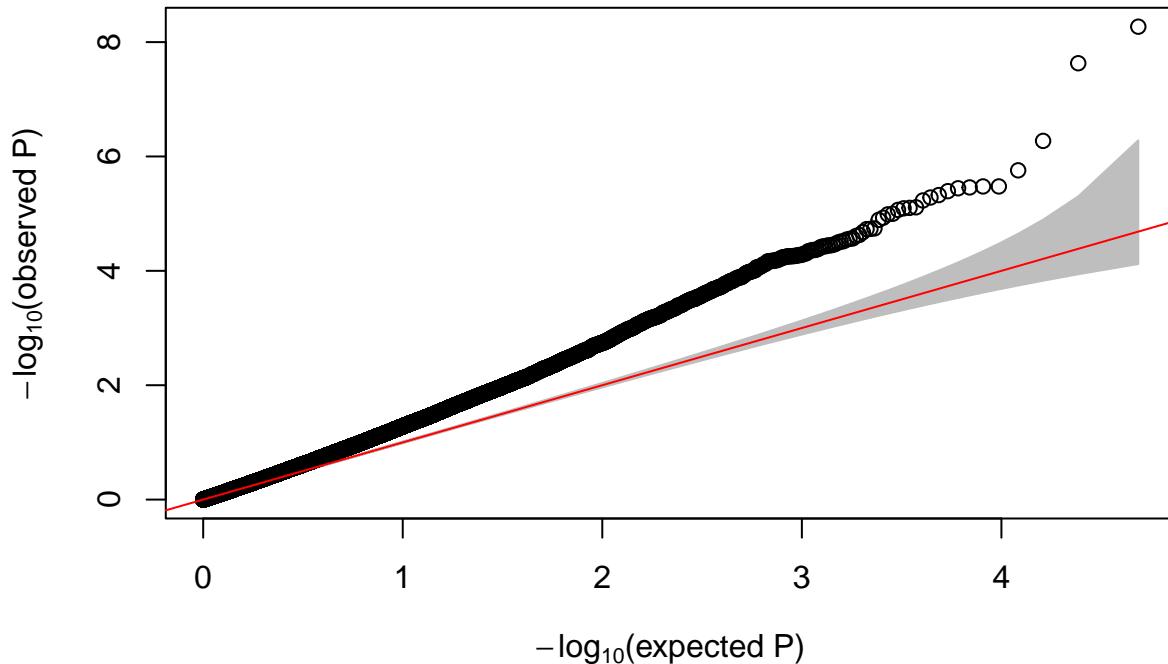
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$SmallAreaEmphasis.original)

```



```
summary(summa.fit.smAem)
```

```
##             (Intercept) GroupSevere   SexM     Age Dwalk FEV1PSPC fume_exposeY
## Down           587          0    130      0     1        0            0
## NotSig        22819        48525  48268  48525  48519        48525        48525
## Up            25119          0   127      0     5        0            0
##             dusty_exposeY history_asthmaY CoughNo chronic cough     BMI Cr_wheezengY
## Down           0            0            0            0        0        0            0
## NotSig        48525        48525        48525        48525        48525        48525
## Up             0            0            0            0        0        0            0
##             SmallAreaEmphasis.original X1      X2      X3      X4      X5      X6      X7
## Down           46   18604  15859  14156  12467  10314  9073  8490
## NotSig        48449  12570  20467  21813  25014  26859  29144  33356
## Up             30   17351  12199  12556  11044  11352  10308  6679
##             X8      X9      X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down         7437  7862  8549  6503  6432  6665  5790  4931  3740  4020  2344  1878
## NotSig       33910 32589 31958 34338 36525 36634 37195 39056 41241 41466 43325 44553
## Up           7178  8074  8018  7684  5568  5226  5540  4538  3544  3039  2856  2094
```

```
head(toptable.smAem, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 230036_at	-0.23389097	5.626065	-6.391864	5.374149e-09	0.0002607806	10.327115
## 239988_at	-0.33778162	2.447993	-6.071003	2.341064e-08	0.0005680006	8.675677
## 218986_s_at	-0.21989277	5.501943	-5.363555	5.340094e-07	0.0086376012	5.964775
## 222986_s_at	-0.05427099	7.893641	-5.083631	1.747382e-06	0.0211979237	4.603441
## 1555764_s_at	-0.17061490	4.881008	-4.927222	3.340242e-06	0.0217824165	4.266649
## 218408_at	-0.18505000	4.198970	-4.927101	3.341900e-06	0.0217824165	4.275307
## 230363_s_at	-0.16087086	1.889961	-4.917311	3.478964e-06	0.0217824165	4.123673
## 204747_at	-0.29617099	5.588170	-4.909052	3.598831e-06	0.0217824165	4.153794
## 208087_s_at	-0.30002166	2.591420	-4.880801	4.040015e-06	0.0217824165	4.059002
## 226603_at	-0.18394563	6.059371	-4.842147	4.729805e-06	0.0229513790	3.868261

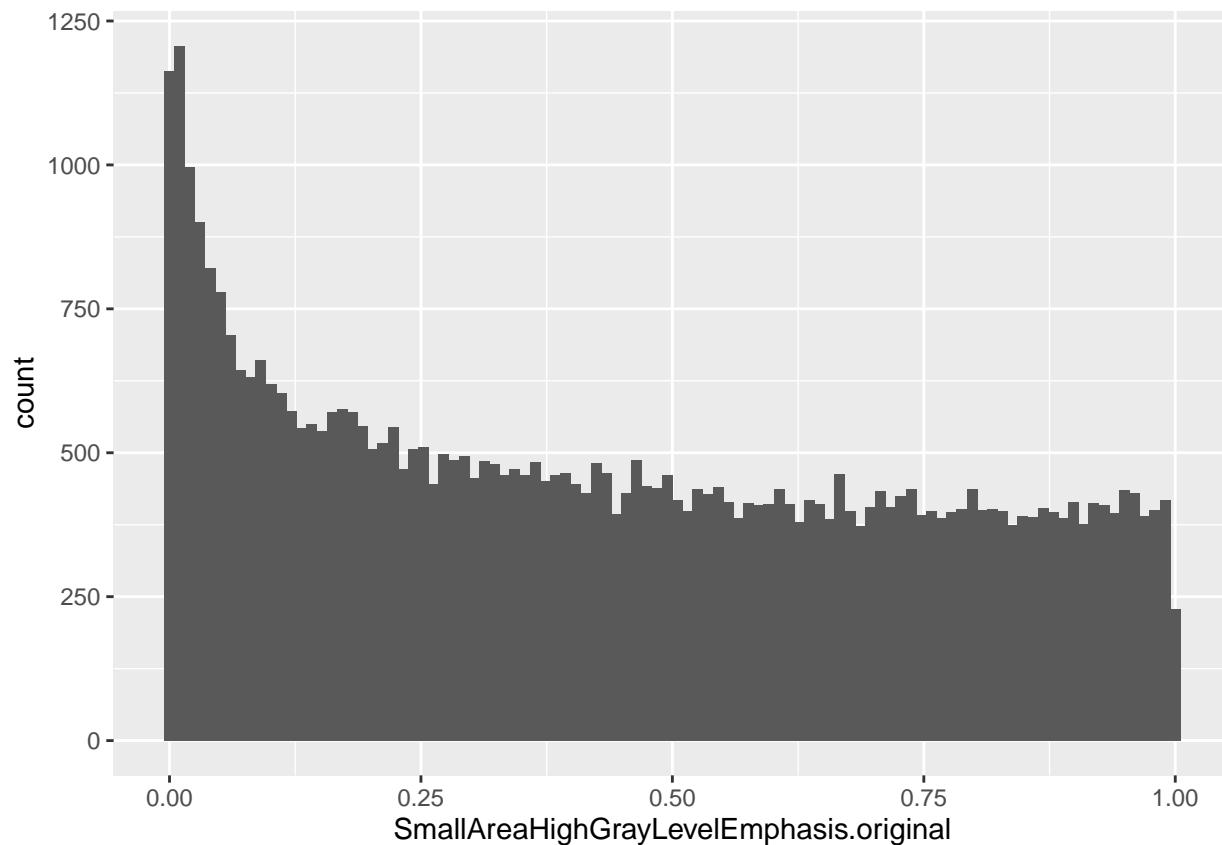
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SmallAreaHighGrayLevelEmphasis.original.rda")

summa.fit.smAHem <- decideTests(fit)
toptable.smAHem <- topTable(fit, coef = "SmallAreaHighGrayLevelEmphasis.original",
  number = dim(counts.ok)[1])
toptable.smAHem <- toptable.idmn0[order(toptable.smAHem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = SmallAreaHighGrayLevelEmphasis.original)) +
  geom_histogram(bins = 100)

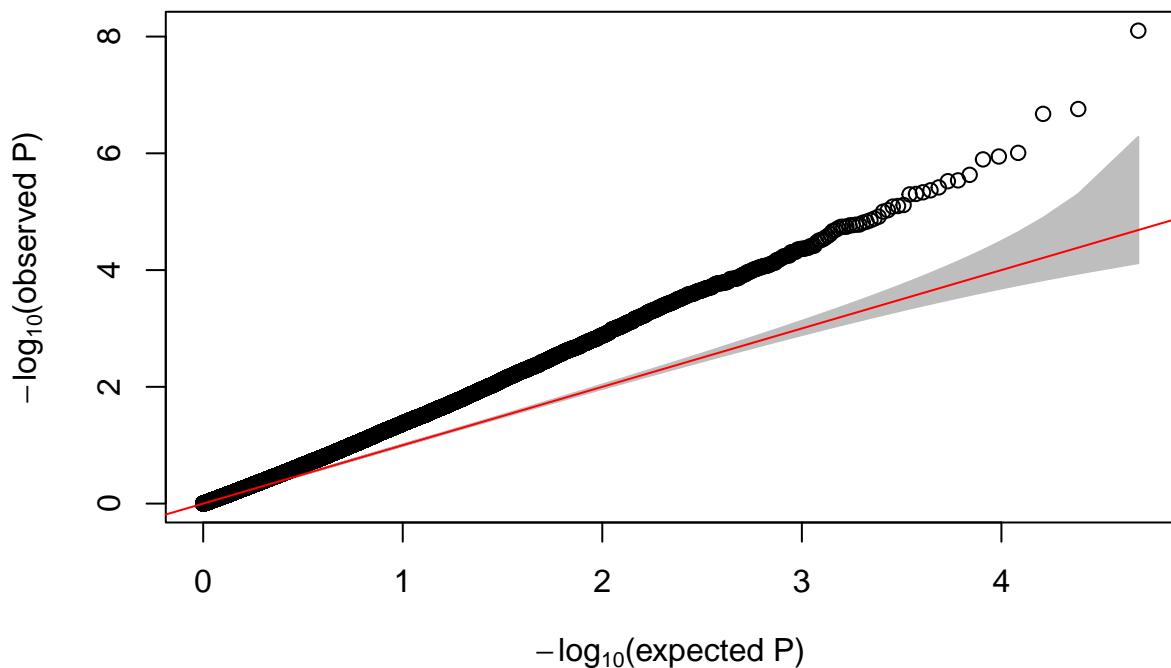
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$SmallAreaHighGrayLevelEmphasis.original)

```



```
summary(summa.fit.smAHem)
```

```
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      576          0     81    0     1      0          0
## NotSig   22720        48525 48398 48525 48519    48525        48525
## Up       25229          0     46    0     5      0          0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0            0              0          0      0      0          0
## NotSig   48525        48525          48525    48525 48525        48525
## Up        0            0              0          0      0      0          0
##          SmallAreaHighGrayLevelEmphasis.original X1 X2 X3 X4 X5
## Down                  22 18603 15869 13559 12700 11267
## NotSig               48463 12613 20631 22649 24504 27064
## Up                   40 17309 12025 12317 11321 10194
##          X6 X7 X8 X9 X10 X11 X12 X13 X14 X15 X16 X17
## Down     8815 8356 6915 7063 8856 6639 6551 6379 5734 4975 4692 2806
## NotSig  29822 33452 34627 34102 31607 33811 36452 36952 37402 38954 39289 41851
## Up      9888 6717 6983 7360 8062 8075 5522 5194 5389 4596 4544 3868
##          X18 X19
## Down     2803 2162
## NotSig  43105 44252
## Up      2617 2111
```

```
head(toptable.smAHem)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 203893_at	0.1004168	5.0379308	5.261247	8.262337e-07	0.04009299	5.554520
## 1554830_a_at	-0.1949350	2.6289573	-5.071015	1.840997e-06	0.04466720	4.581840
## 1555229_a_at	-0.3979940	0.6820437	-4.793267	5.765254e-06	0.07258511	3.111078
## 216922_x_at	-0.2069365	-0.3358964	-4.716413	7.857573e-06	0.07625775	2.217700
## 201645_at	-0.2634144	1.8007395	-4.598154	1.258368e-05	0.10177048	2.811716
## 1562121_at	-0.1776890	0.1193435	-4.784088	5.983317e-06	0.07258511	2.725248

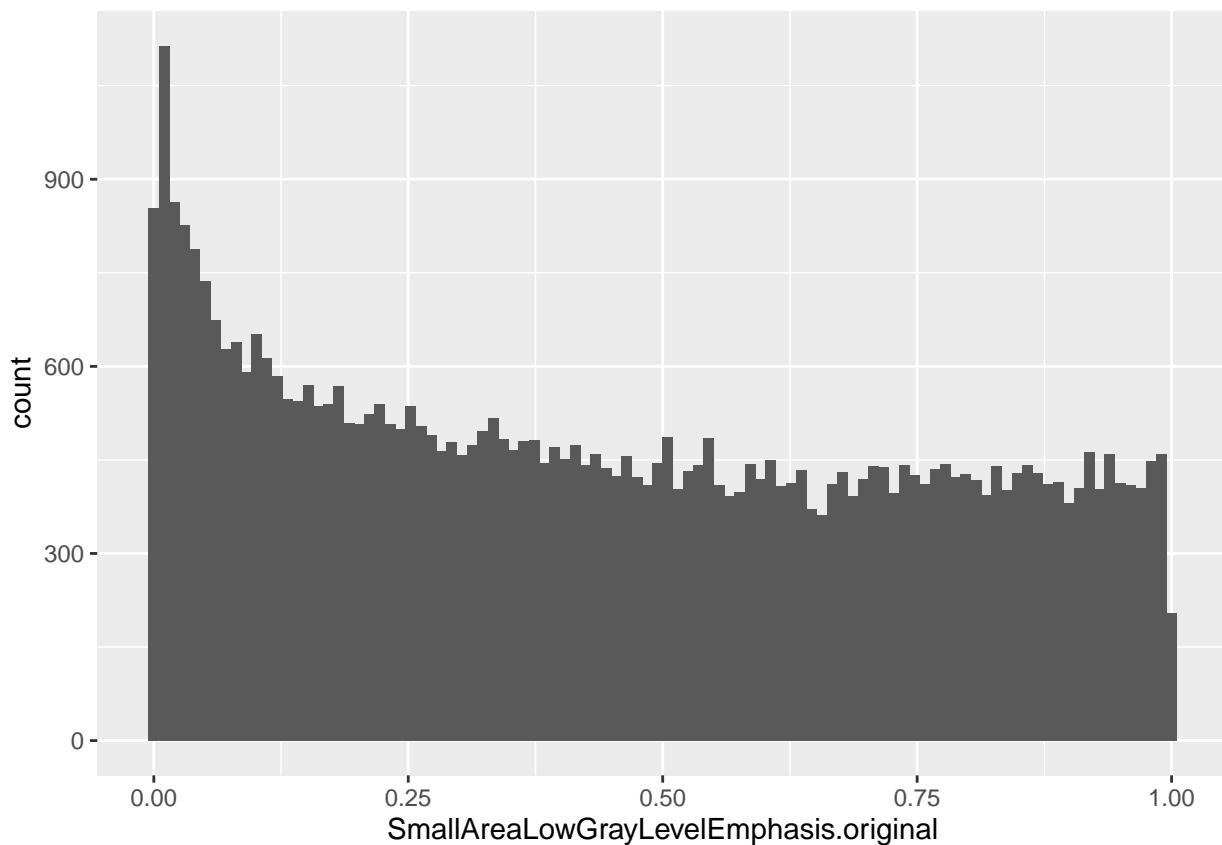
```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SmallAreaLowGrayLevelEmphasis.original.rda")

summa.fit.smALem <- decideTests(fit)
toptable.smALem <- topTable(fit, coef = "SmallAreaLowGrayLevelEmphasis.original",
  number = dim(counts.ok)[1])
toptable.smALem <- toptable.smALem[order(toptable.smALem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = SmallAreaLowGrayLevelEmphasis.original)) +
  geom_histogram(bins = 100)

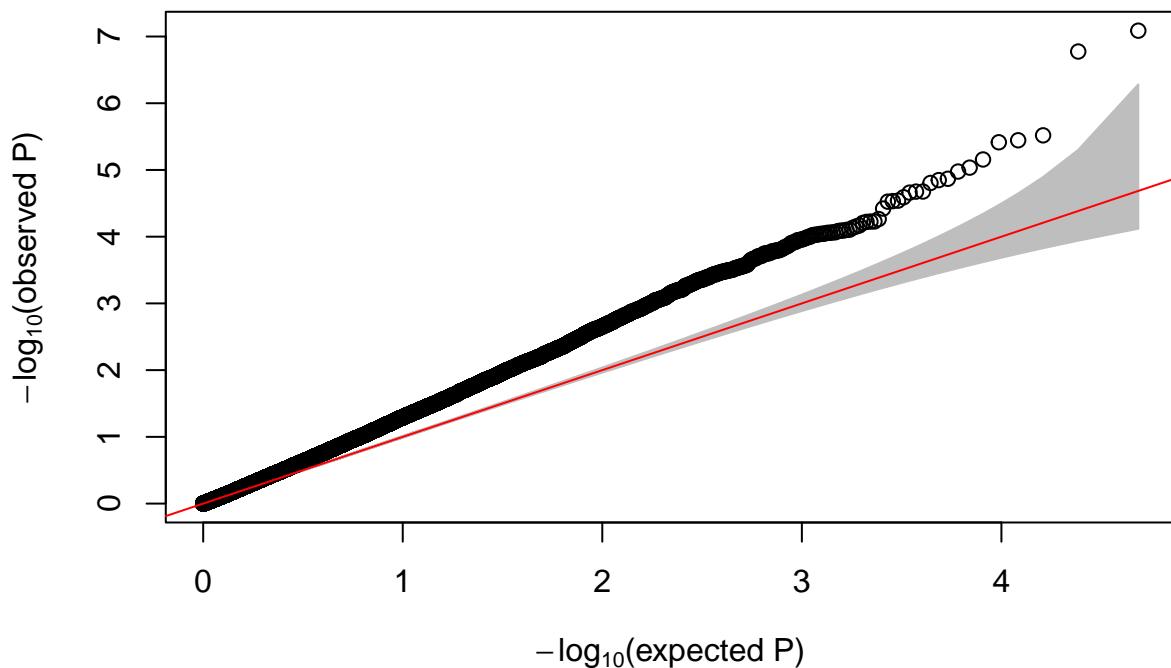
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$SmallAreaLowGrayLevelEmphasis.original)

```



```
summary(summa.fit.smALem)
```

```
##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           627         0   135     0     0      0           0
## NotSig        22638       48525 48272 48525 48523    48525       48525
## Up            25260         0   118     0     2      0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0      0      0           0
## NotSig        48525       48525           0           0    48525 48525       48525
## Up             0           0           0           0      0      0           0
##          SmallAreaLowGrayLevelEmphasis.original X1     X2     X3     X4     X5
## Down           3 18570 16046 13967 11052 10097
## NotSig        48520 12683 20018 21935 25002 27398
## Up             2 17272 12461 12623 12471 11030
##          X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17
## Down        9289  8759  7258  7916  8179  6646  6443  6594  5605  4835  3663  3579
## NotSig     28773 32828 34231 32442 32618 34114 36664 36708 37562 39237 41243 42168
## Up          10463  6938  7036  8167  7728  7765  5418  5223  5358  4453  3619  2778
##          X18     X19
## Down        2205  2637
## NotSig     43524 43821
## Up          2796  2067
```

```
head(toptable.smALem, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 212329_at	0.2089765	3.0460263	5.792749	8.177133e-08	0.003967954	7.442436
## 230036_at	-0.2543247	5.6260651	-5.630095	1.678353e-07	0.004072103	7.066311
## 227973_at	-0.1211576	4.8121414	-4.951176	3.026886e-06	0.037343973	4.365688
## 238453_at	0.3190908	1.0245559	4.909722	3.589034e-06	0.037343973	3.646829
## 231956_at	-0.2904725	3.1575164	-4.892719	3.847911e-06	0.037343973	4.062413
## 222732_at	0.1378213	4.6077523	4.746493	6.965847e-06	0.056336291	3.596343
## 218986_s_at	-0.2429174	5.5019428	-4.676379	9.226060e-06	0.063956368	3.318632

```

## 230363_s_at -0.2120024 1.8899609 -4.642312 1.056679e-05 0.064094199 3.055009
## 1554252_a_at 0.2852936 0.8997812 4.579325 1.355966e-05 0.068889218 2.446105
## 212764_at -0.2040041 5.3623273 -4.567677 1.419664e-05 0.068889218 2.923277

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ZoneEntropy.original.rda")

summa.fit.zoneEn <- decideTests(fit)
summary(summa.fit.zoneEn)

##             (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           596          0    112     0     0       0           0
## NotSig        22682        48525  48338  48525  48523     48525       48525
## Up            25247          0    75      0     2       0           0
##             dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0              0           0           0           0           0
## NotSig        48525         48525         48525       48525       48525       48525
## Up             0              0           0           0           0           0
##             ZoneEntropy.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18479 16203 14076 12457 10402 10675 7010 7273
## NotSig        48525 12724 19734 21874 25055 27085 28404 32655 33407
## Up            0 17322 12588 12575 11013 11038 9446 8860 7845
##             X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down          8140 7813 8257 5563 5272 5602 4626 4234 2916 2589 2680
## NotSig        32370 32852 33312 36364 36624 37230 38745 40079 41684 43566 43316
## Up            8015 7860 6956 6598 6629 5693 5154 4212 3925 2370 2529

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ZonePercentage.original.rda")

summa.fit.zonePer <- decideTests(fit)
summary(summa.fit.zonePer)

##             (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           583          0    99      0     0       0           0
## NotSig        22794        48525  48360  48525  48523     48525       48525
## Up            25148          0    66      0     2       0           0
##             dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0              0           0           0           0           0
## NotSig        48525         48525         48525       48525       48525       48525
## Up             0              0           0           0           0           0
##             ZonePercentage.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           0 18537 16022 13766 12166 10462 10593 7117 7229
## NotSig        48525 12737 20223 22335 25555 26980 28585 32631 33514
## Up            0 17251 12280 12424 10804 11083 9347 8777 7782
##             X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down          8081 7798 8193 5553 5118 5619 4674 4142 2979 2614 2638
## NotSig        32515 32750 33431 36399 36911 37223 38705 40183 41531 43558 43394
## Up            7929 7977 6901 6573 6496 5683 5146 4200 4015 2353 2493

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/ZoneVariance.original.rda")

summa.fit.zoneVar <- decideTests(fit)
toptable.zoneVar <- topTable(fit, coef = "ZoneVariance.original", number =
dim(counts.ok)[1])

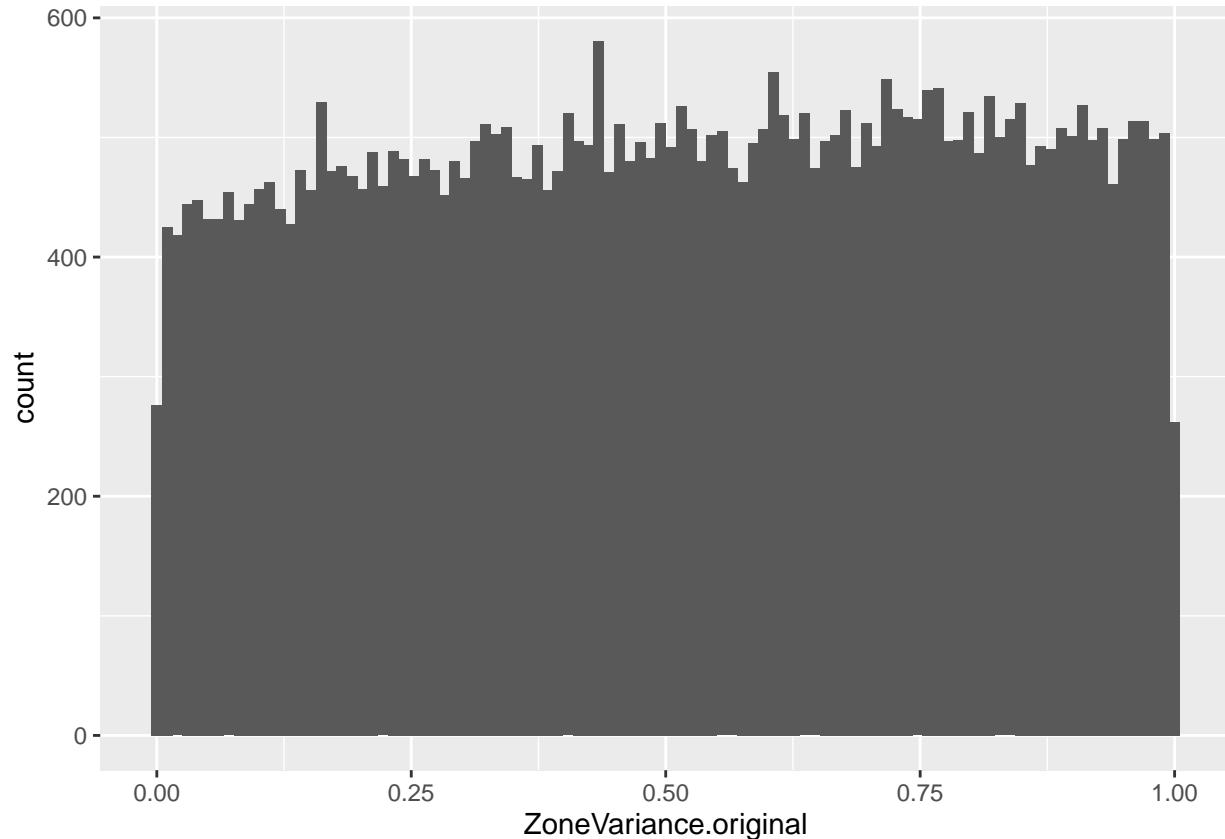
```

```

toptable.zoneVar <- toptable.zoneVar[order(toptable.zoneVar$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = ZoneVariance.original)) + geom_histogram(bins = 100)

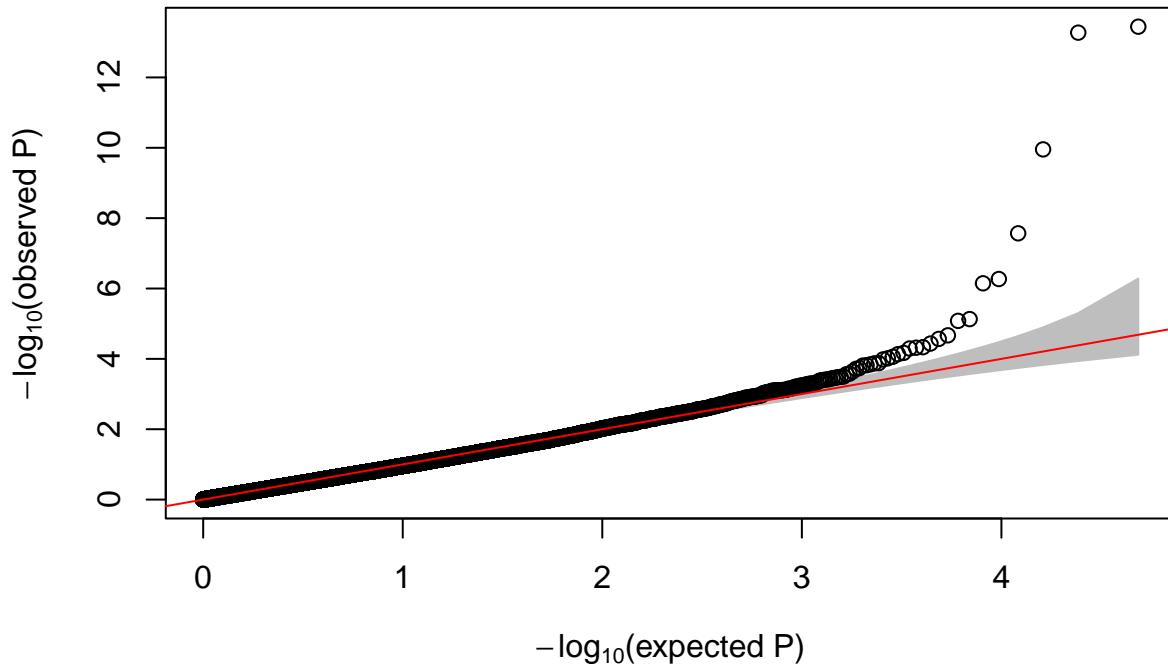
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$ZoneVariance.original)

```



```
summary(summa.fit.zoneVar)
```

```
##          (Intercept) GroupSevere SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           601         0    92      0      0       0           0
## NotSig        23058     48525 48377 48525 48523     48525     48525
## Up            24866         0    56      0      2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig        48525     48525         0           0     48525 48525     48525
## Up             0           0           0           0       0       0           0
##          ZoneVariance.original X1     X2     X3     X4     X5     X6     X7     X8
## Down           2 18540 16207 14053 12381 10504 10708 7190 7285
## NotSig        48519 12722 19692 21936 25201 26951 28349 32477 33444
## Up            4 17263 12626 12536 10943 11070 9468 8858 7796
##          X9     X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down          8119  7860  8285  5549  5228  5604  4676  4231  2847  2679  2594
## NotSig       32447 32674 33328 36352 36749 37242 38734 40129 41842 43446 43250
## Up            7959  7991  6912  6624  6548  5679  5115  4165  3836  2400  2681
```

```
head(toptable.zoneVar, 10)
```

```
##          logFC     AveExpr      t     P.Value   adj.P.Val
## 1563431_x_at -0.12432417 7.6428042 -8.840757 3.608635e-14 1.294321e-09
## 202707_at      0.34377252 0.6160692  8.762647 5.334655e-14 1.294321e-09
## 224373_s_at    -0.09173196 8.7260074 -7.211806 1.109891e-10 1.795249e-06
## 205528_s_at     0.35063443 -0.4655939  6.039538 2.698394e-08 3.273490e-04
## 214839_at       0.26838589 -0.3360599  5.361933 5.375122e-07 5.216556e-03
## 205749_at       0.39494033 -0.7929581  5.296588 7.108909e-07 5.749330e-03
## 229354_at       0.42040518  0.6668949  4.731441 7.398254e-06 5.045322e-02
## 214355_x_at     0.12967369  3.3885361  4.702228 8.317893e-06 5.045322e-02
## 241877_at      -0.24826623  3.2108169 -4.462134 2.144741e-05 1.156373e-01
## 233493_at       0.29651078 -0.8714817  4.401795 2.708830e-05 1.314460e-01
##          B
```

```

## 1563431_x_at 21.656163
## 202707_at     18.277906
## 224373_s_at   14.032629
## 205528_s_at   7.206709
## 214839_at     4.777424
## 205749_at     4.377613
## 229354_at     3.353227
## 214355_x_at   3.361073
## 241877_at     2.427462
## 233493_at     1.404218

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/DependenceEntropy.original.rda")

summa.fit.depEn <- decideTests(fit)
summary(summa.fit.depEn)

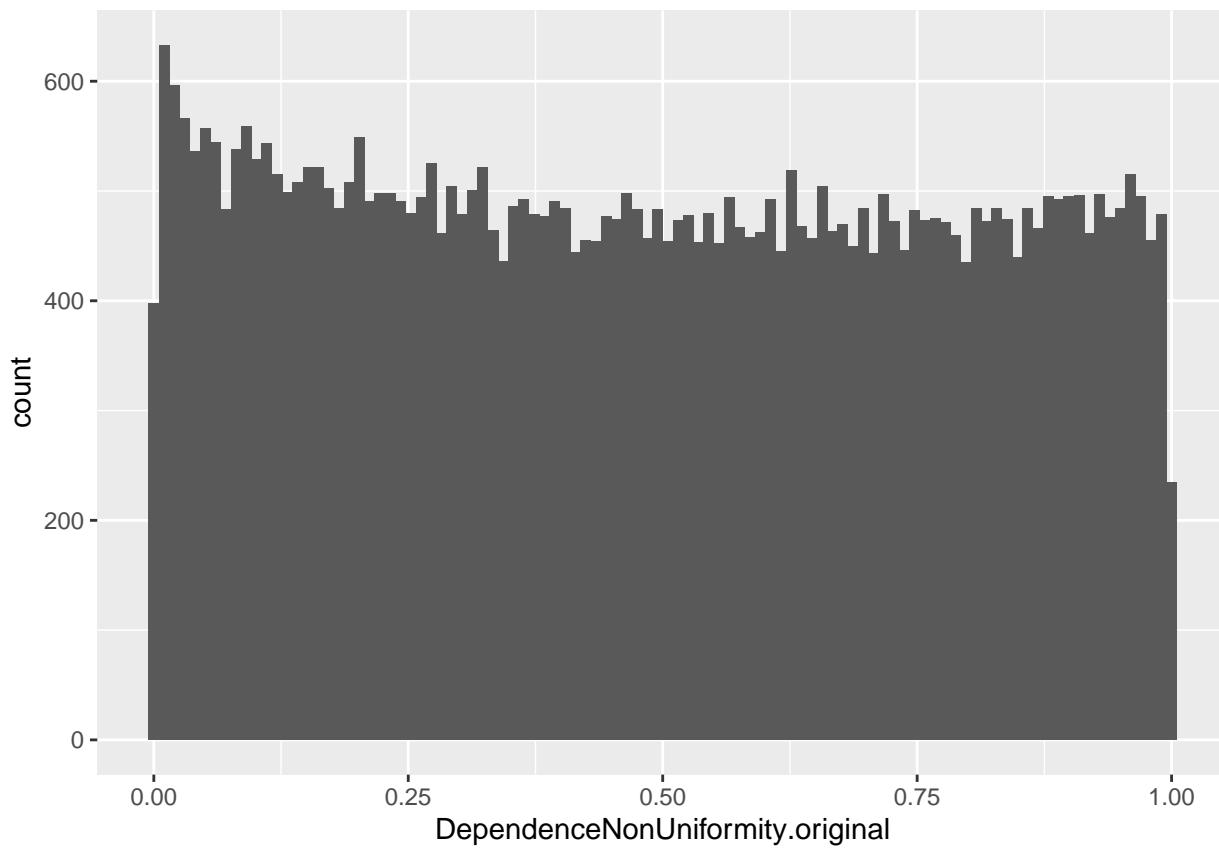
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    96   0    0      0            0
## NotSig        22636        48525 48359 48525 48524    48525        48525
## Up            25288          0    70   0    1      0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0            0            0            0            0
## NotSig        48525        48525        48525        48525        48525        48525
## Up             0            0            0            0            0            0
##          DependenceEntropy.original X1   X2   X3   X4   X5   X6   X7
## Down           0 18474 16244 13936 12383 10538 10667 6971
## NotSig        48525 12751 19564 22146 25210 26935 28379 32901
## Up             0 17300 12717 12443 10932 11052 9479 8653
##          X8   X9   X10  X11  X12  X13  X14  X15  X16  X17  X18  X19
## Down         7273 8058 7849 8267 5444 5305 5649 4526 3964 3328 2653 2576
## NotSig       33483 32524 32679 33347 36596 36470 37450 38929 40490 40954 43502 43250
## Up           7769 7943 7997 6911 6485 6750 5426 5070 4071 4243 2370 2699

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/DependenceNonUniformity.original.rda")

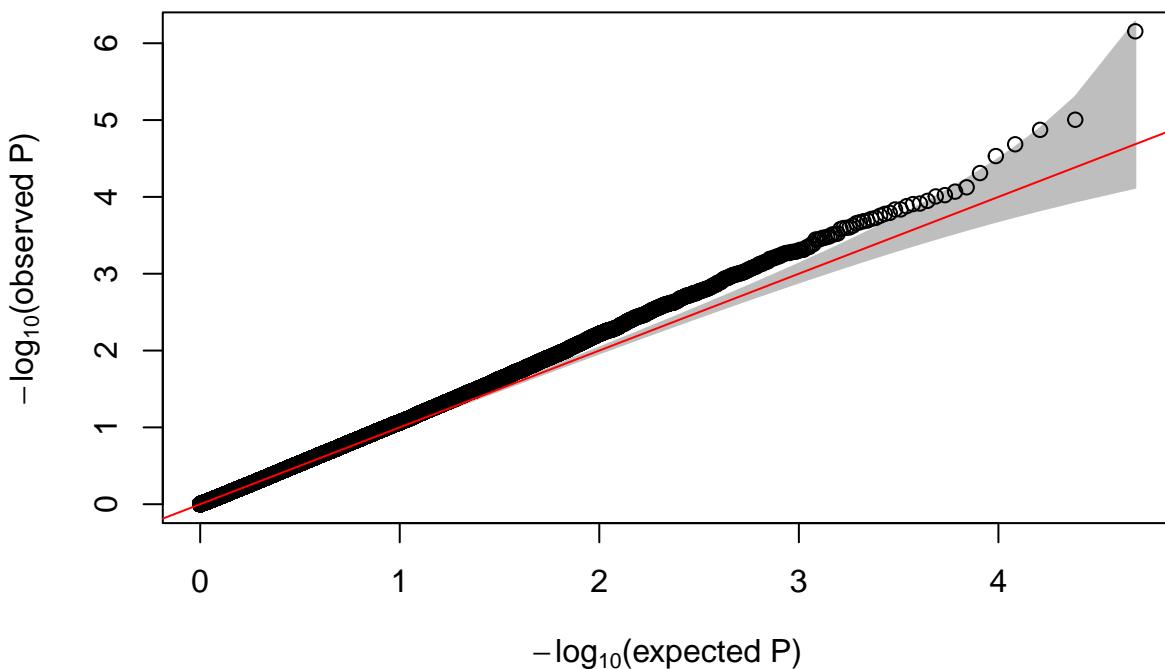
summa.fit.depNU <- decideTests(fit)
toptable.depNU <- topTable(fit, coef = "DependenceNonUniformity.original", number =
dim(counts.ok)[1])
toptable.depNU <- toptable.depNU[order(toptable.depNU$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = DependenceNonUniformity.original)) +
geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$DependenceNonUniformity.original)
```



```
summary(summa.fit.depNU)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      598      0     98      0      0      0      0
## NotSig   22702    48525  48360  48525  48523   48525    48525
## Up       25225      0     67      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      DependenceNonUniformity.original   X1     X2     X3     X4     X5     X6
## Down      1 18539 16252 13982 12418 10526 10683
## NotSig   48524 12703 19615 22020 25099 26987 28405
## Up       0 17283 12658 12523 11008 11012 9437
##      X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down   6823 7277 8141 7736 8288 5504 5380 5570 4667 4131 3112 2660
## NotSig 33216 33426 32396 33041 33261 36464 36395 37431 38691 40255 41289 43499
## Up     8486 7822 7988 7748 6976 6557 6750 5524 5167 4139 4124 2366
##      X19
## Down   2601
## NotSig 43191
## Up     2733

head(toptable.depNU, 10)

##          logFC     AveExpr        t     P.Value adj.P.Val        B
## 215368_at -0.42495040 -0.3006190 -5.300458 6.992227e-07 0.03392978 3.7069385
## 207528_s_at  0.32831671  3.4589663  4.658653 9.898575e-06 0.21672819 3.2093833
## 214769_at   0.31016556  3.2341450  4.582273 1.339896e-05 0.21672819 2.8692370
## 211560_s_at  0.25959781 -0.5812311  4.471790 2.065678e-05 0.25059261 1.2033406
## 206742_at   0.39414196 -0.1501561  4.380450 2.940696e-05 0.28539451 1.2522073
## 241067_at   -0.30422796  0.1543272 -4.246603 4.895558e-05 0.39592828 1.0167009
## 212038_s_at -0.05622987  6.9334155 -4.132557 7.500896e-05 0.42313263 1.3190044
## 244699_at   0.15777630  2.3802461  4.097417 8.542553e-05 0.42313263 1.2230700
## 205148_s_at  0.28695961  1.4321409  4.068936 9.487257e-05 0.42313263 0.9707889
## 216864_at   -0.35973298 -1.6516964 -4.058288 9.865535e-05 0.42313263 -0.5211694

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/DependenceNonUniformityNormalized.original.rda")

summa.fit.depNUn <- decideTests(fit)
summary(summa.fit.depNUn)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down       604          0    92    0    0      0      0      0
## NotSig    22659    48525  48371  48525  48524   48525    48525
## Up        25262          0    62    0    1      0      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      DependenceNonUniformityNormalized.original   X1     X2     X3     X4     X5
## Down      0 18512 16236 14005 12417 10499
## NotSig   48525 12709 19626 21992 25108 27030
## Up       0 17304 12663 12528 11000 10996
##      X6     X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17
## Down   10683 6730 7266 8149 7838 8283 5439 5349 5591 4577 4034 3244
## NotSig 28386 33280 33475 32360 32815 33257 36588 36426 37416 38849 40391 41061

```

```

## Up      9456  8515  7784  8016  7872  6985  6498  6750  5518  5099  4100  4220
##          X18    X19
## Down     2660  2577
## NotSig   43486 43238
## Up       2379  2710

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/DependenceVariance.original.rda")

summa.fit.depVar <- decideTests(fit)
summary(summa.fit.depVar)

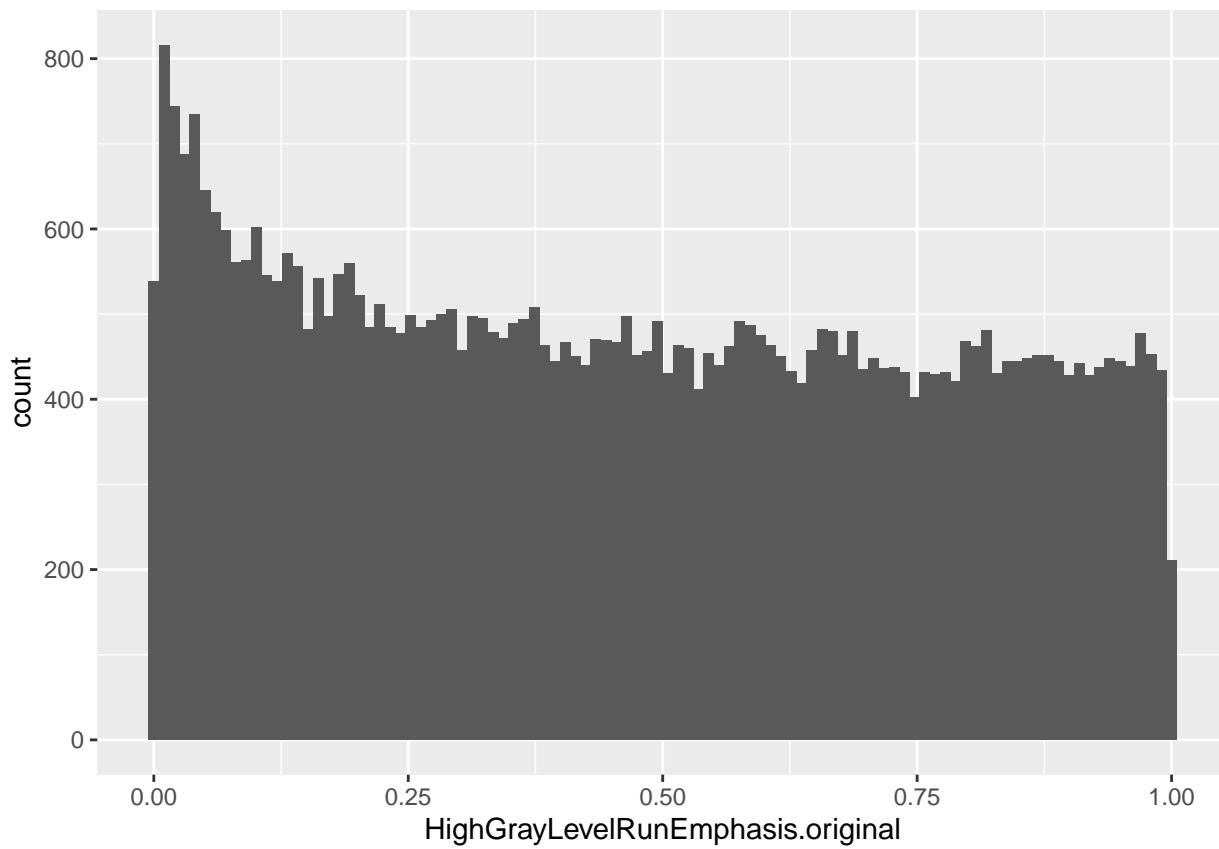
##             (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           603          0    87    0    0        0            0
## NotSig         22651        48525 48377 48525 48524    48525        48525
## Up            25271          0   61    0    1        0            0
##             dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0            0            0            0            0
## NotSig         48525        48525        48525        48525        48525        48525
## Up             0            0            0            0            0            0
##             DependenceVariance.original   X1     X2     X3     X4     X5     X6     X7
## Down           0 18525 16218 14007 12397 10525 10670  6770
## NotSig         48525 12693 19658 21984 25145 26993 28385 33182
## Up             0 17307 12649 12534 10983 11007  9470  8573
##             X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down          7223  8173  7847  8262  5464  5326  5650  4583  4004  3254  2628  2598
## NotSig        33566 32309 32788 33261 36541 36455 37326 38844 40459 41040 43530 43186
## Up            7736  8043  7890  7002  6520  6744  5549  5098  4062  4231  2367  2741

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/HighGrayLevelRunEmphasis.original.rda")

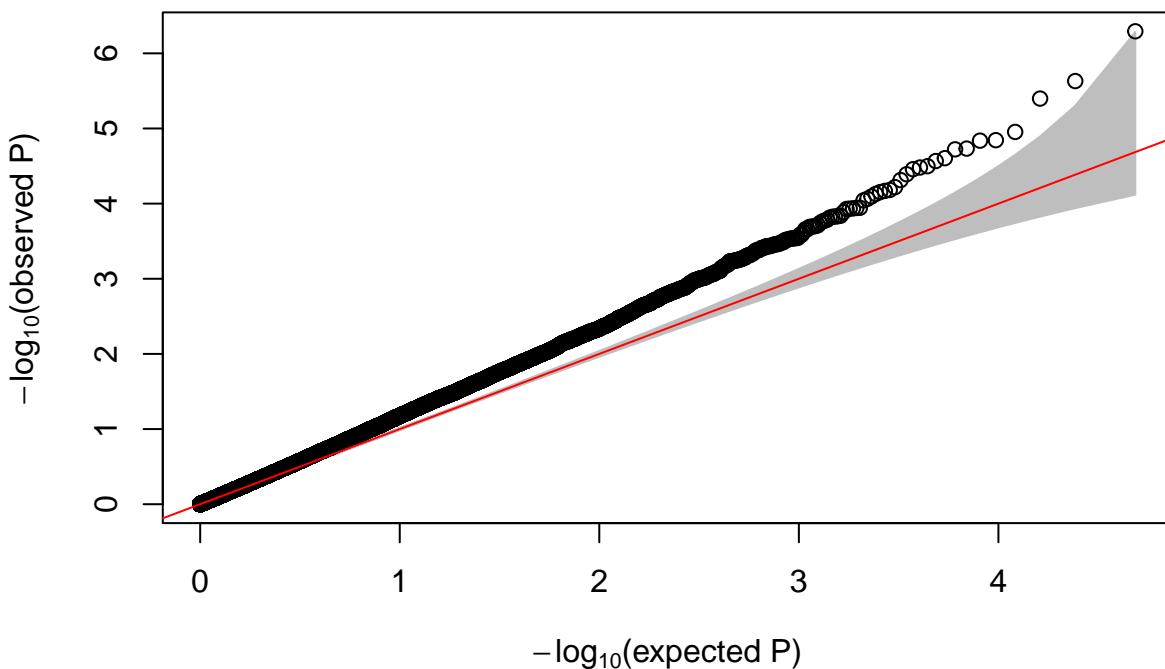
summa.fit.hglRem <- decideTests(fit)
toptable.hglRem <- topTable(fit, coef = "HighGrayLevelRunEmphasis.original", number =
dim(counts.ok)[1])
toptable.hglRem <- toptable.hglRem[order(toptable.hglRem$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = HighGrayLevelRunEmphasis.original)) +
geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$HighGrayLevelRunEmphasis.original)
```



```
summary(summa.fit.hglRem)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      617      0   115      0      0      0      0
## NotSig   22650    48525 48320 48525 48523    48525    48525
## Up       25258      0   90      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##      HighGrayLevelRunEmphasis.original   X1     X2     X3     X4     X5     X6
## Down      1 18492 16048 14100 12264 10448 10566
## NotSig   48524 12709 20084 21850 25403 26787 28695
## Up       0 17324 12393 12575 10858 11290 9264
##      X7     X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down   6759 7088 8231 7875 8035 5359 5188 5670 4507 3752 3050 2731
## NotSig 33150 33979 32335 32389 33822 36827 36626 37193 38966 40870 41364 43596
## Up     8616 7458 7959 8261 6668 6339 6711 5662 5052 3903 4111 2198
##      X19
## Down   2259
## NotSig 44086
## Up     2180

head(toptable.hglRem, 10)

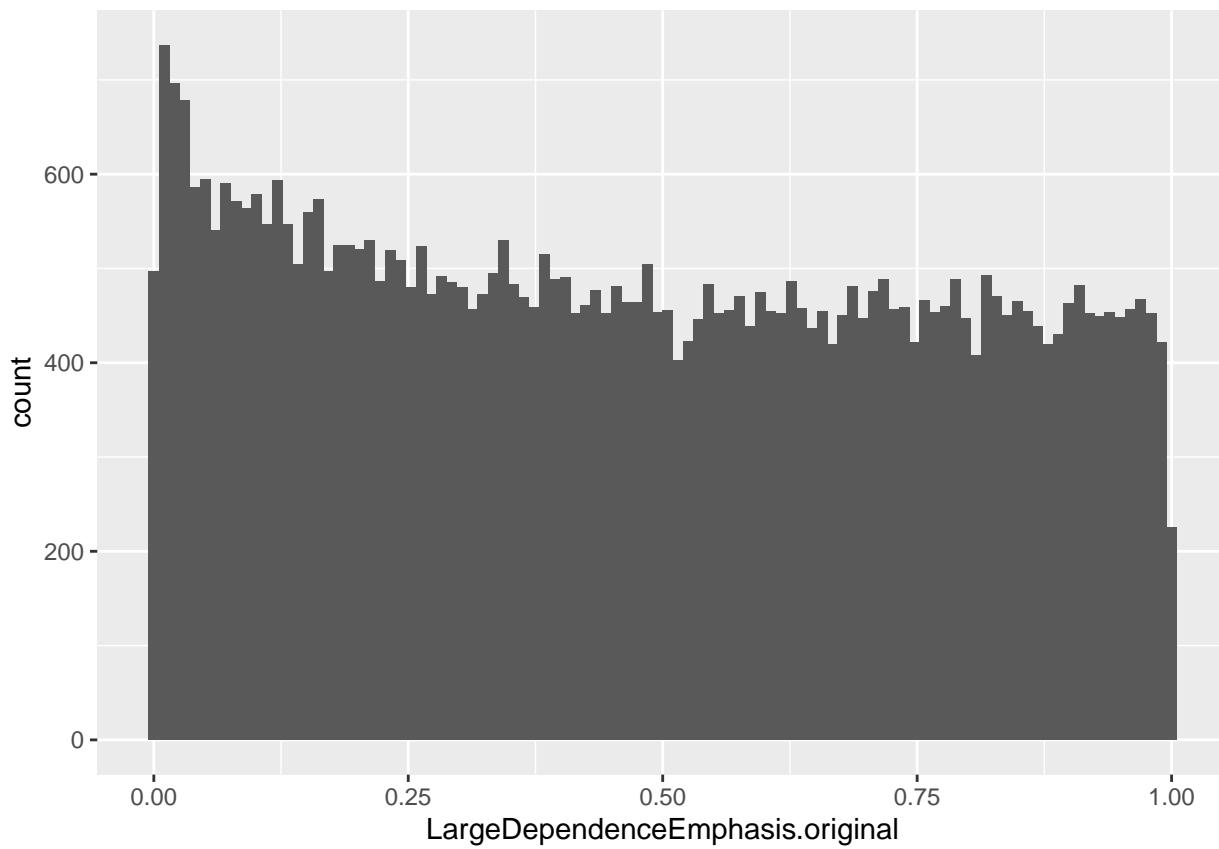
##          logFC     AveExpr        t     P.Value adj.P.Val      B
## 239988_at -0.29153851 2.4479933 -5.374462 5.090765e-07 0.02470294 5.838130
## 230036_at -0.17733875 5.6260651 -5.013366 2.339024e-06 0.05675057 4.586600
## 241514_at  0.40961126 -0.7748055 4.883115 3.999113e-06 0.06468565 2.382877
## 218986_s_at -0.18204570 5.5019428 -4.629469 1.111286e-05 0.11497386 3.132002
## 226130_at  0.15498911 4.2551221 4.565500 1.431038e-05 0.11497386 2.938668
## 238453_at  0.23061485 1.0245559 4.561747 1.452336e-05 0.11497386 2.583610
## 228077_at  0.14854086 3.5670907 4.499613 1.852879e-05 0.11497386 2.691687
## 233127_at  0.31237657 1.0540609 4.493786 1.895499e-05 0.11497386 2.331428
## 1563051_at 0.16786384 3.5601254 4.424154 2.484120e-05 0.13010647 2.419398
## 212579_at  -0.09259944 6.9622936 -4.401280 2.713426e-05 0.13010647 2.161738

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/LargeDependenceEmphasis.original.rda")

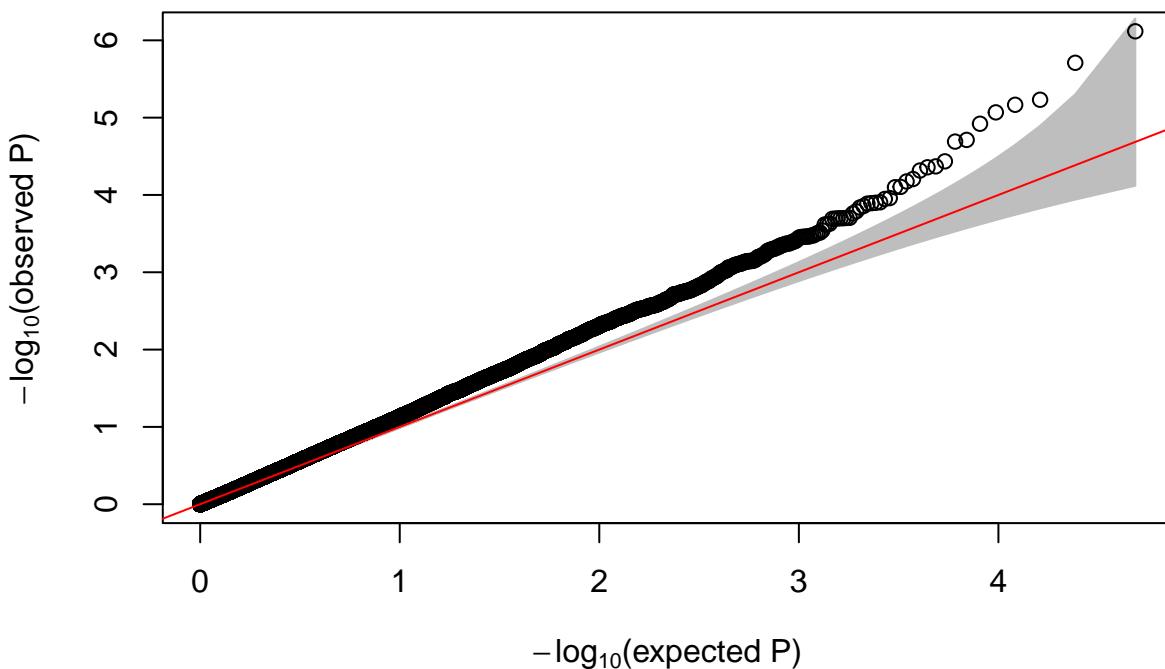
summa.fit.larDepEm <- decideTests(fit)
toptable.larDepEm <- topTable(fit, coef = "LargeDependenceEmphasis.original", number =
dim(counts.ok)[1])
toptable.larDepEm <- toptable.larDepEm[order(toptable.larDepEm$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LargeDependenceEmphasis.original)) +
geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LargeDependenceEmphasis.original)
```



```
summary(summa.fit.larDepEm)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      602      0     90      0      0      0      0
## NotSig   22623    48525  48368  48525  48524    48525    48525
## Up       25300      0     67      0      1      0      0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##          LargeDependenceEmphasis.original   X1     X2     X3     X4     X5     X6
## Down      1 18464 16257 13936 12358 10610 10673
## NotSig   48523 12776 19500 22220 25225 26773 28362
## Up       1 17285 12768 12369 10942 11142 9490
##          X7     X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18
## Down    7123 7269 7933 7844 8248 5397 5294 5708 4526 4006 3252 2655
## NotSig  32693 33562 32753 32632 33438 36684 36504 37398 38917 40448 41087 43506
## Up      8709 7694 7839 8049 6839 6444 6727 5419 5082 4071 4186 2364
##          X19
## Down    2551
## NotSig  43301
## Up      2673

head(toptable.larDepEm)

##           logFC     AveExpr        t     P.Value adj.P.Val      B
## 203893_at  0.1010219  5.0379308  5.279648 7.640199e-07 0.03707406 5.623121
## 1554830_a_at -0.1956586  2.6289573 -5.057077 1.951147e-06 0.04733971 4.517832
## 1555229_a_at -0.3988574  0.6820437 -4.788864 5.868924e-06 0.08270166 3.075136
## 1562121_at   -0.1770310  0.1193435 -4.751753 6.817242e-06 0.08270166 2.602550
## 216922_x_at  -0.2066764 -0.3358964 -4.695589 8.541167e-06 0.08289203 2.127148
## 201645_at    -0.2647713  1.8007395 -4.610326 1.199216e-05 0.09698663 2.839749

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/LargeDependenceHighGrayLevelEmphasis.original.rda")

summa.fit.larDepHigh <- decideTests(fit)
summary(summa.fit.larDepHigh)

##           (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      657      0     139      0      0      0      0
## NotSig   22393    48525  48264  48525  48523    48525    48525
## Up       25475      0     122      0      2      0      0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525    48525    48525    48525
## Up       0      0      0      0      0      0      0
##          LargeDependenceHighGrayLevelEmphasis.original   X1     X2     X3     X4
## Down      0 18494 16196 13741 12101
## NotSig   48525 12772 19694 22359 25620
## Up       0 17259 12635 12425 10804
##          X5     X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16
## Down   10460 9225 8758 7298 7838 8470 6718 6489 6477 5509 4789 3874
## NotSig 26720 28774 32559 34287 32679 32159 33777 36669 37078 37169 39238 40855
## Up     11345 10526 7208 6940 8008 7896 8030 5367 4970 5847 4498 3796
##          X17     X18     X19
## Down    3798 2149 2494
## NotSig 41840 43667 43491

```

```

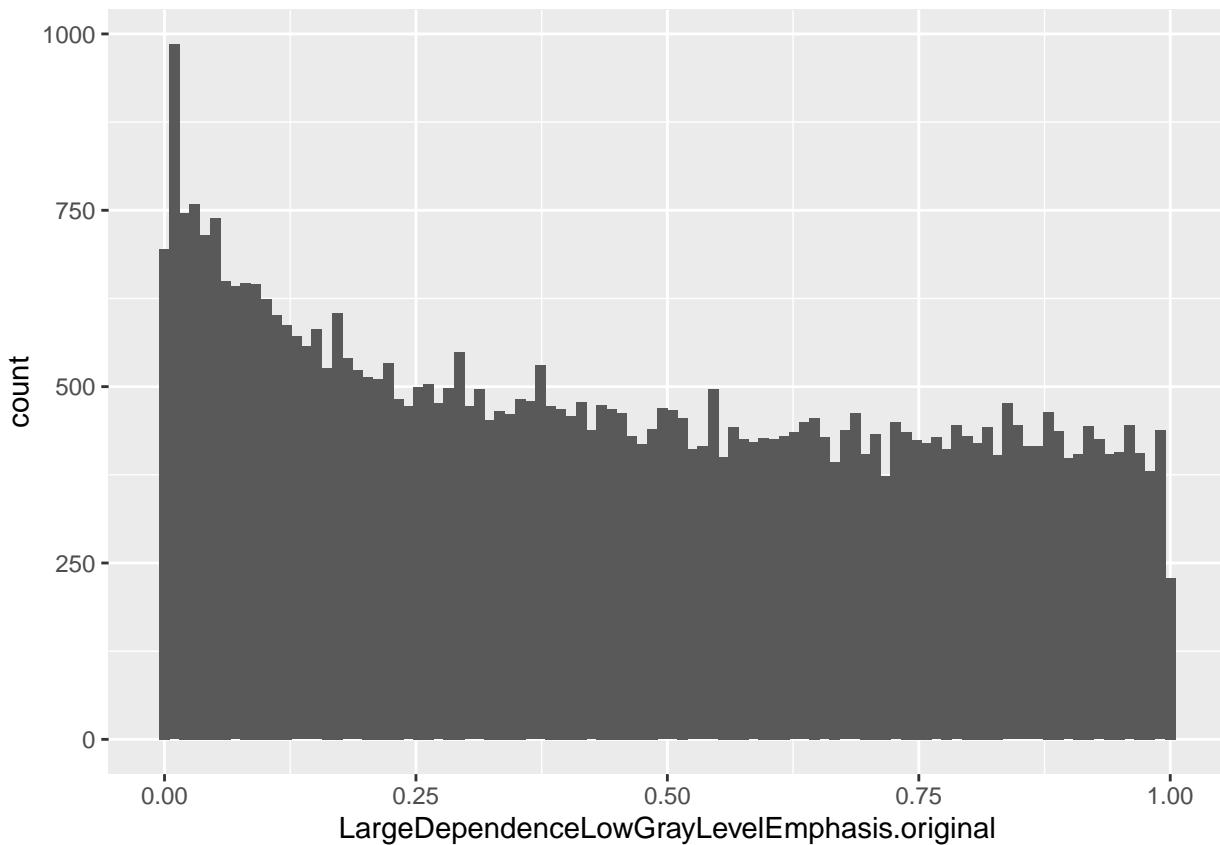
## Up      2887  2709  2540

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/LargeDependenceLowGrayLevelEmphasis.original.rda")

summa.fit.larDepLow <- decideTests(fit)
toptable.larDepLow <- topTable(fit, coef =
"LargeDependenceLowGrayLevelEmphasis.original",
  number = dim(counts.ok)[1])
toptable.larDepLow <- toptable.larDepLow[order(toptable.larDepLow$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = LargeDependenceLowGrayLevelEmphasis.original)) +
  geom_histogram(bins = 100)

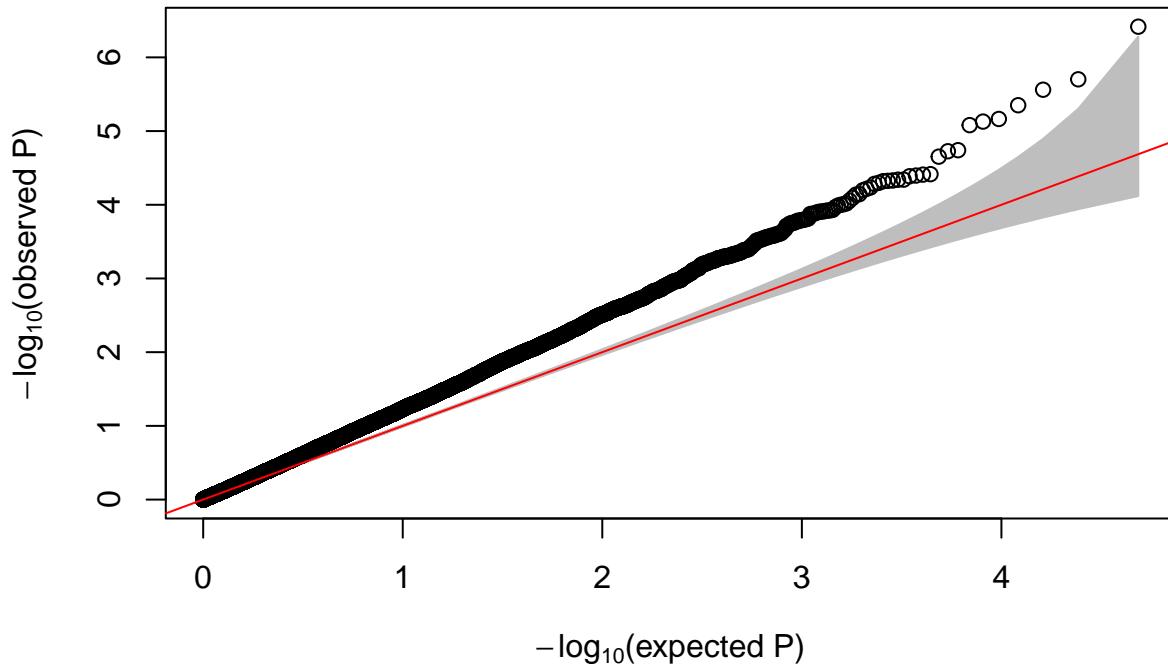
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$LargeDependenceLowGrayLevelEmphasis.original)

```



```
summary(summa.fit.larDepLow)
```

```
##          (Intercept) GroupSevere SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           656         0   119     0     1       0           0
## NotSig        22450      48525 48317 48525 48522     48525      48525
## Up            25419         0    89     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig        48525      48525           0           0     48525 48525      48525
## Up             0           0           0           0       0       0           0
##          LargeDependenceLowGrayLevelEmphasis.original X1     X2     X3     X4
## Down                               1 18376 16277 13909 12246
## NotSig                            48522 12899 19838 22027 25399
## Up                                2 17250 12410 12589 10880
##          X5     X6     X7     X8     X9     X10    X11    X12    X13    X14    X15    X16
## Down  10437  9280  8971  7232  7943  8083  6771  6465  6701  5552  4907  3792
## NotSig 26803 28706 32431 34391 32306 32779 33915 36711 36532 37377 39226 41103
## Up    11285 10539  7123  6902  8276  7663  7839  5349  5292  5596  4392  3630
##          X17    X18    X19
## Down   4017  2128  2568
## NotSig 41454 43698 43592
## Up    3054  2699  2365
```

```
head(toptable.larDepLow, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 212329_at	-0.2326719	3.0460263	-5.440190	3.832987e-07	0.01859957	5.879025
## 230146_s_at	0.2876540	0.3778259	5.052795	1.984712e-06	0.04441945	3.749684
## 227973_at	0.1521623	4.8121414	4.974488	2.746179e-06	0.04441945	4.428084
## 230036_at	0.2711817	5.6260651	4.856236	4.461261e-06	0.05412067	4.008626
## 203238_s_at	0.4520526	2.0908241	4.750411	6.849849e-06	0.05756046	3.325836
## 202174_s_at	0.1354318	5.7516296	4.730062	7.434079e-06	0.05756046	3.537436
## 212764_at	0.2522699	5.3623273	4.702490	8.303416e-06	0.05756046	3.437421

```

## 241358_at      0.5291955 -0.3638065  4.504586 1.816711e-05 0.10128191 1.685112
## 230846_at      0.3068441  1.0762390  4.496023 1.878490e-05 0.10128191 2.253641
## 212916_at     -0.1105720  5.4256914 -4.452653 2.223889e-05 0.10791420 2.538019

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SmallDependenceEmphasis.original.rda")

summa.fit.smDepEm <- decideTests(fit)
summary(summa.fit.smDepEm)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           588          0    89    0    0       0        0
## NotSig         22737        48525 48371 48525 48523     48525     48525
## Up            25200          0    65    0    2       0        0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0        0        0       0       0        0
## NotSig         48525        48525        48525     48525     48525     48525
## Up             0             0        0        0       0       0        0
##          SmallDependenceEmphasis.original   X1   X2   X3   X4   X5   X6
## Down           0 18573 16132 13989 12352 10443 10702
## NotSig         48525 12682 19885 22024 25230 27073 28390
## Up             0 17270 12508 12512 10943 11009 9433
##          X7   X8   X9   X10  X11  X12  X13  X14  X15  X16  X17  X18
## Down          6753 7246 8154 7790 8207 5452 5285 5593 4606 4085 3114 2671
## NotSig        33228 33463 32364 32909 33385 36578 36566 37311 38831 40338 41280 43445
## Up            8544 7816 8007 7826 6933 6495 6674 5621 5088 4102 4131 2409
##          X19
## Down          2602
## NotSig        43188
## Up            2735

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/SmallDependenceHighGrayLevelEmphasis.original.rda")

summa.fit.smDepHigh <- decideTests(fit)
summary(summa.fit.smDepHigh)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           599          0    79    0    1       0        0
## NotSig         22752        48525 48392 48525 48520     48525     48525
## Up            25174          0    54    0    4       0        0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0        0        0       0       0        0
## NotSig         48525        48525        48525     48525     48525     48525
## Up             0             0        0        0       0       0        0
##          SmallDependenceHighGrayLevelEmphasis.original   X1   X2   X3   X4
## Down           0 18449 16234 13880 12405
## NotSig         48525 12766 19722 22178 25190
## Up             0 17310 12569 12467 10930
##          X5   X6   X7   X8   X9   X10  X11  X12  X13  X14  X15  X16
## Down          10304 9294 8503 7561 7976 7999 6886 6348 6857 5537 5019 4328
## NotSig        27330 28691 33423 33764 32361 32671 33345 36889 36254 37435 39081 40043
## Up            10891 10540 6599 7200 8188 7855 8294 5288 5414 5553 4425 4154
##          X17  X18  X19
## Down          4185 2478 2277

```

```

## NotSig 41221 43393 44175
## Up      3119  2654  2073

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/SmallDependenceLowGrayLevelEmphasis.original.rda")

summa.fit.smDepLow <- decideTests(fit)
summary(summa.fit.smDepLow)

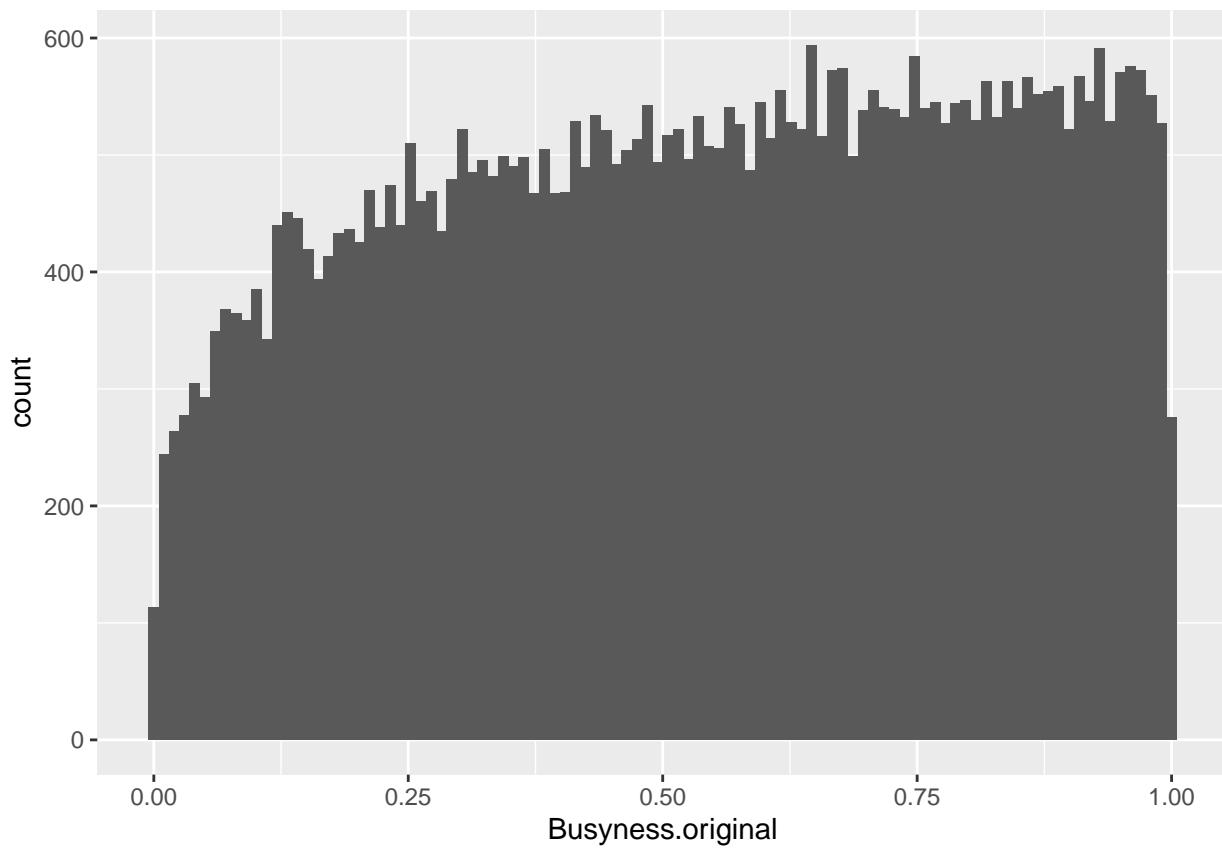
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down           592          0    79   0     0       0           0
## NotSig        22740        48525 48395 48525 48523     48525        48525
## Up            25193          0    51   0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0       0           0
## NotSig        48525          48525          48525     48525 48525        48525
## Up             0             0           0           0       0       0           0
##          SmallDependenceLowGrayLevelEmphasis.original X1   X2   X3   X4
## Down           0 18544 16054 13843 12265
## NotSig        48525 12737 20071 22274 25425
## Up             0 17244 12400 12408 10835
##          X5   X6   X7   X8   X9   X10  X11  X12  X13  X14  X15  X16
## Down  10512 10726 6818 7241 8048 7818 8233 5440 5246 5601 4607 4308
## NotSig 26945 28325 33129 33483 32565 32778 33381 36594 36650 37287 38832 39902
## Up    11068 9474 8578 7801 7912 7929 6911 6491 6629 5637 5086 4315
##          X17  X18  X19
## Down  2929 2685 2591
## NotSig 41594 43428 43230
## Up    4002 2412 2704

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Busyness.original.rda")

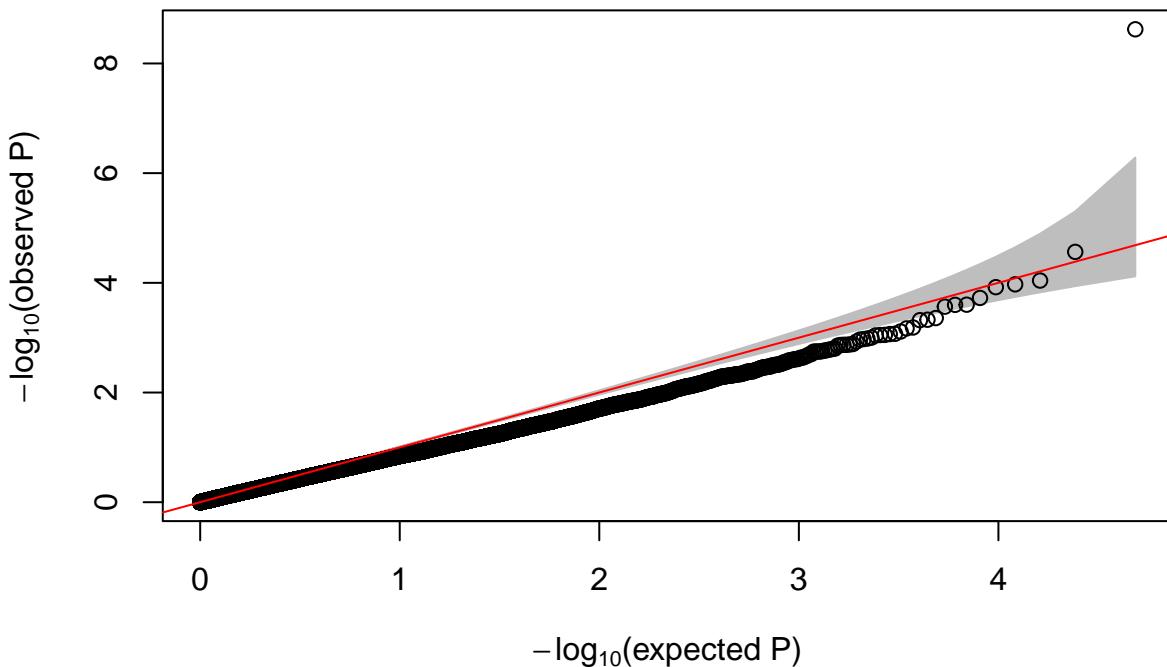
summa.fit.busy <- decideTests(fit)
toptable.busy <- topTable(fit, coef = "Busyness.original", number = dim(counts.ok)[1])
toptable.busy <- toptable.busy[order(toptable.busy$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Busyness.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Busyness.original)
```



```
summary(summa.fit.busy)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      596      0     95      0      0      0      0
## NotSig   22703    48525  48373  48525  48523  48525  48525
## Up       25226      0     57      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0          0          0          0          0          0          0
## NotSig   48525      48525      48525      48525      48525      48525
## Up       0          0          0          0          0          0          0
##      Busyness.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      0 18496 16099 13909 12205 10506 10623 7149 7252 8034
## NotSig   48524 12784 19896 22131 25521 26951 28483 32467 33491 32612
## Up       1 17245 12530 12485 10799 11068 9419 8909 7782 7879
##      X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7829  8287  5527  5221  5432  4646  4175  2923  2627  2591
## NotSig  32716 33349 36370 36727 37593 38807 40206 41588 43569 43220
## Up      7980  6889  6628  6577  5500  5072  4144  4014  2329  2714
head(toptable.busy, 10)

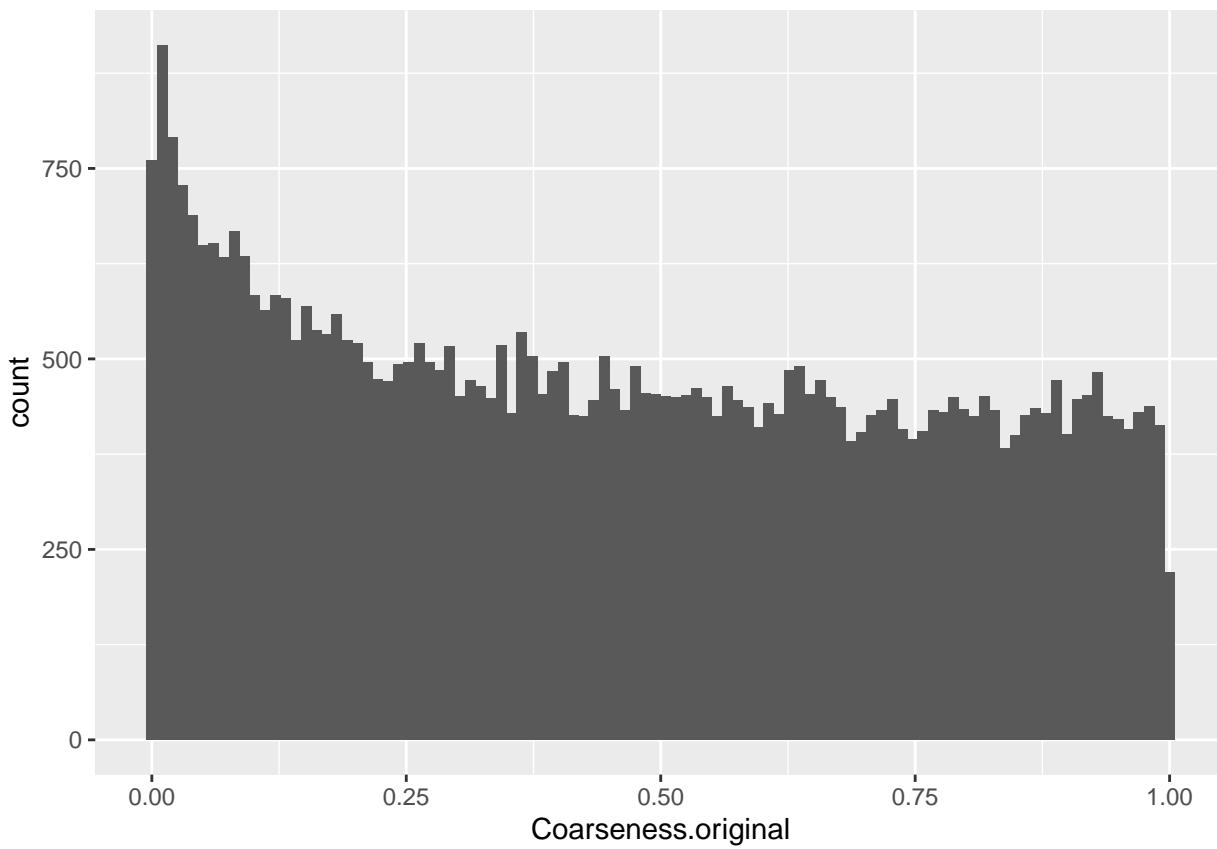
##              logFC      AveExpr        t     P.Value    adj.P.Val
## 232577_at  0.9176569  0.3902588  6.566481 2.382831e-09 0.0001156269
## 238763_at  0.7837212  0.3957949  4.399967 2.728206e-05 0.6619310945
## 218540_at -0.3353031  2.5303325 -4.080717 9.085652e-05 0.9999897388
## 230026_at  0.8767203  2.3909989  4.037362 1.065232e-04 0.9999897388
## 217923_at -0.2912297  5.0552122 -4.004682 1.200098e-04 0.9999897388
## 238181_at -1.1875417 -1.0498092 -3.879328 1.885132e-04 0.9999897388
## 210841_s_at 0.5759793  1.5357202  3.799436 2.501878e-04 0.9999897388
## 202191_s_at 0.4772884  4.4615809  3.797542 2.518610e-04 0.9999897388
## 210842_at  0.6952086  1.8397401  3.775651 2.719850e-04 0.9999897388
## 226428_at -0.2965105  3.3969470 -3.637380 4.390586e-04 0.9999897388
##              B
## 232577_at  0.5404565
## 238763_at -2.2885126
## 218540_at -1.8934568
## 230026_at -1.4005356
## 217923_at -0.8634380
## 238181_at -3.9065611
## 210841_s_at -2.1718226
## 202191_s_at -1.2259012
## 210842_at  -1.9560649
## 226428_at  -2.1891575

load("/Users/carlacasanovasanchez/Desktop/Radiomic features models
(indiv)/Coarseness.original.rda")

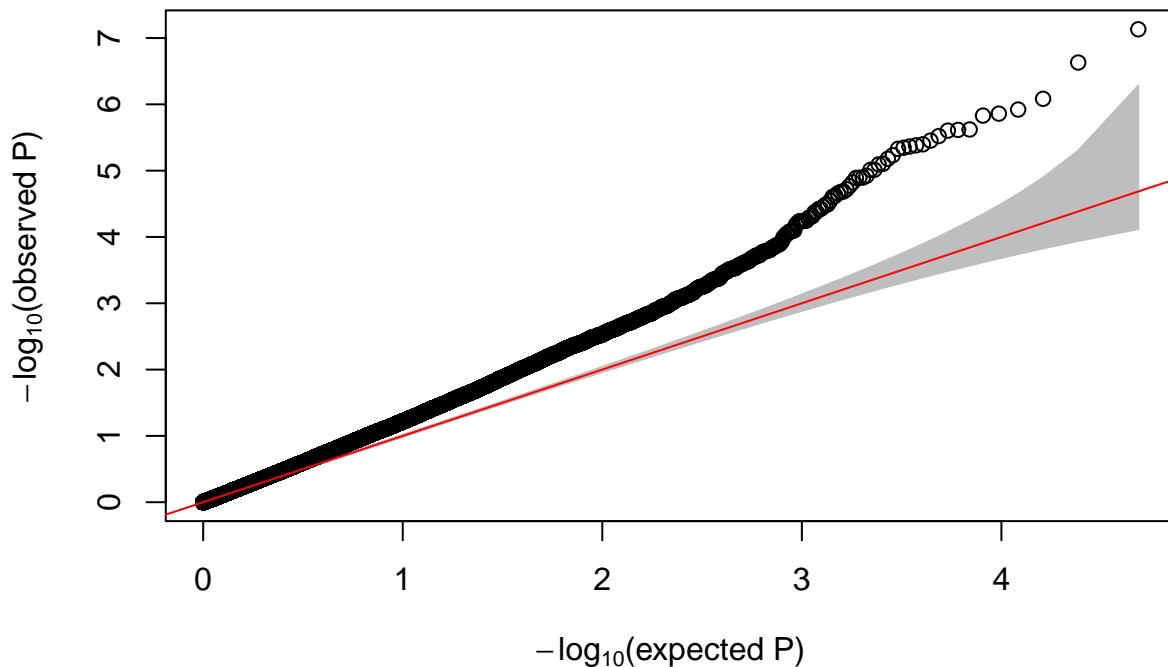
summa.fit.coar <- decideTests(fit)
toptable.coar <- topTable(fit, coef = "Coarseness.original", number = dim(counts.ok)[1])
toptable.coar <- toptable.coar[order(toptable.coar$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Coarseness.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Coarseness.original)
```



```
summary(summa.fit.coar)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      606      0 122      0      1      0      0
## NotSig   22673 48525 48307 48525 48520 48525 48525
## Up       25246      0  96      0      4      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525 48525 48525 48525
## Up       0      0      0      0      0      0      0
##      Coarseness.original X1     X2     X3     X4     X5     X6     X7     X8
## Down      3 18392 16051 14162 12286 10342 10471 6678 7087
## NotSig   48483 12815 20128 21778 25305 26889 28835 33228 33972
## Up       39 17318 12346 12585 10934 11294 9219 8619 7466
##      X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    8243 7903 7758 5556 5256 5688 4444 3714 3188 2757 2381
## NotSig  32375 32272 34198 36425 36552 37116 39087 40905 41210 43544 43983
## Up      7907 8350 6569 6544 6717 5721 4994 3906 4127 2224 2161
head(toptable.coar, 10)

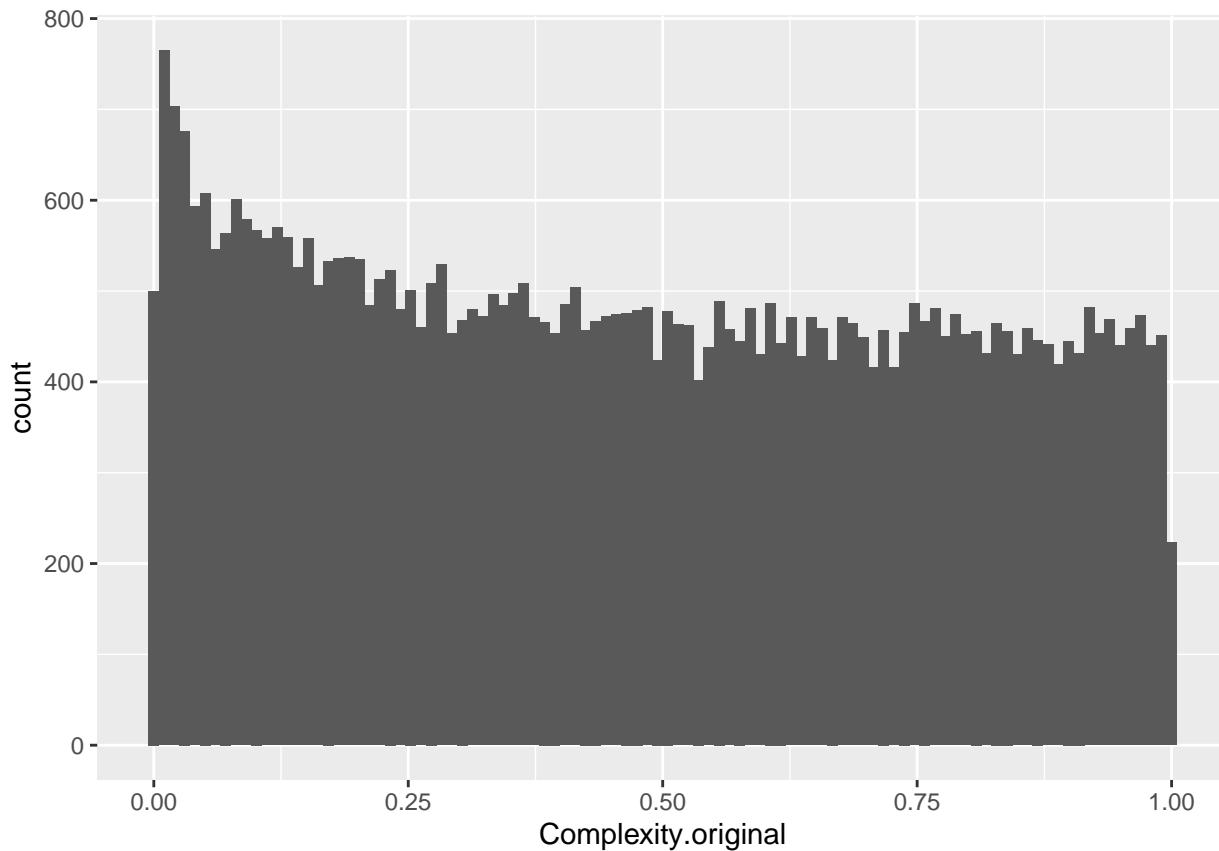
##          logFC AveExpr      t    P.Value adj.P.Val      B
## 230036_at  0.20501321 5.626065 5.815328 7.383980e-08 0.003583076 7.834249
## 239988_at  0.30128756 2.447993 5.553819 2.340761e-07 0.005679271 6.624939
## 218986_s_at 0.20531863 5.501943 5.261416 8.252085e-07 0.011953777 5.547686
## 214059_at  0.41147689 3.679703 5.173247 1.198576e-06 0.011953777 5.219442
## 221816_s_at 0.10713753 6.663139 5.139561 1.381107e-06 0.011953777 4.988945
## 204439_at  0.35754484 5.068404 5.123399 1.478056e-06 0.011953777 5.000675
## 204747_at  0.27510314 5.588170 5.007778 2.393581e-06 0.013434957 4.522903
## 228617_at  0.25440943 5.754949 5.004232 2.429005e-06 0.013434957 4.500641
## 222986_s_at 0.05173578 7.893641 4.998069 2.491800e-06 0.013434957 4.257048
## 206133_at  0.24167375 5.082622 4.952401 3.009000e-06 0.014209066 4.346784

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Complexity.original.rda")

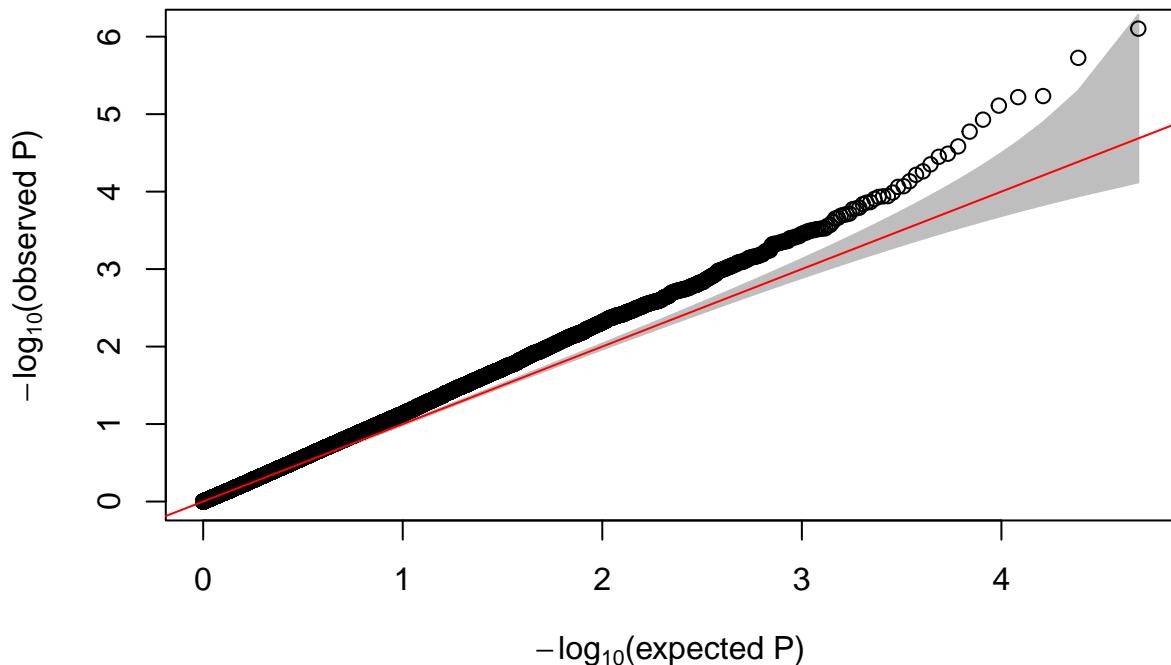
summa.fit.comp <- decideTests(fit)
toptable.comp <- topTable(fit, coef = "Complexity.original", number = dim(counts.ok)[1])
toptable.comp <- toptable.comp[order(toptable.comp$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Complexity.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Complexity.original)
```



```
summary(summa.fit.comp)
```

```

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           602            0     89      0     0            0            0
## NotSig        22629        48525  48368  48525  48524        48525        48525
## Up            25294            0     68      0     1            0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down            0            0            0            0            0            0
## NotSig        48525            48525            48525        48525        48525        48525
## Up            0            0            0            0            0            0
##          Complexity.original   X1      X2      X3      X4      X5      X6      X7      X8
## Down           1 18453 16252 13936 12365 10621 10673 7125 7273
## NotSig        48523 12788 19494 22217 25221 26755 28372 32680 33552
## Up            1 17284 12779 12372 10939 11149 9480 8720 7700
##          X9      X10      X11      X12      X13      X14      X15      X16      X17      X18      X19
## Down         7928    7843    8264    5402    5280    5733    4518    4010    3268    2648    2555
## NotSig      32762   32621   33408   36673   36535   37358   38937   40437   41054   43509   43302
## Up          7835   8061   6853   6450   6710   5434   5070   4078   4203   2368   2668

head(toptable.comp, 10)

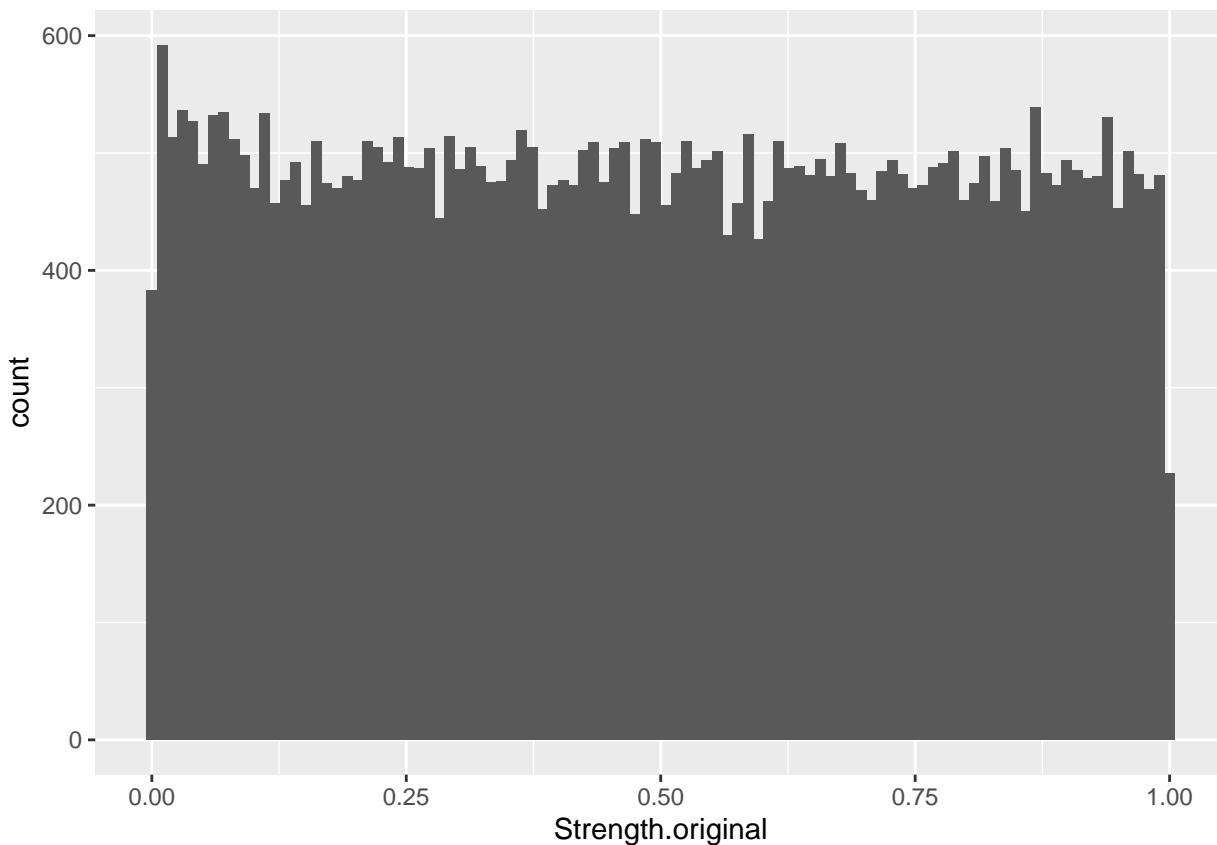
##          logFC      AveExpr       t     P.Value adj.P.Val      B
## 203893_at -0.10050961  5.0379308 -5.272424 7.878688e-07 0.03823133 5.598422
## 1554830_a_at  0.19450868  2.6289573  5.066498 1.876000e-06 0.04551646 4.566115
## 1555229_a_at  0.39726757  0.6820437  4.789937 5.843420e-06 0.07319211 3.101878
## 1562121_at   0.17741058  0.1193435  4.782027 6.033352e-06 0.07319211 2.721147
## 216922_x_at   0.20685436 -0.3358964  4.719360 7.765207e-06 0.07536134 2.227633
## 201645_at    0.26393274  1.8007395  4.614905 1.177649e-05 0.09524232 2.868120
## 219675_s_at   0.09202201  5.0965517  4.524326 1.682589e-05 0.11663945 2.790847
## 224785_at    -0.15243003  3.6686028 -4.411605 2.608065e-05 0.15819547 2.358060
## 217279_x_at   0.21032113  0.8980683  4.355177 3.239944e-05 0.17238384 1.785049
## 218315_s_at  -0.09323833  3.2742864 -4.331093 3.552475e-05 0.17238384 2.070468

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Strength.original.rda")

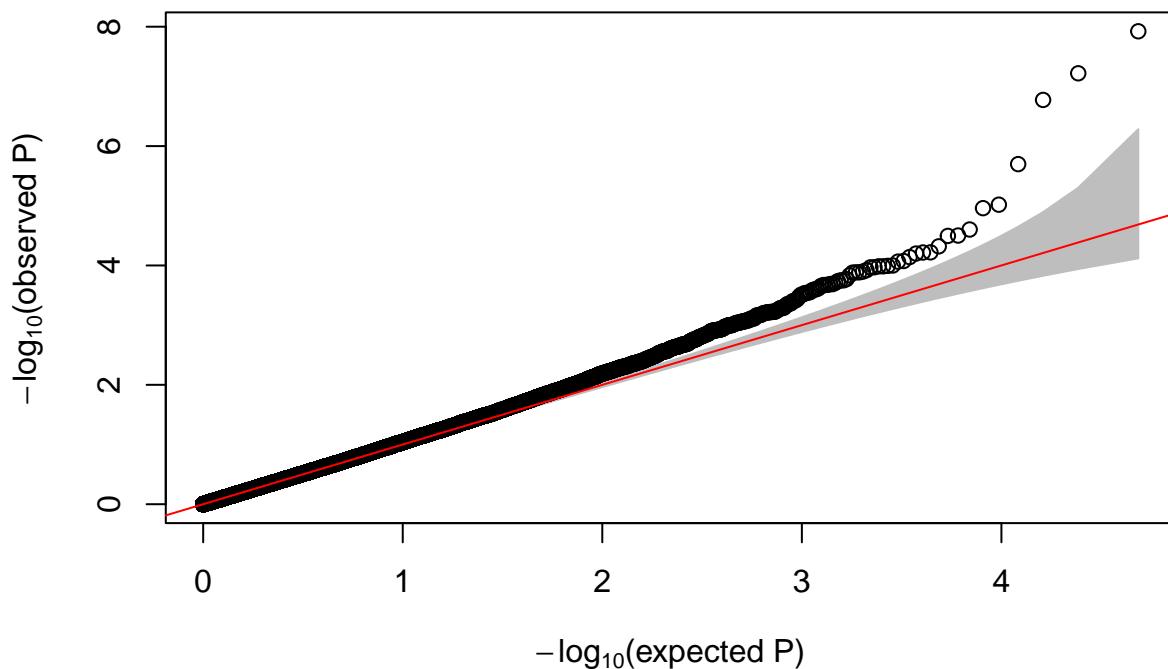
summa.fit.strength <- decideTests(fit)
toptable.strength <- topTable(fit, coef = "Strength.original", number =
dim(counts.ok)[1])
toptable.strength <- toptable.strength[order(toptable.strength$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = Strength.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$Strength.original)
```



```
summary(summa.fit.strength)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      603      0     94      0      0      0      0
## NotSig   22973    48525  48371  48525  48523   48525    48525
## Up       24949      0     60      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
## Strength.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      0 18551 16212 14053 12422 10398 10727 7263 7300 8095
## NotSig   48521 12705 19646 21933 25134 27152 28328 32403 33449 32513
## Up       4 17269 12667 12539 10969 10975 9470 8859 7776 7917
## X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down    7893 8273 5523 5254 5597 4706 4189 2930 2694 2513
## NotSig  32505 33429 36406 36711 37246 38669 40175 41727 43434 43394
## Up      8127 6823 6596 6560 5682 5150 4161 3868 2397 2618
head(toptable.strength, 10)

```

```

##          logFC     AveExpr      t     P.Value adj.P.Val      B
## 1557124_at  0.23097028 1.1177454 6.218611 1.193466e-08 0.0005791295 9.423889
## 210299_s_at  0.17385089 2.8765271 5.860849 6.032529e-08 0.0014636423 8.019843
## 215704_at   0.32925757 0.7895572 5.629074 1.685273e-07 0.0027259287 6.987630
## 215109_at   0.12211612 2.9937086 5.050635 2.004632e-06 0.0243186924 4.747304
## 225601_at   0.15841982 1.3044442 4.666745 9.585570e-06 0.0886396168 3.294559
## 234455_at   -0.28398360 -1.6105994 -4.633064 1.096008e-05 0.0886396168 1.512755
## 214505_s_at  0.15118216 2.0527430 4.422875 2.497340e-05 0.1723586820 2.430373
## 201540_at   0.12429598 4.4346419 4.362381 3.152178e-05 0.1723586820 2.078193
## 234952_s_at  0.07680998 2.9083361 4.358716 3.196761e-05 0.1723586820 2.209159
## 1559612_at  0.16889162 1.3911415 4.252768 4.783372e-05 0.2321131328 1.841648

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Imc1.original.rda")
summa.fit.imc1 <- decideTests(fit)
summary(summa.fit.imc1)

```

```

##      (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      596      0     94      0      0      0      0
## NotSig   22658    48525  48370  48525  48523   48525    48525
## Up       25271      0     61      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
## Imc1.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      0 18548 16176 13844 12308 10571 10850 7040 7021 8230
## NotSig   48525 12721 19849 22210 25260 26945 28093 32637 34231 32247
## Up       0 17256 12500 12471 10957 11009 9582 8848 7273 8048
## X10     X11     X12     X13     X14     X15     X16     X17     X18     X19     X20
## Down    7956 8389 5436 5429 5784 4815 4335 3022 2774 2612 2231
## NotSig  32500 33111 36518 36214 36989 38366 39906 41338 43272 43114 44117
## Up      8069 7025 6571 6882 5752 5344 4284 4165 2479 2799 2177

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Imc2.original.rda")
summa.fit.imc2 <- decideTests(fit)

```

```

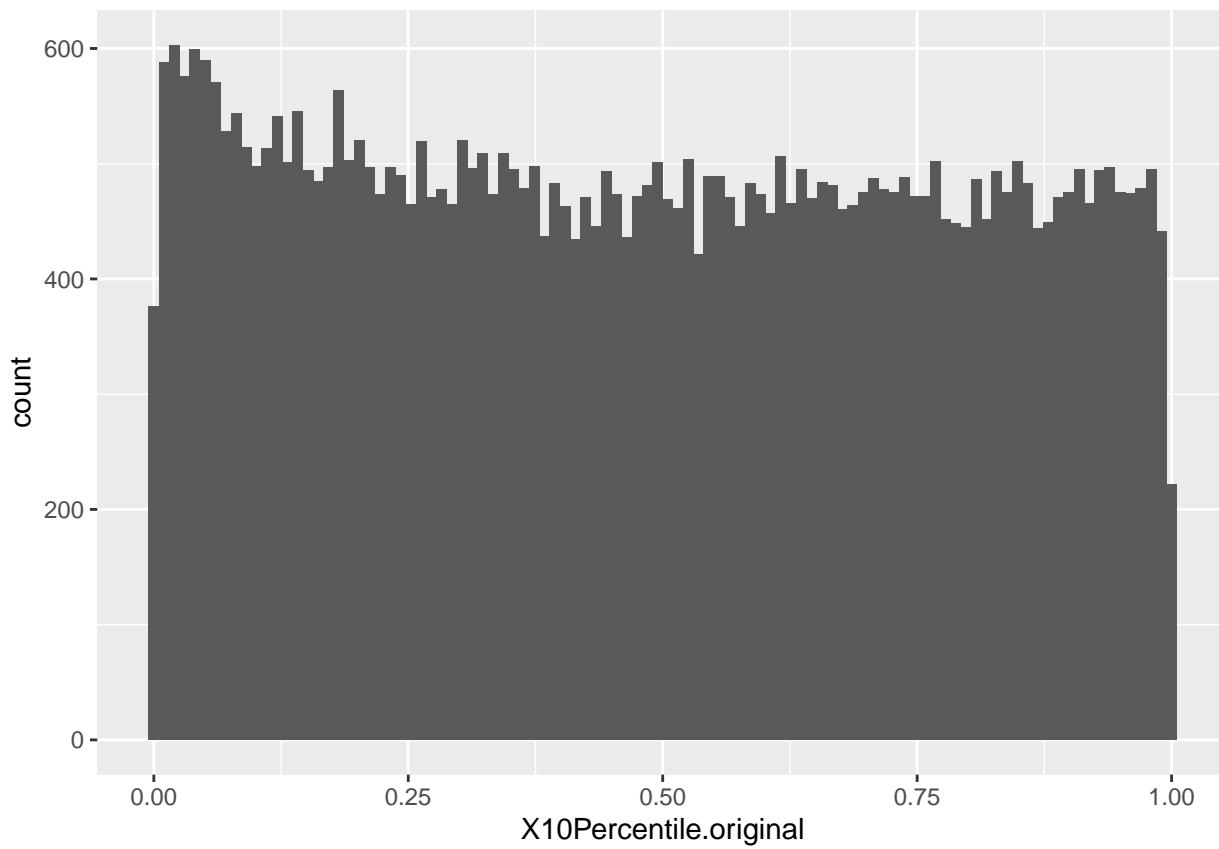
summary(summa.fit.imc2)

##          (Intercept) GroupSevere  SexM    Age Dwalk FEV1PSPC fume_exposeY
## Down           601          0    92     0     0      0            0
## NotSig        22684        48525 48372 48525 48523    48525        48525
## Up            25240          0    61     0     2      0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0            0            0            0            0
## NotSig        48525        48525        48525        48525        48525        48525
## Up             0            0            0            0            0            0
##          Imc2.original   X1      X2      X3      X4      X5      X6      X7      X8      X9
## Down           0 18515 16160 13869 12361 10488 10678 7038 7171 8091
## NotSig        48525 12714 19812 22196 25190 27075 28427 32785 33736 32483
## Up            0 17296 12553 12460 10974 10962 9420 8702 7618 7951
##          X10      X11      X12      X13      X14      X15      X16      X17      X18      X19
## Down           7872 8229 5533 5294 5643 4645 4095 3080 2630 2678
## NotSig        32621 33389 36384 36477 37298 38772 40354 41353 43536 43327
## Up            8032 6907 6608 6754 5584 5108 4076 4092 2359 2520

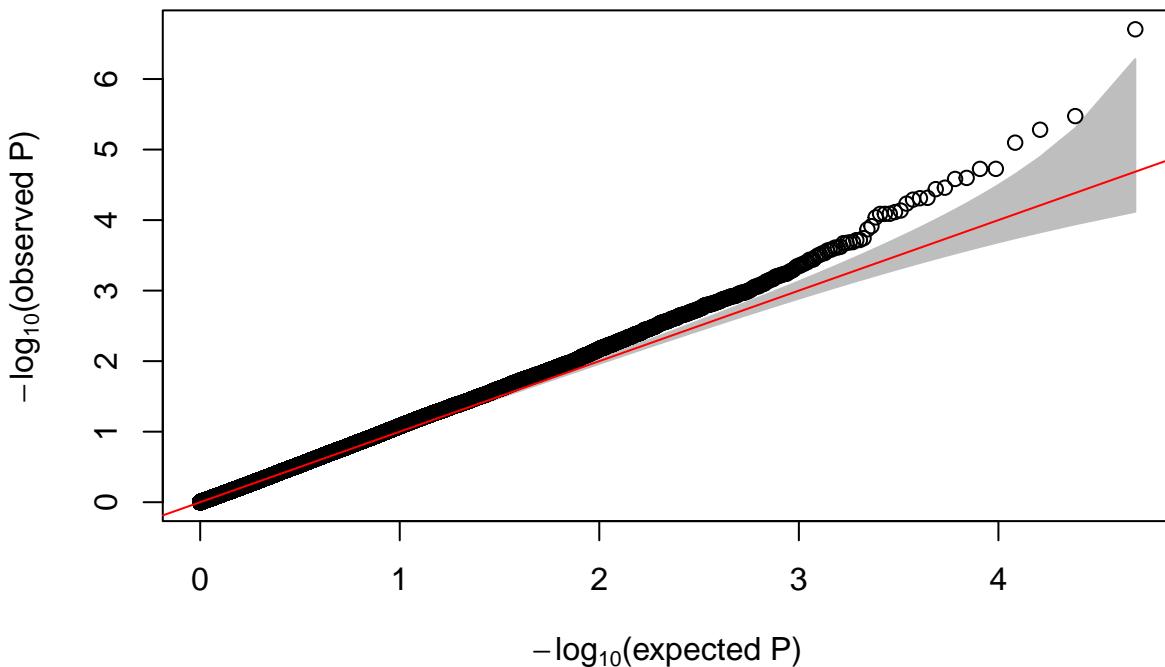
load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/X10Percentile.original.rda")
summa.fit.X10 <- decideTests(fit)
toptable.X10 <- topTable(fit, coef = "X10Percentile.original", number =
dim(counts.ok)[1])
toptable.X10 <- toptable.X10[order(toptable.X10$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = X10Percentile.original)) + geom_histogram(bins = 100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$X10Percentile.original)
```



```
summary(summa.fit.X10)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      591      0    98      0      0      0      0
## NotSig   22727  48525  48362  48525  48523  48525  48525
## Up       25207      0    65      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0          0
## NotSig        48525        48525        48525        48525        48525        48525
## Up           0          0          0          0          0          0          0
##      X10Percentile.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down          0 18567 16135 14054 12413 10356 10713 7173 7247
## NotSig        48524 12694 19844 21934 25112 27338 28370 32406 33503
## Up            1 17264 12546 12537 11000 10831 9442 8946 7775
##      X9     X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down      8164  7840  8281  5505  5300  5596  4698  4301  2845  2722  2591
## NotSig   32375 32685 33314 36443 36525 37220 38683 39935 41749 43332 43210
## Up       7986  8000  6930  6577  6700  5709  5144  4289  3931  2471  2724
head(toptable.X10, 10)

```

```

##              logFC    AveExpr         t    P.Value adj.P.Val      B
## 225418_at    1.8679623 3.3494210  5.593235 1.972251e-07 0.00957035 5.969165
## 1570578_at   1.2890057 1.4967816  4.926212 3.353578e-06 0.08136618 3.175678
## 232079_s_at   2.0221278 2.6051990  4.817120 5.235331e-06 0.08468148 3.085408
## 232078_at    1.7369539 0.8111837  4.712473 7.984488e-06 0.09686182 2.012978
## 217446_x_at  -0.4377652 4.1435225 -4.496340 1.877505e-05 0.15212013 2.385669
## 1564028_s_at  1.6186633 0.2894055  4.495873 1.880929e-05 0.15212013 1.267321
## 202231_at     0.3063878 6.7005036  4.420212 2.523273e-05 0.15841033 2.420150
## 205734_s_at  -0.8839158 2.0935103 -4.411301 2.611608e-05 0.15841033 1.437815
## 203149_at     0.9965351 4.0875738  4.336939 3.474648e-05 0.17672114 1.879047
## 202367_at     0.5145628 2.8798338  4.324626 3.641858e-05 0.17672114 1.500392

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/X90Percentile.original.rda")
summa.fit.X90 <- decideTests(fit)
summary(summa.fit.X90)

```

```

##      (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      566      0    96      0      0      0      0
## NotSig   22801  48525  48369  48525  48523  48525  48525
## Up       25158      0    60      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down          0          0          0          0          0          0          0
## NotSig        48525        48525        48525        48525        48525        48525
## Up           0          0          0          0          0          0          0
##      X90Percentile.original   X1     X2     X3     X4     X5     X6     X7     X8
## Down          0 18554 16213 13877 12334 10334 10718 7184 7259
## NotSig        48525 12686 19695 22170 25208 27320 28340 32390 33490
## Up            0 17285 12617 12478 10983 10871 9467 8951 7776
##      X9     X10     X11     X12     X13     X14     X15     X16     X17     X18     X19
## Down      8139  7819  8287  5562  5339  5611  4689  4277  2973  2692  2600
## NotSig   32421 32785 33323 36311 36456 37254 38697 39987 41506 43427 43201
## Up       7965  7921  6915  6652  6730  5660  5139  4261  4046  2406  2724

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Entropy.original.rda")
summa.fit.ent <- decideTests(fit)

```

```

summary(summa.fit.ent)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           605          0    93     0     0       0           0
## NotSig        22617        48525 48364 48525 48524      48525        48525
## Up            25303          0    68     0     1       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0       0           0
## NotSig        48525          48525          48525        48525        48525        48525
## Up             0             0           0           0       0       0           0
##          Entropy.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down           0 18453 16242 13878 12329 10569 10661 7119 7269 7952
## NotSig        48525 12780 19563 22275 25304 26884 28393 32706 33533 32734
## Up            0 17292 12720 12372 10892 11072 9471 8700 7723 7839
##          X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down          7859  8259  5446  5268  5713  4534  3988  3273  2659  2536
## NotSig        32582 33430 36568 36540 37380 38919 40510 41039 43500 43347
## Up            8084  6836  6511  6717  5432  5072  4027  4213  2366  2642

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Energy.original.rda")
summa.fit.ency <- decideTests(fit)
summary(summa.fit.ency)

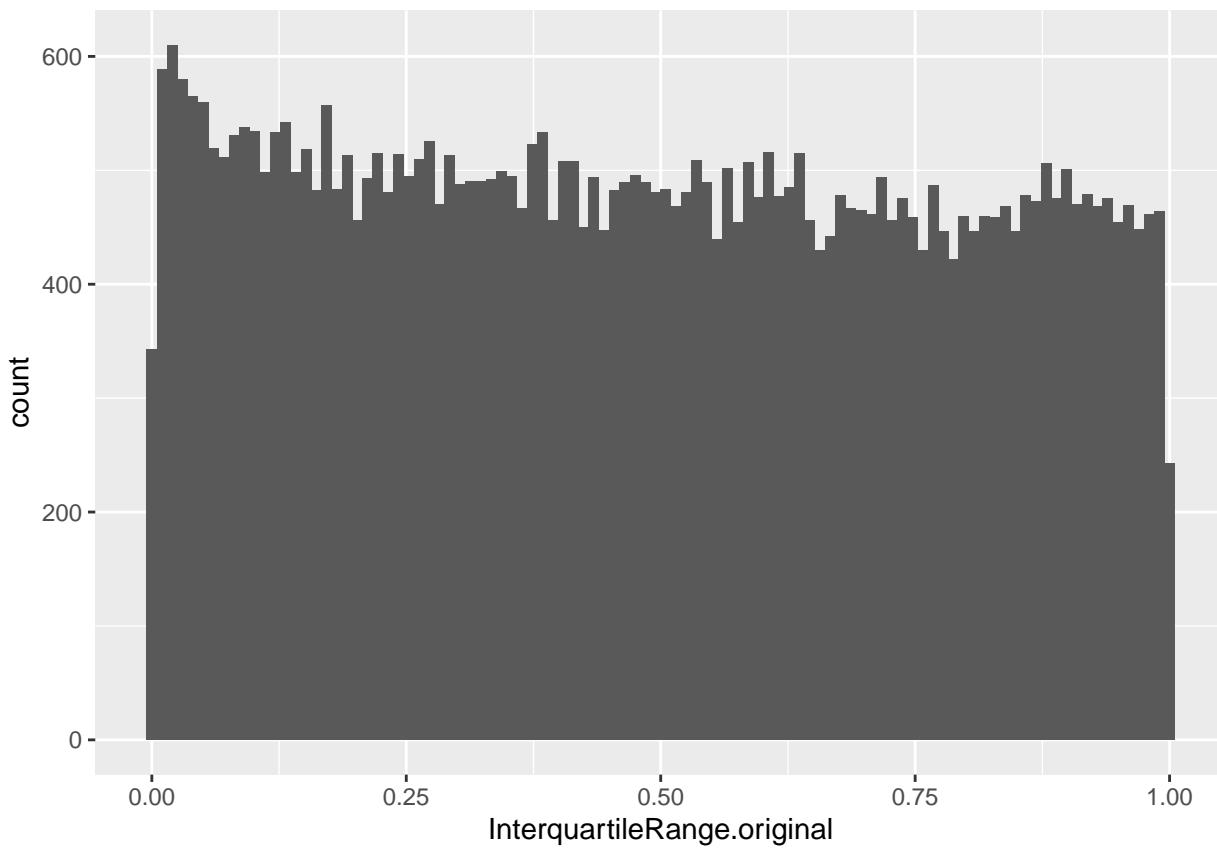
##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down           573          0    94     0     0       0           0
## NotSig        22882        48525 48365 48525 48523      48525        48525
## Up            25070          0    66     0     2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0             0           0           0       0       0           0
## NotSig        48525          48525          48525        48525        48525        48525
## Up             0             0           0           0       0       0           0
##          Energy.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down           0 18574 16147 14064 12374 10380 10553 7149 7284 8024
## NotSig        48525 12669 19782 21911 25142 27199 28702 32542 33419 32579
## Up            0 17282 12596 12550 11009 10946 9270 8834 7822 7922
##          X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down          7887  8237  5602  5351  5626  4653  4267  2722  2709  2606
## NotSig        32561 33456 36222 36452 37166 38678 40039 42047 43353 43155
## Up            8077  6832  6701  6722  5733  5194  4219  3756  2463  2764

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/InterquartileRange.original.rda")

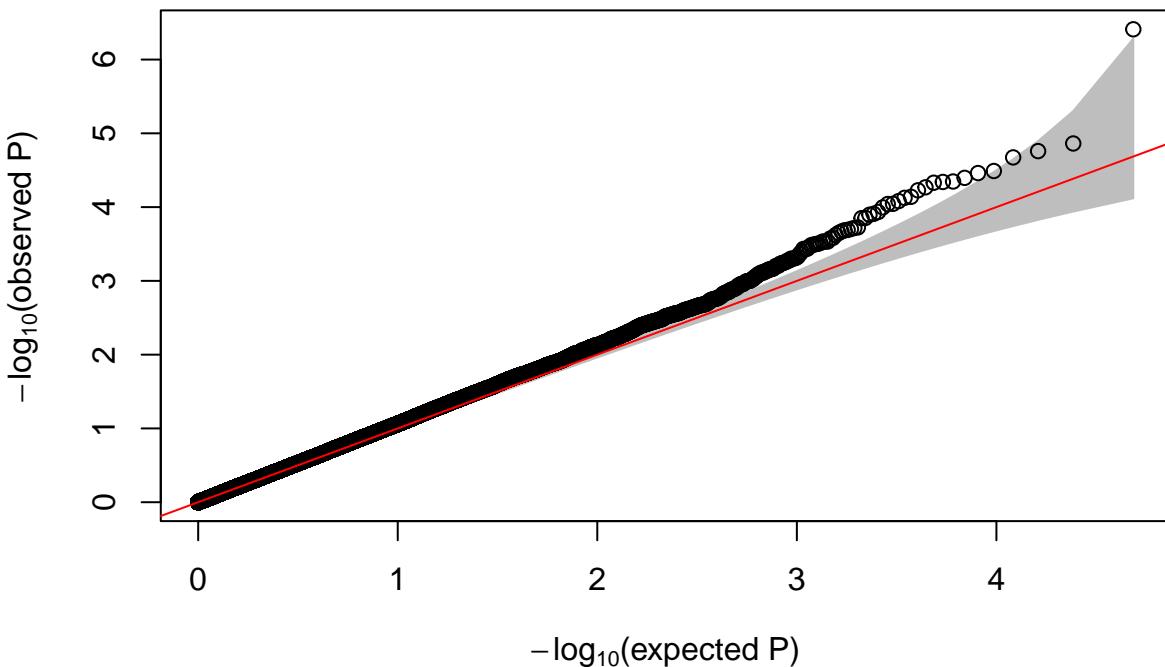
summa.fit.intq <- decideTests(fit)
toptable.intq <- topTable(fit, coef = "InterquartileRange.original", number =
dim(counts.ok)[1])
toptable.intq <- toptable.intq[order(toptable.intq$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = InterquartileRange.original)) + geom_histogram(bins =
100)

```



```
# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$InterquartileRange.original)
```



```
summary(summa.fit.intq)
```

```
## (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
```

```

## Down      559      0     80      0      0      0      0
## NotSig   22801    48525  48404  48525  48523   48525    48525
## Up       25165      0     41      0      2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      InterquartileRange.original X1     X2     X3     X4     X5     X6     X7
## Down      0 18511 16113 13885 12342 10540 10624 7045
## NotSig   48524 12842 19925 22083 25161 26771 28519 32599
## Up       1 17172 12487 12557 11022 11214 9382 8881
##      X8     X9     X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7334  8215  7798  8119  5627  5327  5631  4674  4501  2825  2635  2507
## NotSig  33394 32237 32775 33592 36251 36495 37184 38737 39538 41821 43440 43351
## Up      7797  8073  7952  6814  6647  6703  5710  5114  4486  3879  2450  2667
head(toptable.intq, 10)

```

```

##          logFC     AveExpr      t     P.Value adj.P.Val        B
## 202814_s_at  0.3732773  5.2711632  5.437160 3.889115e-07 0.01887193 5.7703167
## 202815_s_at  0.3568653  4.4813489  4.576102 1.373196e-05 0.22674183 2.5691282
## 207720_at   -0.5690804  0.6048606 -4.515522 1.742030e-05 0.22674183 0.5659996
## 226426_at   0.2681267  5.3109313  4.465243 2.119344e-05 0.22674183 2.3920929
## 212769_at   -0.2963126  4.9146649 -4.355103 3.241599e-05 0.22674183 1.9381902
## 215897_at   0.4786812  1.0450237  4.338541 3.453621e-05 0.22674183 0.6025368
## 1552915_at  0.9694990 -0.6807490  4.299066 4.014250e-05 0.22674183 -0.7399409
## 218660_at   -0.2880625  6.2337504 -4.269144 4.496611e-05 0.22674183 1.8535282
## 1557126_a_at -0.5475201  2.4320863 -4.265234 4.563611e-05 0.22674183 0.9581359
## 208686_s_at  0.2552648  5.0900203  4.258987 4.672681e-05 0.22674183 1.6876191

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Kurtosis.original.rda")
summa.fit.kur <- decideTests(fit)
summary(summa.fit.kur)

```

```

##      (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      535      0     93     0     1      0      0
## NotSig   22827    48525  48380  48525  48522   48525    48525
## Up       25163      0     52     0     2      0      0
##      dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down      0      0      0      0      0      0      0
## NotSig   48525      48525      48525  48525    48525    48525
## Up       0      0      0      0      0      0      0
##      Kurtosis.original X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down      0 18481 16179 13838 12296 10389 10611 6938 7297 8126
## NotSig   48525 12904 19857 22149 25212 27112 28540 32791 33508 32452
## Up       0 17140 12489 12538 11017 11024 9374 8796 7720 7947
##      X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down    7745  8301  5512  5388  5585  4609  4178  3148  2644  2598
## NotSig  32943 33322 36361 36388 37292 38891 40107 41182 43510 43190
## Up      7837  6902  6652  6749  5648  5025  4240  4195  2371  2737

```

```

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Maximum.original.rda")
summa.fit.max <- decideTests(fit)

```

```

summary(summa.fit.max)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      594           0     89    0    0       0           0
## NotSig    22698        48525 48383 48525 48523     48525       48525
## Up       25233           0    53    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig     48525           48525           48525     48525       48525       48525
## Up            0           0           0           0       0       0           0
##          Maximum.original   X1     X2     X3     X4     X5     X6     X7     X8     X9
## Down           0 18516 16129 14056 12400 10458 10709 7185 7218 8107
## NotSig     48525 12769 19948 21911 25126 27049 28316 32403 33566 32471
## Up            0 17240 12448 12558 10999 11018 9500 8937 7741 7947
##          X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down      7820  8319  5575  5230  5558  4600  4307  2879  2609  2626
## NotSig    32738 33272 36304 36712 37416 38842 39904 41681 43569 43163
## Up       7967  6934  6646  6583  5551  5083  4314  3965  2347  2736

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/MeanAbsoluteDeviation.original.rda")
summa.fit.meanAb <- decideTests(fit)
summary(summa.fit.meanAb)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      568           0    104    0    0       0           0
## NotSig    22792        48525 48354 48525 48523     48525       48525
## Up       25165           0    67    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig     48525           48525           48525     48525       48525       48525
## Up            0           0           0           0       0       0           0
##          MeanAbsoluteDeviation.original   X1     X2     X3     X4     X5     X6     X7
## Down           0 18561 16096 13762 12246 10533 10478 7122
## NotSig     48525 12815 19946 22277 25320 26829 28877 32463
## Up            0 17149 12483 12486 10959 11163 9170 8940
##          X8     X9    X10    X11    X12    X13    X14    X15    X16    X17    X18    X19
## Down      7336  8201  7844  8199  5491  5370  5590  4659  4093  3044  2644  2770
## NotSig    33413 32259 32766 33394 36481 36407 37226 38761 40279 41482 43508 43175
## Up       7776  8065  7915  6932  6553  6748  5709  5105  4153  3999  2373  2580

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Mean.original.rda")
summa.fit.mean <- decideTests(fit)
summary(summa.fit.mean)

##          (Intercept) GroupSevere SexM   Age Dwalk FEV1PSPC fume_exposeY
## Down      581           0    96    0    0       0           0
## NotSig    22780        48525 48363 48525 48523     48525       48525
## Up       25164           0    66    0    2       0           0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezengY
## Down           0           0           0           0       0       0           0
## NotSig     48525           48525           48525     48525       48525       48525
## Up            0           0           0           0       0       0           0

```

```

##      Mean.original   X1    X2    X3    X4    X5    X6    X7    X8    X9
## Down          0 18564 16167 14001 12370 10304 10744 7181 7254 8138
## NotSig        48525 12683 19791 22009 25158 27426 28285 32411 33498 32413
## Up           0 17278 12567 12515 10997 10795 9496 8933 7773 7974
##      X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down     7839  8305  5516  5346  5608  4691  4271  2931  2702  2592
## NotSig   32730 33294 36393 36443 37227 38692 39998 41590 43368 43197
## Up       7956  6926  6616  6736  5690  5142  4256  4004  2455  2736

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Median.original.rda")
summa.fit.med <- decideTests(fit)
summary(summa.fit.med)

##      (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down          586          0  96   0   0   0   0
## NotSig        22756        48525 48363 48525 48523 48525 48525
## Up           25183          0  66   0   2   0   0
##      dusty_exposeY history_asthmaY CoughNo chronic cough  BMI Cr_wheezengY
## Down          0             0           0           0           0           0
## NotSig        48525         48525         48525         48525         48525
## Up            0             0           0           0           0           0
##      Median.original   X1    X2    X3    X4    X5    X6    X7    X8    X9
## Down          0 18562 16155 14026 12378 10307 10730 7178 7252 8134
## NotSig        48525 12685 19807 21979 25152 27451 28313 32422 33474 32411
## Up           0 17278 12563 12520 10995 10767 9482 8925 7799 7980
##      X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down     7846  8280  5515  5329  5596  4690  4256  2913  2706  2589
## NotSig   32725 33317 36408 36451 37253 38689 40020 41628 43369 43185
## Up       7954  6928  6602  6745  5676  5146  4249  3984  2450  2751

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Minimum.original.rda")
summa.fit.min <- decideTests(fit)
summary(summa.fit.min)

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/Range.original.rda")
summa.fit.range <- decideTests(fit)
summary(summa.fit.range)

##      (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down          594          0  89   0   0   0   0
## NotSig        22698        48525 48383 48525 48523 48525 48525
## Up           25233          0  53   0   2   0   0
##      dusty_exposeY history_asthmaY CoughNo chronic cough  BMI Cr_wheezengY
## Down          0             0           0           0           0           0
## NotSig        48525         48525         48525         48525         48525
## Up            0             0           0           0           0           0
##      Range.original   X1    X2    X3    X4    X5    X6    X7    X8    X9
## Down          0 18516 16129 14056 12400 10458 10709 7185 7218 8107
## NotSig        48525 12769 19948 21911 25126 27049 28316 32403 33566 32471
## Up           0 17240 12448 12558 10999 11018 9500 8937 7741 7947
##      X10   X11   X12   X13   X14   X15   X16   X17   X18   X19
## Down     7820  8319  5575  5230  5558  4600  4307  2879  2609  2626

```

```

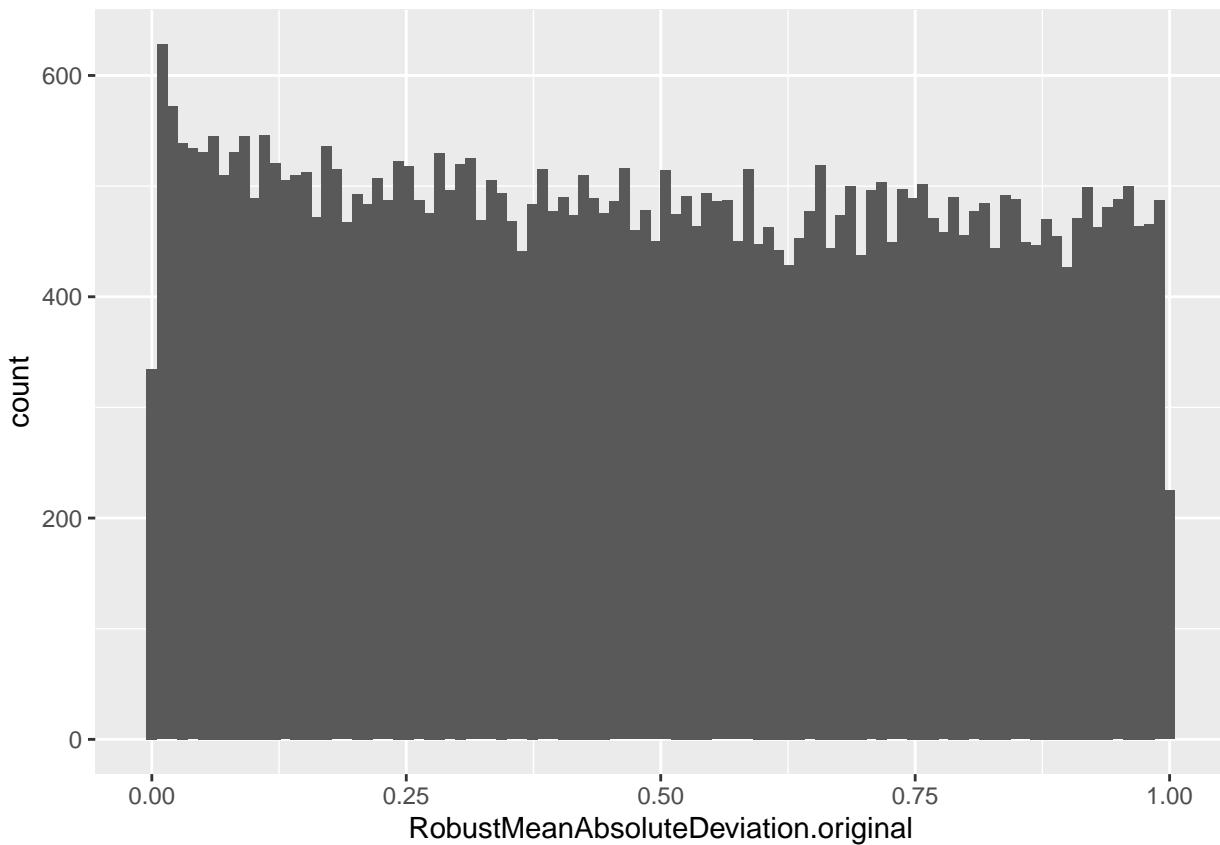
## NotSig 32738 33272 36304 36712 37416 38842 39904 41681 43569 43163
## Up      7967   6934   6646   6583   5551   5083   4314   3965   2347   2736

load("/Users/carlacasanova/Downloads/Radiomic features models
(indiv)/RobustMeanAbsoluteDeviation.original.rda")

summa.fit.robustM <- decideTests(fit)
toptable.robustM <- topTable(fit, coef = "RobustMeanAbsoluteDeviation.original",
                               number = dim(counts.ok)[1])
toptable.robustM <- toptable.robustM[order(toptable.robustM$P.Value), ]
p.val.voom <- as.data.frame(fit$p.value)

# P-value distribution of results computed by limma
ggplot(data = p.val.voom, aes(x = RobustMeanAbsoluteDeviation.original)) +
  geom_histogram(bins = 100)

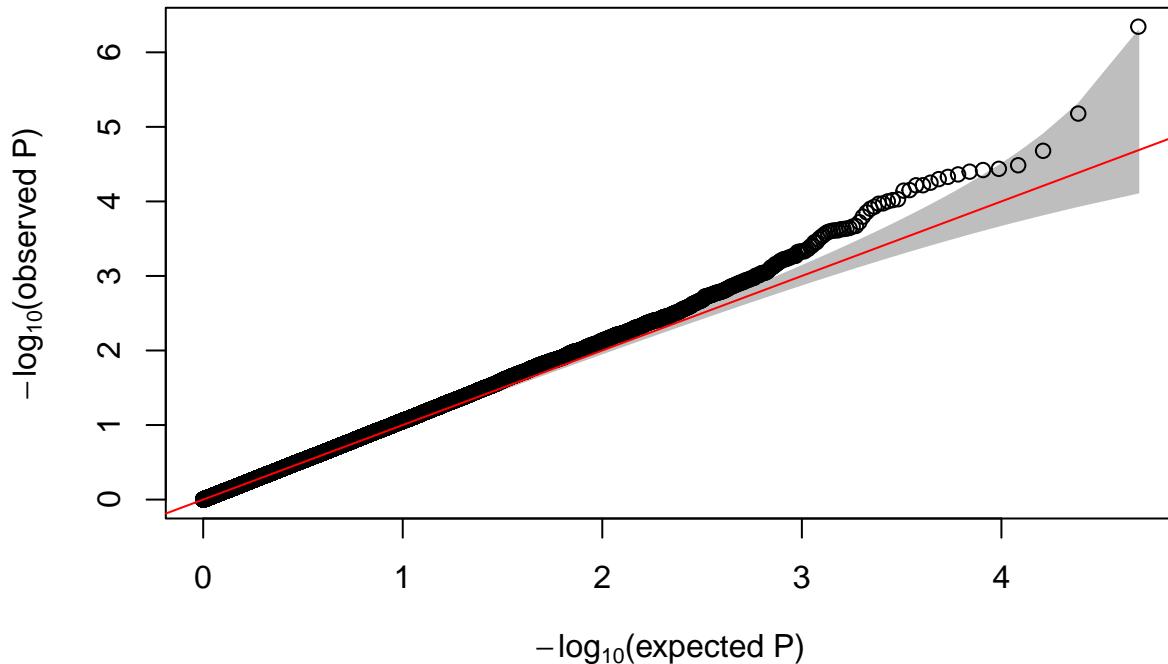
```



```

# QQplot plot for p-values computed by limma
GWASTools::qqPlot(p.val.voom$RobustMeanAbsoluteDeviation.original)

```



```
summary(summa.fit.robustM)
```

```
##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down      566        0    99   0    0     0       0
## NotSig    22696      48525 48361 48525 48523 48525 48525
## Up       25263        0    65   0    2     0       0
##          dusty_exposeY history_asthmaY CoughNo chronic cough   BMI Cr_wheezezengY
## Down      0           0           0       0     0       0       0
## NotSig   48525      48525           48525 48525 48525 48525
## Up        0           0           0       0     0       0       0
##          RobustMeanAbsoluteDeviation.original X1 X2 X3 X4 X5 X6
## Down                   0 18524 16210 13858 12205 10647 10700
## NotSig                48524 12753 19744 22125 25456 26600 28351
## Up                    1 17248 12571 12542 10864 11278 9474
##          X7 X8 X9 X10 X11 X12 X13 X14 X15 X16 X17 X18
## Down    7078 7330 8322 7918 8235 5505 5431 5744 4807 4318 2976 2801
## NotSig  32530 33465 32004 32540 33328 36427 36254 37017 38427 39856 41458 43145
## Up      8917 7730 8199 8067 6962 6593 6840 5764 5291 4351 4091 2579
##          X19 X20
## Down    2858 2168
## NotSig  43005 44198
## Up      2662 2159
```

```
head(toptable.robustM, 10)
```

	logFC	AveExpr	t	P.Value	adj.P.Val	B
## 202814_s_at	0.3866122	5.2711632	5.405595	4.528322e-07	0.02197368	5.6158215
## 207720_at	-0.6189316	0.6048606	-4.761404	6.628514e-06	0.16082433	1.0151831
## 230825_at	0.6573018	1.0470995	4.470464	2.094525e-05	0.22706849	0.8956456
## 202815_s_at	0.3562382	4.4813489	4.354616	3.273064e-05	0.22706849	1.8481946
## 231264_at	0.9482917	1.0264606	4.325574	3.656647e-05	0.22706849	0.4529331
## 212769_at	-0.3040292	4.9146649	-4.315810	3.795082e-05	0.22706849	1.7962493
## 1552915_at	1.0046610	-0.6807490	4.302613	3.990243e-05	0.22706849	-0.8322306

```

## 213132_s_at -0.4582360 1.4077957 -4.280209 4.343885e-05 0.22706849 0.5001447
## 201969_at 0.2865061 3.3327030 4.259980 4.688979e-05 0.22706849 1.2723018
## 215897_at 0.4901017 1.0450237 4.241656 5.024250e-05 0.22706849 0.2949648

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/RootMeanSquared.original.rda")
summa.fit.root <- decideTests(fit)
summary(summa.fit.root)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down           566          0    92   0     0      0            0
## NotSig        22821        48525 48374 48525 48523    48525        48525
## Up            25138          0    59   0     2      0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0            0            0            0            0
## NotSig        48525        48525        48525        48525        48525        48525
## Up             0            0            0            0            0            0
##          RootMeanSquared.original X1   X2   X3   X4   X5   X6   X7   X8
## Down           0 18511 16132 14056 12435 10415 10407 6961 7356
## NotSig        48525 12703 19905 21934 25090 27025 28964 32767 33479
## Up            0 17311 12488 12535 11000 11085 9154 8797 7690
##          X9   X10  X11  X12  X13  X14  X15  X16  X17  X18  X19  X20
## Down         8155 8020 8298 5546 5499 5723 4714 4256 2952 2864 2450 2343
## NotSig      32290 32243 33308 36381 36177 37044 38582 39960 41534 43151 43470 43937
## Up          8080 8262 6919 6598 6849 5758 5229 4309 4039 2510 2605 2245

load("/Users/carlacasanovasuarez/Desktop/Radiomic features models
(indiv)/Skewness.original.rda")
summa.fit.skw <- decideTests(fit)
summary(summa.fit.skw)

##          (Intercept) GroupSevere SexM Age Dwalk FEV1PSPC fume_exposeY
## Down           534          0    83   0     1      0            0
## NotSig        22820        48525 48396 48525 48522    48525        48525
## Up            25171          0    46   0     2      0            0
##          dusty_exposeY history_asthmaY CoughNo chronic cough    BMI Cr_wheezengY
## Down           0            0            0            0            0            0
## NotSig        48525        48525        48525        48525        48525        48525
## Up             0            0            0            0            0            0
##          Skewness.original X1   X2   X3   X4   X5   X6   X7   X8   X9
## Down           0 18496 16185 13823 12325 10409 10610 7047 7325 8122
## NotSig        48525 12874 19833 22165 25164 27065 28537 32618 33454 32467
## Up            0 17155 12507 12537 11036 11051 9378 8860 7746 7936
##          X10  X11  X12  X13  X14  X15  X16  X17  X18  X19
## Down         7757 8299 5525 5396 5596 4613 4161 3181 2628 2609
## NotSig      32893 33307 36349 36376 37286 38878 40115 41107 43526 43136
## Up          7875 6919 6651 6753 5643 5034 4249 4237 2371 2780

```

Features with positive DE

Load RadAR object in order to retrieve rowdata later:

```

load("/Users/carlacasanovasuarez/Documents/Master Bioinformatics UAB/Prácticas
Radiomics/Radiomic
features/Results_rfeatures/radar_L1_Norm_scaled_adjusted_min_int_center_final.rda")
rdr_L1_final

```

```

## class: SummarizedExperiment
## dim: 101 1773
## metadata(1): extractor
## assays(2): values adjusted_min_int_center
## rownames(101): Elongation.original Flatness.original ...
## Complexity.original Strength.original
## rowData names(4): feature_name image_type feature_description
## feature_type
## colnames(1773): 2314000005 2314000006 ... 26658003992 26658003997
## colData names(201): filename sample_id ... change.fv1 D_SUBJID

```

Load annotation data of genes stored in annotation.sputum.ok object to check which ones have annotations:

```

load("/Users/carlacasanovasuarez/Documents/Master Bioinformatics UAB/Prácticas
Radiomics/Radiomic features/Results_rfeatures/R objects/sputum_eset_annotationOK.rda")

```

Create a vector with feature names of features positively associated with genes DE:

```

pos_rf <- c("Sphericity.original", "Variance.original", "Autocorrelation.original",
           "ClusterShade.original", "Contrast.original", "DifferenceAverage.original",
           "Id.original",
           "Idm.original", "Idmn.original", "Idn.original", "InverseVariance.original",
           "JointAverage.original", "SumAverage.original", "HighGrayLevelEmphasis.original",
           "LongRunLowGrayLevelEmphasis.original", "LowGrayLevelRunEmphasis.original",
           "RunPercentage.original",
           "LargeAreaEmphasis.original", "LowGrayLevelEmphasis.original",
           "LargeAreaHighGrayLevelEmphasis.original",
           "LargeAreaLowGrayLevelEmphasis.original", "SmallAreaEmphasis.original",
           "SmallAreaHighGrayLevelEmphasis.original",
           "SmallAreaLowGrayLevelEmphasis.original", "ZoneVariance.original",
           "DependenceNonUniformity.original",
           "HighGrayLevelRunEmphasis.original", "LargeDependenceEmphasis.original",
           "LargeDependenceLowGrayLevelEmphasis.original",
           "Busyness.original", "Coarseness.original", "Complexity.original",
           "Strength.original",
           "X10Percentile.original", "InterquartileRange.original")

```

Not all the features are equally robust. We're just interested in *first order, shape* and *glcm*:

```

# Create a data frame with feature types
feature_names <- substr(pos_rf, 1, nchar(pos_rf) - 9)

# Check row data of rdr object which as feature name and feature type
ids <- rowData(rdr_L1_final)$feature_name %in% feature_names
out <- cbind(feature_names, feature.type = rowData(rdr_L1_final)[ids, ]$feature_type)
out <- as.data.frame(out)

out

```

##	feature_names	feature.type
## 1	Sphericity	first_order_shape
## 2	Variance	first_order_statistics
## 3	Autocorrelation	first_order_statistics
## 4	ClusterShade	grey_level_co-occurrence_matrix
## 5	Contrast	grey_level_co-occurrence_matrix
## 6	DifferenceAverage	grey_level_co-occurrence_matrix
## 7	Id	grey_level_co-occurrence_matrix
## 8	Idm	grey_level_co-occurrence_matrix
## 9	Idmn	grey_level_co-occurrence_matrix
## 10	Idn	grey_level_co-occurrence_matrix
## 11	InverseVariance	grey_level_co-occurrence_matrix
## 12	JointAverage	grey_level_co-occurrence_matrix
## 13	SumAverage	grey_level_co-occurrence_matrix
## 14	HighGrayLevelEmphasis	grey_level_co-occurrence_matrix
## 15	LongRunLowGrayLevelEmphasis	grey_level_run_length_matrix
## 16	LowGrayLevelRunEmphasis	grey_level_run_length_matrix
## 17	RunPercentage	grey_level_run_length_matrix
## 18	LargeAreaEmphasis	grey_level_run_length_matrix
## 19	LowGrayLevelEmphasis	grey_level_run_length_matrix
## 20	LargeAreaHighGrayLevelEmphasis	grey_level_size_zone_matrix
## 21	LargeAreaLowGrayLevelEmphasis	grey_level_size_zone_matrix
## 22	SmallAreaEmphasis	grey_level_size_zone_matrix
## 23	SmallAreaHighGrayLevelEmphasis	grey_level_size_zone_matrix
## 24	SmallAreaLowGrayLevelEmphasis	grey_level_size_zone_matrix
## 25	ZoneVariance	grey_level_size_zone_matrix
## 26	DependenceNonUniformity	grey_level_size_zone_matrix
## 27	HighGrayLevelRunEmphasis	grey_level_dependence_matrix
## 28	LargeDependenceEmphasis	grey_level_dependence_matrix
## 29	LargeDependenceLowGrayLevelEmphasis	grey_level_dependence_matrix
## 30	Busyness	grey_level_dependence_matrix
## 31	Coarseness	neighbouring_grey_tone_difference_matrix
## 32	Complexity	neighbouring_grey_tone_difference_matrix
## 33	Strength	neighbouring_grey_tone_difference_matrix
## 34	X10Percentile	first_order_statistics
## 35	InterquartileRange	first_order_shape

First order enrichment analysis

Check features are *first order*:

```
first.order.DE <- out[out$feature.type == "first_order_statistics", ]  
  
# In this case, the only features correlated are LowGrayLevelEmphasis and  
# Autocorrelation  
first.order.DE
```

```
##      feature_names      feature.type  
## 2          Variance first_order_statistics  
## 3      Autocorrelation first_order_statistics  
## 19 LowGrayLevelEmphasis first_order_statistics  
## 34      X10Percentile first_order_statistics
```

Store names of genes DE (p.adj < 0.01 if possible):

```

# Create bools for genes with the most restrictive p.value
dd.fo.Auto <- toptable.autoc$adj.P.Val < 0.01 & !is.na(toptable.autoc$adj.P.Val)
dd.fo.Variance <- toptable.variance$adj.P.Val < 0.04 &
!is.na(toptable.variance$adj.P.Val)
dd.fo.X10 <- toptable.X10$adj.P.Val < 0.01 & !is.na(toptable.X10$adj.P.Val)

deGenes.fo <- c(rownames(toptable.variance[dd.fo.Variance, ]),
rownames(toptable.X10[dd.fo.X10,
]),
rownames(toptable.autoc[dd.fo.Auto, ]))

deGenes.fo

## [1] "202814_s_at" "230825_at"    "1561431_at"   "225418_at"    "212329_at"
## [6] "227973_at"

length(deGenes.fo)

## [1] 6

table(duplicated(deGenes.fo))

```

```

##  

## FALSE  

##      6

```

Check if there are annotations available:

```

# Check info
annotation.sputum.ok[deGenes.fo, ]

## # A tibble: 6 x 9
##   PROBEID     ENSEMBL ENTREZID SYMBOL GENENAME GO     EVIDENCE ONTOLOGY GENETYPE
##   <chr>       <chr>   <chr>    <chr>   <chr>   <chr>   <chr>    <chr>
## 1 202814_s_at "ENSG00~" "10614"  "HEXI~" "HEXIM ~" "GO:~" "IBA|IC~" "BP|CC|~" "protei~
## 2 230825_at   ""        ""        ""        ""        ""        ""        ""        ""
## 3 1561431_at  ""        ""        ""        ""        ""        ""        ""        ""
## 4 225418_at   "ENSG00~" "5819"   "NECT~" "nectin~" "GO:~" "HDA|IB~" "BP|CC|~" "protei~
## 5 212329_at   "ENSG00~" "22937"  "SCAP"   "SREBF ~" "GO:~" "IDA|IE~" "BP|CC|~" "protei~
## 6 227973_at   "ENSG00~" "205327" "C2or~" "chromo~" "GO:~" "IDA|IE~" "BP|CC"   "protei~

```

Create gene universe:

```

geneUniverse.fo <- rownames(toptable.autoc[!is.na(toptable.autoc$P.Value), ])
length(geneUniverse.fo)

```

```

## [1] 48525

```

Change annotation to ENTREZ:

```

# Retrieve ENTREZ names
deGenes.fo.entrez <- unlist(mget(deGenes.fo, envir = hgu133plus2ENTREZID, ifnotfound = NA))
geneUniverse.fo.entrez <- unlist(mget(geneUniverse.fo, envir = hgu133plus2ENTREZID,
ifnotfound = NA))

```

GO enrichment:

```

ans.go.fo <- enrichGO(gene = deGenes.fo.entrez, ont = "BP", universe =
geneUniverse.fo.entrez,
  OrgDb = "org.Hs.eg.db", readable = TRUE, pvalueCutoff = 0.05)

# See results
tab.go.fo <- as.data.frame(ans.go.fo@result)
# tab.go.fo<- subset(tab.go.fo, Count>5)
tab.go.fo[1:5, 1:6]

## ID Description
## GO:0045089 GO:0045089 positive regulation of innate immune response
## GO:0050792 GO:0050792 regulation of viral process
## GO:0002833 GO:0002833 positive regulation of response to biotic stimulus
## GO:0045088 GO:0045088 regulation of innate immune response
## GO:0031349 GO:0031349 positive regulation of defense response
## GeneRatio BgRatio pvalue p.adjust
## GO:0045089 2/4 127/15058 0.0004187940 0.03059353
## GO:0050792 2/4 148/15058 0.0005683204 0.03059353
## GO:0002833 2/4 160/15058 0.0006638456 0.03059353
## GO:0045088 2/4 213/15058 0.0011727686 0.03059353
## GO:0031349 2/4 254/15058 0.0016628762 0.03059353

ans.kegg.fo <- enrichKEGG(gene = deGenes.fo.entrez, universe = geneUniverse.fo.entrez,
  organism = "hsa", pvalueCutoff = 0.05)

# See results
tab.kegg.fo <- as.data.frame(ans.kegg.fo@result)
# tab.kegg.fo<- subset(tab.kegg.fo, Count>5)
tab.kegg.fo[1:5, 1:6]

## ID Description GeneRatio BgRatio
## hsa04520 hsa04520 Adherens junction 1/1 68/6910
## hsa04514 hsa04514 Cell adhesion molecules 1/1 144/6910
## hsa05168 hsa05168 Herpes simplex virus 1 infection 1/1 435/6910
## NA <NA> <NA> <NA> <NA>
## NA.1 <NA> <NA> <NA> <NA>
## pvalue p.adjust
## hsa04520 0.00984081 0.02952243
## hsa04514 0.02083936 0.03125904
## hsa05168 0.06295224 0.06295224
## NA NA NA
## NA.1 NA NA
```

DisGeNet analysis. Get API:

```

library(disgenet2r)

# Get API
disgenet_api_key <- get_disgenet_api_key(email = "carlacasanovasuzarez@gmail.com",
  password = "mypassword1234", verbose = TRUE)

Sys.setenv(DISGENET_API_KEY = disgenet_api_key)

res_enrich.fo <- disease_enrichment(entities = deGenes.fo.entrez, vocabulary = "ENTREZ",
  database = "CURATED")
```

```
res.table.disgenet.fo <- res_enrich.fo@qresult
res.table.disgenet.fo
```

	ID	Description	source	Ratio	BgRatio
##					
## 7	C0019348	Herpes Simplex Infections	CURATED	1/3	2/9703
## 23	C0403824	Teratozoospermia	CURATED	1/3	3/9703
## 24	C0403825	Globozoospermia	CURATED	1/3	4/9703
## 38	C1861537	OROFACIAL CLEFT 1	CURATED	1/3	2/9703
## 17	C0079774	Peripheral T-Cell Lymphoma	CURATED	1/3	10/9703
## 18	C0234985	Mental deterioration	CURATED	1/3	9/9703
## 35	C1270972	Mild cognitive disorder	CURATED	1/3	9/9703
## 21	C0338656	Impaired cognition	CURATED	1/3	14/9703
## 15	C0036421	Systemic Scleroderma	CURATED	1/3	19/9703
## 19	C0242339	Dyslipidemias	CURATED	1/3	24/9703
## 27	C0598784	Dyslipoproteinemias	CURATED	1/3	24/9703
## 10	C0026769	Multiple Sclerosis	CURATED	1/3	45/9703
## 31	C0751324	Multiple Sclerosis, Acute Fulminating	CURATED	1/3	45/9703
## 2	C0004153	Atherosclerosis	CURATED	1/3	59/9703
## 9	C0023893	Liver Cirrhosis, Experimental	CURATED	2/3	774/9703
## 16	C0079744	Diffuse Large B-Cell Lymphoma	CURATED	1/3	55/9703
## 37	C1563937	Atherogenesis	CURATED	1/3	59/9703
## 1	C0002395	Alzheimer's Disease	CURATED	1/3	101/9703
## 6	C0011265	Presenile dementia	CURATED	1/3	99/9703
## 13	C0030567	Parkinson Disease	CURATED	1/3	85/9703
## 20	C0276496	Familial Alzheimer Disease (FAD)	CURATED	1/3	100/9703
## 25	C0494463	Alzheimer Disease, Late Onset	CURATED	1/3	99/9703
## 26	C0546126	Acute Confusional Senile Dementia	CURATED	1/3	99/9703
## 29	C0750900	Alzheimer's Disease, Focal Onset	CURATED	1/3	99/9703
## 30	C0750901	Alzheimer Disease, Early Onset	CURATED	1/3	99/9703
## 3	C0005684	Malignant neoplasm of urinary bladder	CURATED	1/3	141/9703
## 4	C0005695	Bladder Neoplasm	CURATED	1/3	140/9703
## 11	C0026998	Acute Myeloid Leukemia, M1	CURATED	1/3	125/9703
## 32	C0919267	ovarian neoplasm	CURATED	1/3	134/9703
## 33	C1140680	Malignant neoplasm of ovary	CURATED	1/3	137/9703
## 39	C1879321	Acute Myeloid Leukemia (AML-M2)	CURATED	1/3	125/9703
## 8	C0023467	Leukemia, Myelocytic, Acute	CURATED	1/3	173/9703
## 12	C0027627	Neoplasm Metastasis	CURATED	1/3	217/9703
## 28	C0678222	Breast Carcinoma	CURATED	1/3	538/9703
## 34	C1257931	Mammary Neoplasms, Human	CURATED	1/3	525/9703
## 36	C1458155	Mammary Neoplasms	CURATED	1/3	527/9703
## 40	C2239176	Liver carcinoma	CURATED	1/3	507/9703
## 41	C4704874	Mammary Carcinoma, Human	CURATED	1/3	525/9703
## 14	C0033578	Prostatic Neoplasms	CURATED	1/3	616/9703
## 22	C0376358	Malignant neoplasm of prostate	CURATED	1/3	616/9703
## 5	C0006142	Malignant neoplasm of breast	CURATED	1/3	1074/9703
##	pvalue	FDR disease_class			
## 7	0.0006183654	0.01267388	C01;C17		
## 23	0.0009274525	0.01267388	C12		
## 24	0.0012364759	0.01267388	C12		
## 38	0.0006183654	0.01267388	C05;C07;C16		
## 17	0.0030892780	0.01809434	C04;C15;C20		
## 18	0.0027806369	0.01809434	F03		

```

## 35 0.0027806369 0.01809434      F03
## 21 0.0043232056 0.02215643      F03
## 15 0.0058641826 0.02671461      C17
## 19 0.0074035689 0.02759512      C18
## 27 0.0074035689 0.02759512      C18
## 10 0.0138516385 0.04368594      C10;C20
## 31 0.0138516385 0.04368594      C10;C20
## 2  0.0181348002 0.04373687      C14
## 9   0.0180623456 0.04373687      C06;C23
## 16 0.0169123079 0.04373687      C04;C15;C20
## 37 0.0181348002 0.04373687      C14
## 1  0.0309098368 0.05069213      C10;F03
## 6   0.0303040293 0.05069213      C10;F03
## 13 0.0260563057 0.05069213      C10
## 20 0.0306069646 0.05069213      C10;F03
## 25 0.0303040293 0.05069213      C10;F03
## 26 0.0303040293 0.05069213      C10;F03
## 29 0.0303040293 0.05069213      C10;F03
## 30 0.0303040293 0.05069213      C10;F03
## 3  0.0429730606 0.05683534      C04;C12;C13
## 4   0.0426727069 0.05683534      C04;C12;C13
## 11 0.0381598578 0.05683534      C04
## 32 0.0408692651 0.05683534      C04;C13;C19
## 33 0.0417712688 0.05683534      C04;C13;C19
## 39 0.0381598578 0.05683534      C04
## 8   0.0525512405 0.06733128      C04
## 12 0.0656165835 0.08152363      C04;C23
## 28 0.1573183336 0.16973820      C04;C17
## 34 0.1537265805 0.16973820      C04;C17
## 36 0.1542798209 0.16973820      C04;C17
## 40 0.1487365557 0.16973820      C04;C06
## 41 0.1537265805 0.16973820      C04;C17
## 14 0.1786556376 0.18312203      C04;C12
## 22 0.1786556376 0.18312203      C04;C12
## 5   0.2967173894 0.29671739      C04;C17
##
## 7
## 23
## 24
## 38 Musculoskeletal Diseases;Stomatognathic Diseases;Congenital, Hereditary, and Neonatal Diseases and Disorders;Neoplasms;Hemic and Lymphatic Diseases;Immune System Diseases;Infectious Diseases;Skin and Connective Tissue Diseases;Male Urogenital System Diseases;Male Urogenital System Diseases
## 17
## 18
## 35
## 21
## 15
## 19
## 27
## 10
## 31
## 2
## 9
## 16
## 37
## 1

```

dis
Infections;Skin and Connective Tissue Diseases
Male Urogenital System Diseases
Male Urogenital System Diseases
Male Urogenital System Diseases
Skin and Connective Tissue Diseases
Nutritional and Metabolic Diseases
Nutritional and Metabolic Diseases
Nervous System Diseases;Immune System Diseases
Nervous System Diseases;Immune System Diseases
Cardiovascular Diseases
Digestive System Diseases;Pathological Conditions, Signs and Symptoms
Neoplasms;Hemic and Lymphatic Diseases;Immune System Diseases
Cardiovascular Diseases
Nervous System Diseases;Male Urogenital System Diseases

```

## 6 Nervous System Diseases;Male
## 13 Nervous System Diseases;Male
## 20 Nervous System Diseases;Male
## 25 Nervous System Diseases;Male
## 26 Nervous System Diseases;Male
## 29 Nervous System Diseases;Male
## 30 Nervous System Diseases;Male
## 3 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy
## 4 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy
## 11
## 32 Neoplasms;Female Urogenital Diseases and Pregnancy Complications;Endocrine System
## 33 Neoplasms;Female Urogenital Diseases and Pregnancy Complications;Endocrine System
## 39
## 8
## 12 Neoplasms;Pathological Conditions, Signs and Symptoms
## 28 Neoplasms;Skin and Connective Tissue
## 34 Neoplasms;Skin and Connective Tissue
## 36 Neoplasms;Skin and Connective Tissue
## 40 Neoplasms;Digestive System Diseases
## 41 Neoplasms;Skin and Connective Tissue
## 14 Neoplasms;Male Urogenital Diseases
## 22 Neoplasms;Male Urogenital Diseases
## 5 Neoplasms;Skin and Connective Tissue
## disease_semantic_type shared_geneid shared_symbol Count gg
## 7 Disease or Syndrome 5819 NECTIN2 1 0.2
## 23 Disease or Syndrome 5819 NECTIN2 1 0.2
## 24 Finding 5819 NECTIN2 1 0.2
## 38 Disease or Syndrome 5819 NECTIN2 1 0.2
## 17 Neoplastic Process 5819 NECTIN2 1 0.2
## 18 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 35 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 21 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 15 Disease or Syndrome 5819 NECTIN2 1 0.2
## 19 Disease or Syndrome 5819 NECTIN2 1 0.2
## 27 Pathologic Function 5819 NECTIN2 1 0.2
## 10 Disease or Syndrome 5819 NECTIN2 1 0.2
## 31 Disease or Syndrome 5819 NECTIN2 1 0.2
## 2 Disease or Syndrome 5819 NECTIN2 1 0.2
## 9 Experimental Model of Disease 5819;10614 NECTIN2;HEXIM1 2 0.4
## 16 Neoplastic Process 5819 NECTIN2 1 0.2
## 37 Pathologic Function 5819 NECTIN2 1 0.2
## 1 Disease or Syndrome 5819 NECTIN2 1 0.2
## 6 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 13 Disease or Syndrome 5819 NECTIN2 1 0.2
## 20 Disease or Syndrome 5819 NECTIN2 1 0.2
## 25 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 26 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 29 Mental or Behavioral Dysfunction 5819 NECTIN2 1 0.2
## 30 Disease or Syndrome 5819 NECTIN2 1 0.2
## 3 Neoplastic Process 5819 NECTIN2 1 0.2
## 4 Neoplastic Process 5819 NECTIN2 1 0.2
## 11 Neoplastic Process 5819 NECTIN2 1 0.2
## 32 Neoplastic Process 5819 NECTIN2 1 0.2
## 33 Neoplastic Process 5819 NECTIN2 1 0.2

```

```

## 39      Neoplastic Process      5819      NECTIN2      1 0.2
## 8       Neoplastic Process      5819      NECTIN2      1 0.2
## 12      Neoplastic Process      5819      NECTIN2      1 0.2
## 28      Neoplastic Process      5819      NECTIN2      1 0.2
## 34      Neoplastic Process      5819      NECTIN2      1 0.2
## 36      Neoplastic Process      5819      NECTIN2      1 0.2
## 40      Neoplastic Process     22937      SCAP        1 0.2
## 41      Neoplastic Process      5819      NECTIN2      1 0.2
## 14      Neoplastic Process      5819      NECTIN2      1 0.2
## 22      Neoplastic Process      5819      NECTIN2      1 0.2
## 5       Neoplastic Process      5819      NECTIN2      1 0.2

# save(res.table.disgenet.fo, file =
# '/Users/carlacasanovasuarez/Desktop/DisGenet_fo_features.rda')

```

MSigDb enrichment analysis (group C7 immunologic signature):

```

# Load terms for genes coded by ENTREZ of the gene set C7
c3.tf <- read.gmt("/Users/carlacasanovasuarez/Downloads/c7.all.v7.5.1.entrez.gmt.txt")

# Enrichment
ans.tf.fo <- enricher(deGenes.fo.entrez, TERM2GENE = c3.tf)
tab.tf.fo <- as.data.frame(ans.tf.fo@result)
# tab.tf.fo<- subset(tab.tf.fo, Count>5)
tab.tf.fo[1:5, 1:5]

## 
## GSE42724_MEMORY_VS_B1_BCELL_DN
## GSE29618_PRE_VS_DAY7_POST_TIV_FLU_VACCINE_MONOCYTE_DN
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## GSE34217_MIR17_92_OVEREXPRESS VS_WT_ACT_CD8_TCELL_DN
##
## GSE42724_MEMORY_VS_B1_BCELL_DN
## GSE29618_PRE_VS_DAY7_POST_TIV_FLU_VACCINE_MONOCYTE_DN
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## GSE34217_MIR17_92_OVEREXPRESS VS_WT_ACT_CD8_TCELL_DN
##
## GSE42724_MEMORY_VS_B1_BCELL_DN
## GSE29618_PRE_VS_DAY7_POST_TIV_FLU_VACCINE_MONOCYTE_DN
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## GSE34217_MIR17_92_OVEREXPRESS VS_WT_ACT_CD8_TCELL_DN
##
## GSE42724_MEMORY_VS_B1_BCELL_DN
## GSE29618_PRE_VS_DAY7_POST_TIV_FLU_VACCINE_MONOCYTE_DN
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## GSE34217_MIR17_92_OVEREXPRESS VS_WT_ACT_CD8_TCELL_DN
##
## GSE42724_MEMORY_VS_B1_BCELL_DN
## GSE29618_PRE_VS_DAY7_POST_TIV_FLU_VACCINE_MONOCYTE_DN
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## MATSUMIYA_PBMC_MODIFIED_VACCINIA_ANKARA_VACCINE AGE_18_55YO_VACCINATED VS_CONTROL_TREATED_IN_VITRO_W
## GSE34217_MIR17_92_OVEREXPRESS VS_WT_ACT_CD8_TCELL_DN
## 
```

```
## GSE34217_MIR17_92_OVEREXPRESS_VS_WT_ACT_CD8_TCELL_DN
```

Shape

```
shape.DE <- out[out$feature.type == "first_order_shape", ]  
  
# In this case, these features are not correlated  
shape.DE  
  
## feature_names      feature.type  
## 1                 Sphericity first_order_shape  
## 35 InterquartileRange first_order_shape  
  
Store names of genes DE (p.adj < 0.01 if possible):  
  
# Create bools for genes with the most restrictive p.value  
dd.shape.s <- toptable.sphericity$adj.P.Val < 0.01 &  
!is.na(toptable.sphericity$adj.P.Val)  
dd.shape.intq <- toptable.intq$adj.P.Val < 0.02 & !is.na(toptable.intq$adj.P.Val)  
  
deGenes.shape <- c(rownames(toptable.sphericity[dd.shape.s, ]),  
rownames(toptable.intq[dd.shape.intq,  
]))  
  
deGenes.shape  
  
## [1] "1555057_at"   "233228_at"    "221916_at"    "1561614_at"   "1560222_at"  
## [6] "1557566_at"   "239013_at"    "202814_s_at"  
  
length(deGenes.shape)  
  
## [1] 8  
  
table(duplicated(deGenes.shape))  
  
##  
## FALSE  
##     8
```

Check if there are annotations available:

```
# Check info  
annotation.sputum.ok[deGenes.shape, ]  
  
## # A tibble: 8 x 9  
##   PROBEID    ENSEMBL ENTREZID SYMBOL GENENAME GO      EVIDENCE ONTOLOGY GENETYPE  
##   <chr>      <chr>   <chr>   <chr>   <chr>   <chr>   <chr>   <chr>  
## 1 1555057_at "ENSG00~" "4724"   "NDUF~"  "NADH:u~" "GO:~"  "IBA|ID~" "BP|CC|~" "protei~  
## 2 233228_at  ""        ""       ""       ""       ""       ""       ""       ""  
## 3 221916_at  "ENSG00~" "4747"   "NEFL"   "neurof~" "GO:~"  "IDA|IE~" "BP|CC|~" "protei~  
## 4 1561614_at "ENSG00~" "6546"   "SLC8~"  "solute~" "GO:~"  "IBA|IC~" "BP|CC|~" "protei~  
## 5 1560222_at ""        "100287~" "LINC~"  "long i~"  ""       ""       ""       "ncRNA"  
## 6 1557566_at ""        "100507~" "LOC1~"  "unchar~" ""       ""       ""       "ncRNA"  
## 7 239013_at  "ENSG00~" "9117"   "SEC2~"  "SEC22 ~" "GO:~"  "IEA|IP~" "BP|CC|~" "protei~  
## 8 202814_s_at "ENSG00~" "10614"  "HEXI~"  "HEXIM ~" "GO:~"  "IBA|IC~" "BP|CC|~" "protei~
```

Gene universe shape:

```
geneUniverse.sh <- rownames(toptable.sphericity[!is.na(toptable.sphericity$P.Value),
      ])
length(geneUniverse.sh)
```

[1] 48525

Change annotation to ENTREZ:

```
# Retrieve ENTREZ names
deGenes.sh.entrez <- unlist(mget(deGenes.shape, envir = hgu133plus2ENTREZID, ifnotfound = NA))
geneUniverse.sh.entrez <- unlist(mget(geneUniverse.sh, envir = hgu133plus2ENTREZID,
      ifnotfound = NA))
```

GO enrichment:

```
ans.go.sh <- enrichGO(gene = deGenes.sh.entrez, ont = "BP", universe =
geneUniverse.sh.entrez,
  OrgDb = "org.Hs.eg.db", readable = TRUE, pvalueCutoff = 0.05)
```

See results

```
tab.go.sh <- as.data.frame(ans.go.sh@result)
# tab.go.sh<- subset(tab.go.sh, Count>5)
tab.go.sh[1:5, 1:6]
```

	ID	Description			
##					
##	GO:0051591	GO:0051591	response to cAMP		
##	GO:0071901	GO:0071901	negative regulation of protein serine/threonine kinase activity		
##	GO:0046683	GO:0046683	response to organophosphorus		
##	GO:0014074	GO:0014074	response to purine-containing compound		
##	GO:0006469	GO:0006469	negative regulation of protein kinase activity		
##		GeneRatio	BgRatio	pvalue	p.adjust
##	GO:0051591	2/5	83/15058	0.0002969660	0.04324596
##	GO:0071901	2/5	107/15058	0.0004933050	0.04324596
##	GO:0046683	2/5	114/15058	0.0005597626	0.04324596
##	GO:0014074	2/5	120/15058	0.0006200137	0.04324596
##	GO:0006469	2/5	192/15058	0.0015770028	0.04461063

KEGG enrichment:

```
ans.kegg.sh <- enrichKEGG(gene = deGenes.sh.entrez, organism = "hsa", universe =
geneUniverse.sh.entrez,
  pvalueCutoff = 0.05)
```

See results

```
tab.kegg.sh <- as.data.frame(ans.kegg.sh@result)
# tab.kegg.sh <- subset(tab.kegg.sh, Count>5)
tab.kegg.sh[1:5, 1:6]
```

	ID	Description		
--	----	-------------	--	--

```

## hsa05014 hsa05014          Amyotrophic lateral sclerosis
## hsa05022 hsa05022          Pathways of neurodegeneration - multiple diseases
## hsa04961 hsa04961 Endocrine and other factor-regulated calcium reabsorption
## hsa04978 hsa04978          Mineral absorption
## hsa05412 hsa05412          Arrhythmogenic right ventricular cardiomyopathy
##           GeneRatio   BgRatio      pvalue    p.adjust
## hsa05014        2/3 341/6910 0.007047181 0.09460395
## hsa05022        2/3 439/6910 0.011573203 0.09460395
## hsa04961        1/3  51/6910 0.021981963 0.09460395
## hsa04978        1/3  56/6910 0.024119551 0.09460395
## hsa05412        1/3  74/6910 0.031789076 0.09460395

```

Disgenet:

```

res_enrich.sh <- disease_enrichment(entities = deGenes.sh.entrez, vocabulary = "ENTREZ",
                                       database = "CURATED")

res.table.disgenet.sh <- res_enrich.sh@qresult
res.table.disgenet.sh

```

	ID	Description	source
## 5	C0025160	Megacolon	CURATED
## 43	C1843164	Charcot-Marie-Tooth disease, demyelinating, Type 1F	CURATED
## 44	C1843225	CHARCOT-MARIE-TOOTH DISEASE, AXONAL, TYPE 2E (disorder)	CURATED
## 56	C4693509	CHARCOT-MARIE-TOOTH DISEASE, DOMINANT INTERMEDIATE	G CURATED
## 57	C4749824	Charcot-Marie-Tooth disease type 2B5	CURATED
## 13	C0206157	Myopathies, Nemaline	CURATED
## 31	C0751267	Encephalopathy, Subacute Necrotizing, Infantile	CURATED
## 32	C0751268	Encephalopathy, Subacute Necrotizing, Juvenile	CURATED
## 2	C0022333	Jacksonian Seizure	CURATED
## 3	C0023264	Leigh Disease	CURATED
## 6	C0027055	Myocardial Reperfusion Injury	CURATED
## 9	C0038220	Status Epilepticus	CURATED
## 11	C0149958	Complex partial seizures	CURATED
## 14	C0234533	Generalized seizures	CURATED
## 15	C0234535	Clonic Seizures	CURATED
## 16	C0270823	Petit mal status	CURATED
## 17	C0270824	Visual seizure	CURATED
## 18	C0270844	Tonic Seizures	CURATED
## 19	C0270846	Epileptic drop attack	CURATED
## 20	C0311335	Grand Mal Status Epilepticus	CURATED
## 21	C0393734	Complex Partial Status Epilepticus	CURATED
## 22	C0422850	Seizures, Somatosensory	CURATED
## 23	C0422852	Seizures, Auditory	CURATED
## 24	C0422853	Olfactory seizure	CURATED
## 25	C0422854	Gustatory seizure	CURATED
## 26	C0422855	Vertiginous seizure	CURATED
## 27	C0494475	Tonic - clonic seizures	CURATED
## 28	C0751056	Non-epileptic convulsion	CURATED
## 29	C0751110	Single Seizure	CURATED
## 30	C0751123	Atonic Absence Seizures	CURATED
## 33	C0751494	Convulsive Seizures	CURATED
## 34	C0751495	Seizures, Focal	CURATED
## 35	C0751496	Seizures, Sensory	CURATED
## 36	C0751522	Status Epilepticus, Subclinical	CURATED

```

## 37 C0751523          Non-Convulsive Status Epilepticus CURATED
## 38 C0751524          Simple Partial Status Epilepticus CURATED
## 39 C0751651          Mitochondrial Diseases CURATED
## 41 C1838951          LEIGH SYNDROME DUE TO MITOCHONDRIAL COMPLEX I DEFICIENCY CURATED
## 42 C1838979          MITOCHONDRIAL COMPLEX I DEFICIENCY CURATED
## 45 C1850597          Leigh Syndrome Due To Mitochondrial Complex II Deficiency CURATED
## 46 C1850598          Leigh Syndrome due to Mitochondrial Complex III Deficiency CURATED
## 47 C1850599          Leigh Syndrome due to Mitochondrial Complex IV Deficiency CURATED
## 48 C1850600          Leigh Syndrome due to Mitochondrial Complex V Deficiency CURATED
## 49 C2931891          Necrotizing encephalopathy, infantile subacute, of Leigh CURATED
## 50 C3495874          Nonepileptic Seizures CURATED
## 51 C4048158          Convulsions CURATED
## 52 C4316903          Absence Seizures CURATED
## 53 C4317109          Epileptic Seizures CURATED
## 54 C4317123          Myoclonic Seizures CURATED
## 55 C4505436          Generalized Absence Seizures CURATED
## 12 C0151744          Myocardial Ischemia CURATED
## 8 C0036572           Seizures CURATED
## 40 C1269683          Major Depressive Disorder CURATED
## 10 C0041696          Unipolar Depression CURATED
## 1 C0005586          Bipolar Disorder CURATED
## 4 C0023893          Liver Cirrhosis, Experimental CURATED
## 7 C0036341          Schizophrenia CURATED

##   Ratio  BgRatio      pvalue      FDR disease_class
##  5    1/4   1/9703 0.0004122861 0.004700062      C06
## 43   1/4   1/9703 0.0004122861 0.004700062  C10;C16
## 44   1/4   1/9703 0.0004122861 0.004700062  C10;C16
## 56   1/4   1/9703 0.0004122861 0.004700062      <NA>
## 57   1/4   1/9703 0.0004122861 0.004700062  C10;C16
## 13   1/4   8/9703 0.0032947205 0.026405160      C05;C10
## 31   1/4   9/9703 0.0037059874 0.026405160  C10;C16;C18
## 32   1/4   9/9703 0.0037059874 0.026405160  C10;C16;C18
##  2   1/4  101/9703 0.0410014036 0.048107604      C10;C23
##  3   1/4   47/9703 0.0192400484 0.048107604  C10;C16;C18
##  6   1/4   85/9703 0.0345917438 0.048107604      C14;C23
##  9   1/4   68/9703 0.0277463314 0.048107604      C10;C23
## 11   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 14   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 15   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 16   1/4   67/9703 0.0273425296 0.048107604      C10;C23
## 17   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 18   1/4  102/9703 0.0414009447 0.048107604      C10;C23
## 19   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 20   1/4   67/9703 0.0273425296 0.048107604      C10;C23
## 21   1/4   67/9703 0.0273425296 0.048107604      C10;C23
## 22   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 23   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 24   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 25   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 26   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 27   1/4  104/9703 0.0421996525 0.048107604      C10;C23
## 28   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 29   1/4  101/9703 0.0410014036 0.048107604      C10;C23
## 30   1/4  101/9703 0.0410014036 0.048107604      C10;C23

```

```

## 33 1/4 101/9703 0.0410014036 0.048107604 C10;C23
## 34 1/4 104/9703 0.0421996525 0.048107604 C10;C23
## 35 1/4 101/9703 0.0410014036 0.048107604 C10;C23
## 36 1/4 67/9703 0.0273425296 0.048107604 C10;C23
## 37 1/4 67/9703 0.0273425296 0.048107604 C10;C23
## 38 1/4 67/9703 0.0273425296 0.048107604 C10;C23
## 39 1/4 49/9703 0.0200525663 0.048107604 C18
## 41 1/4 37/9703 0.0151698771 0.048107604 C10;C16;C18
## 42 1/4 30/9703 0.0123132288 0.048107604 C18
## 45 1/4 36/9703 0.0147621643 0.048107604 C10;C16;C18
## 46 1/4 36/9703 0.0147621643 0.048107604 C10;C16;C18
## 47 1/4 36/9703 0.0147621643 0.048107604 C10;C16;C18
## 48 1/4 36/9703 0.0147621643 0.048107604 C10;C16;C18
## 49 1/4 36/9703 0.0147621643 0.048107604 C10;C16;C18
## 50 1/4 101/9703 0.0410014036 0.048107604 C10;C23
## 51 1/4 102/9703 0.0414009447 0.048107604 C10;C23
## 52 1/4 102/9703 0.0414009447 0.048107604 C10;C23
## 53 1/4 101/9703 0.0410014036 0.048107604 C10;C23
## 54 1/4 104/9703 0.0421996525 0.048107604 C10;C23
## 55 1/4 101/9703 0.0410014036 0.048107604 C10;C23
## 12 1/4 176/9703 0.0706222646 0.078930766 C14
## 8 1/4 218/9703 0.0869071859 0.095263646 C10;C23
## 40 1/4 243/9703 0.0964984140 0.103781313 F03
## 10 1/4 259/9703 0.1025970161 0.108296850 F03
## 1 1/4 477/9703 0.1826528979 0.189294821 F03
## 4 1/4 774/9703 0.2829517913 0.288004502 C06;C23
## 7 1/4 883/9703 0.3173385310 0.317338531 F03
##
## 5
## 43 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutrition and Metabolism
## 44 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutrition and Metabolism
## 56
## 57 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Pathological Conditions and Mechanisms
## 13 Musculoskeletal Diseases
## 31 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutrition and Metabolism
## 32 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutrition and Metabolism
## 2 Nervous System Diseases;Pathological Conditions and Mechanisms
## 3 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutrition and Metabolism
## 6 Cardiovascular Diseases;Pathological Conditions and Mechanisms
## 9 Nervous System Diseases;Pathological Conditions and Mechanisms
## 11 Nervous System Diseases;Pathological Conditions and Mechanisms
## 14 Nervous System Diseases;Pathological Conditions and Mechanisms
## 15 Nervous System Diseases;Pathological Conditions and Mechanisms
## 16 Nervous System Diseases;Pathological Conditions and Mechanisms
## 17 Nervous System Diseases;Pathological Conditions and Mechanisms
## 18 Nervous System Diseases;Pathological Conditions and Mechanisms
## 19 Nervous System Diseases;Pathological Conditions and Mechanisms
## 20 Nervous System Diseases;Pathological Conditions and Mechanisms
## 21 Nervous System Diseases;Pathological Conditions and Mechanisms
## 22 Nervous System Diseases;Pathological Conditions and Mechanisms
## 23 Nervous System Diseases;Pathological Conditions and Mechanisms
## 24 Nervous System Diseases;Pathological Conditions and Mechanisms
## 25 Nervous System Diseases;Pathological Conditions and Mechanisms
## 26 Nervous System Diseases;Pathological Conditions and Mechanisms

```

```

## 27 Nervous System Diseases;Pathological Condi
## 28 Nervous System Diseases;Pathological Condi
## 29 Nervous System Diseases;Pathological Condi
## 30 Nervous System Diseases;Pathological Condi
## 33 Nervous System Diseases;Pathological Condi
## 34 Nervous System Diseases;Pathological Condi
## 35 Nervous System Diseases;Pathological Condi
## 36 Nervous System Diseases;Pathological Condi
## 37 Nervous System Diseases;Pathological Condi
## 38 Nervous System Diseases;Pathological Condi
## 39 Nervous System Diseases;Pathological Condi
## 41 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 42 Nutritiona
## 45 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 46 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 47 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 48 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 49 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritiona
## 50 Nervous System Diseases;Pathological Condi
## 51 Nervous System Diseases;Pathological Condi
## 52 Nervous System Diseases;Pathological Condi
## 53 Nervous System Diseases;Pathological Condi
## 54 Nervous System Diseases;Pathological Condi
## 55 Nervous System Diseases;Pathological Condi
## 12 Nervous System Diseases;Pathological Condi
## 8 Nervous System Diseases;Pathological Condi
## 40 Nervous System Diseases;Pathological Condi
## 10 Nervous System Diseases;Pathological Condi
## 1 Nervous System Diseases;Pathological Condi
## 4 Digestive System Diseases;Pathological Condi
## 7

##          disease_semantic_type shared_geneid shared_symbol Count    gg
## 5            Pathologic Function      6546     SLC8A1    1 0.125
## 43           Disease or Syndrome     4747      NEFL    1 0.125
## 44           Disease or Syndrome     4747      NEFL    1 0.125
## 56           Disease or Syndrome     4747      NEFL    1 0.125
## 57           Disease or Syndrome     4747      NEFL    1 0.125
## 13           Disease or Syndrome     4747      NEFL    1 0.125
## 31           Disease or Syndrome     4724     NDUFS4    1 0.125
## 32           Disease or Syndrome     4724     NDUFS4    1 0.125
## 2            Disease or Syndrome     6546     SLC8A1    1 0.125
## 3            Disease or Syndrome     4724     NDUFS4    1 0.125
## 6            Pathologic Function      6546     SLC8A1    1 0.125
## 9            Disease or Syndrome     6546     SLC8A1    1 0.125
## 11           Disease or Syndrome     6546     SLC8A1    1 0.125
## 14           Disease or Syndrome     6546     SLC8A1    1 0.125
## 15           Disease or Syndrome     6546     SLC8A1    1 0.125
## 16           Disease or Syndrome     6546     SLC8A1    1 0.125
## 17           Disease or Syndrome     6546     SLC8A1    1 0.125
## 18           Disease or Syndrome     6546     SLC8A1    1 0.125
## 19           Disease or Syndrome     6546     SLC8A1    1 0.125
## 20           Disease or Syndrome     6546     SLC8A1    1 0.125
## 21           Disease or Syndrome     6546     SLC8A1    1 0.125
## 22         Pathologic Function      6546     SLC8A1    1 0.125

```

```

## 23 Pathologic Function 6546 SLC8A1 1 0.125
## 24 Disease or Syndrome 6546 SLC8A1 1 0.125
## 25 Sign or Symptom 6546 SLC8A1 1 0.125
## 26 Disease or Syndrome 6546 SLC8A1 1 0.125
## 27 Disease or Syndrome 6546 SLC8A1 1 0.125
## 28 Sign or Symptom 6546 SLC8A1 1 0.125
## 29 Disease or Syndrome 6546 SLC8A1 1 0.125
## 30 Disease or Syndrome 6546 SLC8A1 1 0.125
## 33 Sign or Symptom 6546 SLC8A1 1 0.125
## 34 Disease or Syndrome 6546 SLC8A1 1 0.125
## 35 Sign or Symptom 6546 SLC8A1 1 0.125
## 36 Disease or Syndrome 6546 SLC8A1 1 0.125
## 37 Disease or Syndrome 6546 SLC8A1 1 0.125
## 38 Disease or Syndrome 6546 SLC8A1 1 0.125
## 39 Disease or Syndrome 4724 NDUFS4 1 0.125
## 41 Disease or Syndrome 4724 NDUFS4 1 0.125
## 42 Disease or Syndrome 4724 NDUFS4 1 0.125
## 45 Disease or Syndrome 4724 NDUFS4 1 0.125
## 46 Disease or Syndrome 4724 NDUFS4 1 0.125
## 47 Disease or Syndrome 4724 NDUFS4 1 0.125
## 48 Disease or Syndrome 4724 NDUFS4 1 0.125
## 49 Disease or Syndrome 4724 NDUFS4 1 0.125
## 50 Disease or Syndrome 6546 SLC8A1 1 0.125
## 51 Sign or Symptom 6546 SLC8A1 1 0.125
## 52 Disease or Syndrome 6546 SLC8A1 1 0.125
## 53 Disease or Syndrome 6546 SLC8A1 1 0.125
## 54 Sign or Symptom 6546 SLC8A1 1 0.125
## 55 Disease or Syndrome 6546 SLC8A1 1 0.125
## 12 Disease or Syndrome 6546 SLC8A1 1 0.125
## 8 Sign or Symptom 6546 SLC8A1 1 0.125
## 40 Mental or Behavioral Dysfunction 4747 NEFL 1 0.125
## 10 Mental or Behavioral Dysfunction 4747 NEFL 1 0.125
## 1 Mental or Behavioral Dysfunction 4747 NEFL 1 0.125
## 4 Experimental Model of Disease 10614 HEXIM1 1 0.125
## 7 Mental or Behavioral Dysfunction 4747 NEFL 1 0.125

# save(res.table.disgenet.sh, file =
# '/Users/carlacasanovasuarez/Desktop/DisGenet_shape_features.rda')

```

MSigDb enrichment analysis (group C7 immunologic signature):

```

# Load terms for genes coded by ENTREZ of the gene set C7
c3.tf <- read.gmt("/Users/carlacasanovasuarez/Downloads/c7.all.v7.5.1.entrez.gmt.txt")

```

```

# Enrichment
ans.tf.sh <- enricher(deGenes.sh.entrez, TERM2GENE = c3.tf)
tab.tf.sh <- as.data.frame(ans.tf.sh@result)
# tab.tf.sh <- subset(tab.tf.sh, Count>5)
tab.tf.sh[1:5, 1:5]

```

```

##
## GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN GSE28726_NAIVE_VS_ACTIVATI
## GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_T
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP GSE37416_OH_VS_12H_F_TULAREN
## GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN GSE2770_IL12_VS_IL4_TREATED
```

```

## SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP          SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP
##                                                               GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN
## GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN          GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN
## GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP        GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP        GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP
## GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN         GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN
## SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP          SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP
##                                                               GeneRatio
## GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN          2/6
## GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN 2/6
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP        2/6
## GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN         2/6
## SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP          1/6
##                                                               BgRatio
## GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN          197/21355
## GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN 197/21355
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP        197/21355
## GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN         199/21355
## SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP          24/21355
##                                                               pvalue
## GSE28726_NAIVE_VS_ACTIVATED_VA24NEG_NKTCELL_DN          0.001239475
## GSE36476_YOUNG_VS_OLD_DONOR_MEMORY_CD4_TCELL_40H_TSST_ACT_DN 0.001239475
## GSE37416_OH_VS_12H_F_TULARENSIS_LVS_NEUTROPHIL_UP        0.001239475
## GSE2770_IL12_VS_IL4_TREATED_ACT_CD4_TCELL_48H_DN         0.001264518
## SCHERER_PBMC_APSP_WETVAX_AGE_18_40YO_5_TO_7DY_UP          0.006725019

```

glcm

```

glcm.DE <- out[out$feature.type == "grey_level_co-occurrence_matrix", ]

# In this case, these features tightly correlated: id, idm, idmn, idn. Features
# correlated with first order are also found, such as JointAverage and
# SumAverage (they are also correlated between them)
glcm.DE

```

```

##           feature_names           feature.type
## 4      ClusterShade grey_level_co-occurrence_matrix
## 5          Contrast grey_level_co-occurrence_matrix
## 6 DifferenceAverage grey_level_co-occurrence_matrix
## 7             Id grey_level_co-occurrence_matrix
## 8            Idm grey_level_co-occurrence_matrix
## 9            Idmn grey_level_co-occurrence_matrix
## 10           Idn grey_level_co-occurrence_matrix
## 11     InverseVariance grey_level_co-occurrence_matrix
## 12       JointAverage grey_level_co-occurrence_matrix
## 13       SumAverage grey_level_co-occurrence_matrix
## 14 HighGrayLevelEmphasis grey_level_co-occurrence_matrix

```

Store names of genes DE (p.adj < 0.01 if possible):

```

# Create bools for genes with the most restrictive p.value
dd.glcm.clusS <- toptable.sphericity$adj.P.Val < 0.01 &
!is.na(toptable.sphericity$adj.P.Val)
dd.glcm.sum <- toptable.sumAv$adj.P.Val < 0.01 & !is.na(toptable.sumAv$adj.P.Val)

```

```

dd.glcM.id <- toptable.id0$adj.P.Val < 0.05 & !is.na(toptable.id0$adj.P.Val)
dd.glcM.idm <- toptable.idm0$adj.P.Val < 0.05 & !is.na(toptable.idm0$adj.P.Val)
dd.glcM.hglEm <- toptable.hglEm$adj.P.Val < 0.01 & !is.na(toptable.hglEm$adj.P.Val)

deGenes.glcM <- c(rownames(toptable.idm0[dd.glcM.idm, ]),
rownames(toptable.id0[dd.glcM.id,
]), rownames(toptable.clustSh[dd.glcM.clusS, ]),
rownames(toptable.sumAv[dd.glcM.sum,
]), rownames(toptable.hglEm[dd.glcM.hglEm, ]))

deGenes.glcM

## [1] "203893_at"      "1554830_a_at"    "203893_at"      "1554830_a_at"    "214027_x_at"
## [6] "239081_at"      "204233_s_at"    "213564_x_at"    "201030_x_at"    "233092_s_at"
## [11] "230774_at"      "212329_at"     "227973_at"      "212329_at"      "227973_at"

length(deGenes.glcM)

## [1] 15

table(duplicated(deGenes.glcM))

##
## FALSE  TRUE
##    11     4

deGenes.glcM <- unique(deGenes.glcM)

```

Check if there are annotations available:

```

# Check info
annotation.sputum.ok[deGenes.glcM, ]

## # A tibble: 11 x 9
##   PROBEID      ENSEMBL ENTREZID SYMBOL GENENAME GO      EVIDENCE ONTOLOGY GENETYPE
##   <chr>        <chr>   <chr>   <chr>   <chr>   <chr>   <chr>   <chr>
## 1 203893_at   "ENSG0~" "102157~" "AK6"    "adenyl~" "GO:~"  "HDA|IB~" "BP|CC|~" "protei~"
## 2 1554830_a_~ "ENSG0~" "55240"   "STEA~"  "STEAP3~" "GO:~"  "IBA|ID~" "BP|CC|~" "protei~"
## 3 214027_x_at "ENSG0~" "1674|5~" "DES|~"  "desmin~" "GO:~"  "HDA|IB~" "BP|CC|~" "protei~"
## 4 239081_at    ""       ""       ""       ""       ""       ""       ""       ""
## 5 204233_s_at "ENSG0~" "1119"   "CHKA"   "cholin~" "GO:~"  "IBA|ID~" "BP|CC|~" "protei~"
## 6 213564_x_at "ENSG0~" "3945"   "LDHB"   "lactat~" "GO:~"  "HDA|IB~" "BP|CC|~" "protei~"
## 7 201030_x_at "ENSG0~" "3945"   "LDHB"   "lactat~" "GO:~"  "HDA|IB~" "BP|CC|~" "protei~"
## 8 233092_s_at ""       ""       ""       ""       ""       ""       ""       ""
## 9 230774_at    "ENSG0~" "145482" "PTGR~"  "prosta~" "GO:~"  "IBA|ID~" "BP|CC|~" "protei~"
## 10 212329_at   "ENSG0~" "22937"  "SCAP"   "SREBF ~" "GO:~"  "IDA|IE~" "BP|CC|~" "protei~"
## 11 227973_at   "ENSG0~" "205327" "C2or~"  "chromo~" "GO:~"  "IDA|IE~" "BP|CC"   "protei~"

```

Gene universe shape:

```

geneUniverse.glcM <- rownames(toptable.sumAv[!is.na(toptable.sumAv$P.Value), ])
length(geneUniverse.glcM)

```

```
## [1] 48525
```

Change annotation to ENTREZ:

```
# Retrieve ENTREZ names
deGenes.glcM.entrez <- unlist(mget(deGenes.glcM, envir = hgu133plus2ENTREZID, ifnotfound = NA))
geneUniverse.glcM.entrez <- unlist(mget(geneUniverse.glcM, envir = hgu133plus2ENTREZID, ifnotfound = NA))
```

GO enrichment:

```
ans.go.glcM <- enrichGO(gene = deGenes.glcM.entrez, ont = "BP", universe =
geneUniverse.glcM.entrez,
  OrgDb = "org.Hs.eg.db", readable = TRUE, pvalueCutoff = 0.05)

# See results
tab.go.glcM <- as.data.frame(ans.go.glcM@result)
# tab.go.glcM <- subset(tab.go.glcM, Count>5)
tab.go.glcM[1:5, 1:6]
```

	ID	Description
##		
##	G0:0006646 G0:0006646	phosphatidylethanolamine biosynthetic process
##	G0:0046940 G0:0046940	nucleoside monophosphate phosphorylation
##	G0:1902931 G0:1902931	negative regulation of alcohol biosynthetic process
##	G0:0006089 G0:0006089	lactate metabolic process
##	G0:0006825 G0:0006825	copper ion transport
##	GeneRatio BgRatio pvalue p.adjust	
##	G0:0006646 1/7 10/15058 0.004640363 0.06320076	
##	G0:0046940 1/7 11/15058 0.005103383 0.06320076	
##	G0:1902931 1/7 13/15058 0.006028868 0.06320076	
##	G0:0006089 1/7 15/15058 0.006953615 0.06320076	
##	G0:0006825 1/7 15/15058 0.006953615 0.06320076	

KEGG enrichment:

```
ans.kegg.glcM <- enrichKEGG(gene = deGenes.glcM.entrez, universe =
geneUniverse.glcM.entrez,
  organism = "hsa", pvalueCutoff = 0.05)

# See results
tab.kegg.glcM <- as.data.frame(ans.kegg.glcM@result)
# tab.kegg.glcM <- subset(tab.kegg.glcM, Count>5)
tab.kegg.glcM[1:5, 1:6]
```

	ID	Description	GeneRatio	BgRatio
##				
##	hsa00640 hsa00640	Propanoate metabolism	1/4	31/6910
##	hsa04216 hsa04216	Ferroptosis	1/4	40/6910
##	hsa00270 hsa00270	Cysteine and methionine metabolism	1/4	45/6910
##	hsa00620 hsa00620	Pyruvate metabolism	1/4	46/6910
##	hsa00010 hsa00010	Glycolysis / Gluconeogenesis	1/4	62/6910
##	pvalue p.adjust			
##	hsa00640 0.01782845 0.06665618			
##	hsa04216 0.02295951 0.06665618			
##	hsa00270 0.02580139 0.06665618			
##	hsa00620 0.02636903 0.06665618			
##	hsa00010 0.03541745 0.06665618			

Disgenet:

```

res_enrich.glcml <- disease_enrichment(entities = deGenes.glcml.entrez, vocabulary =
"ENTREZ",
database = "CURATED")

res.table.disgenet.glcml <- res_enrich.glcml@qresult
res.table.disgenet.glcml

```

	ID	Description	source	Ratio
## 1	C0002884	Hypochromic anemia	CURATED	1/4
## 25	C3279904	Lactate Dehydrogenase B Deficiency	CURATED	1/4
## 26	C3808920	ANEMIA, HYPOCHROMIC MICROCYTIC, WITH IRON OVERLOAD	2 CURATED	1/4
## 24	C2673913	Anemia, Hypochromic Microcytic, With Iron Overload	CURATED	1/4
## 3	C0007124	Noninfiltrating Intraductal Carcinoma	CURATED	1/4
## 21	C1332347	Atypical Ductal Breast Hyperplasia	CURATED	1/4
## 9	C0038219	Status Dysraphicus	CURATED	1/4
## 10	C0080178	Spina Bifida	CURATED	1/4
## 11	C0266508	Rachischisis	CURATED	1/4
## 6	C0025521	Inborn Errors of Metabolism	CURATED	1/4
## 15	C0948089	Acute Coronary Syndrome	CURATED	1/4
## 4	C0007134	Renal Cell Carcinoma	CURATED	1/4
## 17	C1266042	Chromophobe Renal Cell Carcinoma	CURATED	1/4
## 18	C1266043	Sarcomatoid Renal Cell Carcinoma	CURATED	1/4
## 19	C1266044	Collecting Duct Carcinoma of the Kidney	CURATED	1/4
## 20	C1306837	Papillary Renal Cell Carcinoma	CURATED	1/4
## 12	C0279702	Conventional (Clear Cell) Renal Cell Carcinoma	CURATED	1/4
## 7	C0027626	Neoplasm Invasiveness	CURATED	1/4
## 14	C0678222	Breast Carcinoma	CURATED	1/4
## 16	C1257931	Mammary Neoplasms, Human	CURATED	1/4
## 22	C1458155	Mammary Neoplasms	CURATED	1/4
## 23	C2239176	Liver carcinoma	CURATED	1/4
## 27	C4704874	Mammary Carcinoma, Human	CURATED	1/4
## 8	C0033578	Prostatic Neoplasms	CURATED	1/4
## 13	C0376358	Malignant neoplasm of prostate	CURATED	1/4
## 5	C0023893	Liver Cirrhosis, Experimental	CURATED	1/4
## 2	C0006142	Malignant neoplasm of breast	CURATED	1/4
	BgRatio	pvalue	FDR disease_class	
## 1	1/9703	0.0004122861	0.003710575	C15
## 25	1/9703	0.0004122861	0.003710575	C16;C18
## 26	1/9703	0.0004122861	0.003710575	<NA>
## 24	2/9703	0.0008244448	0.005565002	C15
## 3	5/9703	0.0020601559	0.009270702	C04
## 21	5/9703	0.0020601559	0.009270702	C04
## 9	12/9703	0.0049390244	0.014817073	C10;C16
## 10	12/9703	0.0049390244	0.014817073	C10;C16
## 11	12/9703	0.0049390244	0.014817073	C10;C16
## 6	17/9703	0.0069915423	0.018877164	C16;C18
## 15	33/9703	0.0135382665	0.033230291	C14
## 4	128/9703	0.0517452655	0.087320136	C04;C12;C13
## 17	128/9703	0.0517452655	0.087320136	C04;C12;C13
## 18	128/9703	0.0517452655	0.087320136	C04;C12;C13
## 19	128/9703	0.0517452655	0.087320136	C04;C12;C13
## 20	128/9703	0.0517452655	0.087320136	C04;C12;C13
## 12	148/9703	0.0596452881	0.094730752	C04;C12;C13

```

## 7 184/9703 0.0737408156 0.110611223 C04;C23
## 14 538/9703 0.2040615790 0.239550549 C04;C17
## 16 525/9703 0.1995347613 0.239550549 C04;C17
## 22 527/9703 0.2002324484 0.239550549 C04;C17
## 23 507/9703 0.1932350159 0.239550549 C04;C06
## 27 525/9703 0.1995347613 0.239550549 C04;C17
## 8 616/9703 0.2308206162 0.249286266 C04;C12
## 13 616/9703 0.2308206162 0.249286266 C04;C12
## 5 774/9703 0.2829517913 0.293834553 C06;C23
## 2 1074/9703 0.3745940287 0.374594029 C04;C17

##                                     disease_class_name
## 1                                     Hemic and Lymphatic Disease
## 25 Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritional and Metabolic Disease <NA>
## 26
## 24                                     Hemic and Lymphatic Disease
## 3                                     Neoplasm
## 21                                     Neoplasm
## 9 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities
## 10 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities
## 11 Nervous System Diseases;Congenital, Hereditary, and Neonatal Diseases and Abnormalities
## 6 Congenital, Hereditary, and Neonatal Diseases and Abnormalities;Nutritional and Metabolic Disease
## 15 Cardiovascular Disease
## 4 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 17 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 18 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 19 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 20 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 12 Neoplasms;Male Urogenital Diseases;Female Urogenital Diseases and Pregnancy Complications
## 7 Neoplasms;Pathological Conditions, Signs and Symptoms
## 14 Neoplasms;Skin and Connective Tissue Disease
## 16 Neoplasms;Skin and Connective Tissue Disease
## 22 Neoplasms;Skin and Connective Tissue Disease
## 23 Neoplasms;Digestive System Disease
## 27 Neoplasms;Skin and Connective Tissue Disease
## 8 Neoplasms;Male Urogenital Disease
## 13 Neoplasms;Male Urogenital Disease
## 5 Digestive System Diseases;Pathological Conditions, Signs and Symptoms
## 2 Neoplasms;Skin and Connective Tissue Disease

##             disease_semantic_type shared_geneid shared_symbol Count
## 1           Disease or Syndrome      55240    STEAP3     1
## 25          Disease or Syndrome      3945     LDHB      1
## 26          Disease or Syndrome      55240    STEAP3     1
## 24          Disease or Syndrome      55240    STEAP3     1
## 3            Neoplastic Process      3945     LDHB      1
## 21          Neoplastic Process      3945     LDHB      1
## 9            Congenital Abnormality   1119     CHKA      1
## 10           Congenital Abnormality   1119     CHKA      1
## 11           Congenital Abnormality   1119     CHKA      1
## 6 Congenital Abnormality;Disease or Syndrome 3945     LDHB      1
## 15          Disease or Syndrome      3945     LDHB      1
## 4            Neoplastic Process      3945     LDHB      1
## 17          Neoplastic Process      3945     LDHB      1
## 18          Neoplastic Process      3945     LDHB      1
## 19          Neoplastic Process      3945     LDHB      1

```

```

## 20           Neoplastic Process      3945     LDHB      1
## 12           Neoplastic Process      3945     LDHB      1
## 7            Pathologic Function    3945     LDHB      1
## 14           Neoplastic Process      3945     LDHB      1
## 16           Neoplastic Process      3945     LDHB      1
## 22           Neoplastic Process      3945     LDHB      1
## 23           Neoplastic Process      22937    SCAP      1
## 27           Neoplastic Process      3945     LDHB      1
## 8            Neoplastic Process      3945     LDHB      1
## 13           Neoplastic Process      3945     LDHB      1
## 5            Experimental Model of Disease 3945     LDHB      1
## 2            Neoplastic Process      3945     LDHB      1

##          gg
## 1  0.125
## 25 0.125
## 26 0.125
## 24 0.125
## 3  0.125
## 21 0.125
## 9  0.125
## 10 0.125
## 11 0.125
## 6  0.125
## 15 0.125
## 4  0.125
## 17 0.125
## 18 0.125
## 19 0.125
## 20 0.125
## 12 0.125
## 7  0.125
## 14 0.125
## 16 0.125
## 22 0.125
## 23 0.125
## 27 0.125
## 8  0.125
## 13 0.125
## 5  0.125
## 2  0.125

# save(res.table.disgenet.glc, file =
# '/Users/carlacasanovasuarez/Desktop/DisGenet_glc_features.rda')
# write.csv(res.table.disgenet.glc, './Disgenet_enrichment_glc.csv')

```

MSigDb enrichment analysis (group C7 immunologic signature):

```

# Load terms for genes coded by ENTREZ of the gene set C7
c3.tf <- readgmt("/Users/carlacasanovasuarez/Downloads/c7.all.v7.5.1.entrez.gmt.txt")

# Enrichment
ans.tf.glc <- enricher(deGenes.glc.entrez, TERM2GENE = c3.tf)
tab.tf.glc <- as.data.frame(ans.tf.glc@result)
# tab.tf.glc <- subset(tab.tf.glc, Count>5)
tab.tf.glc[1:5, 1:5]

```

```

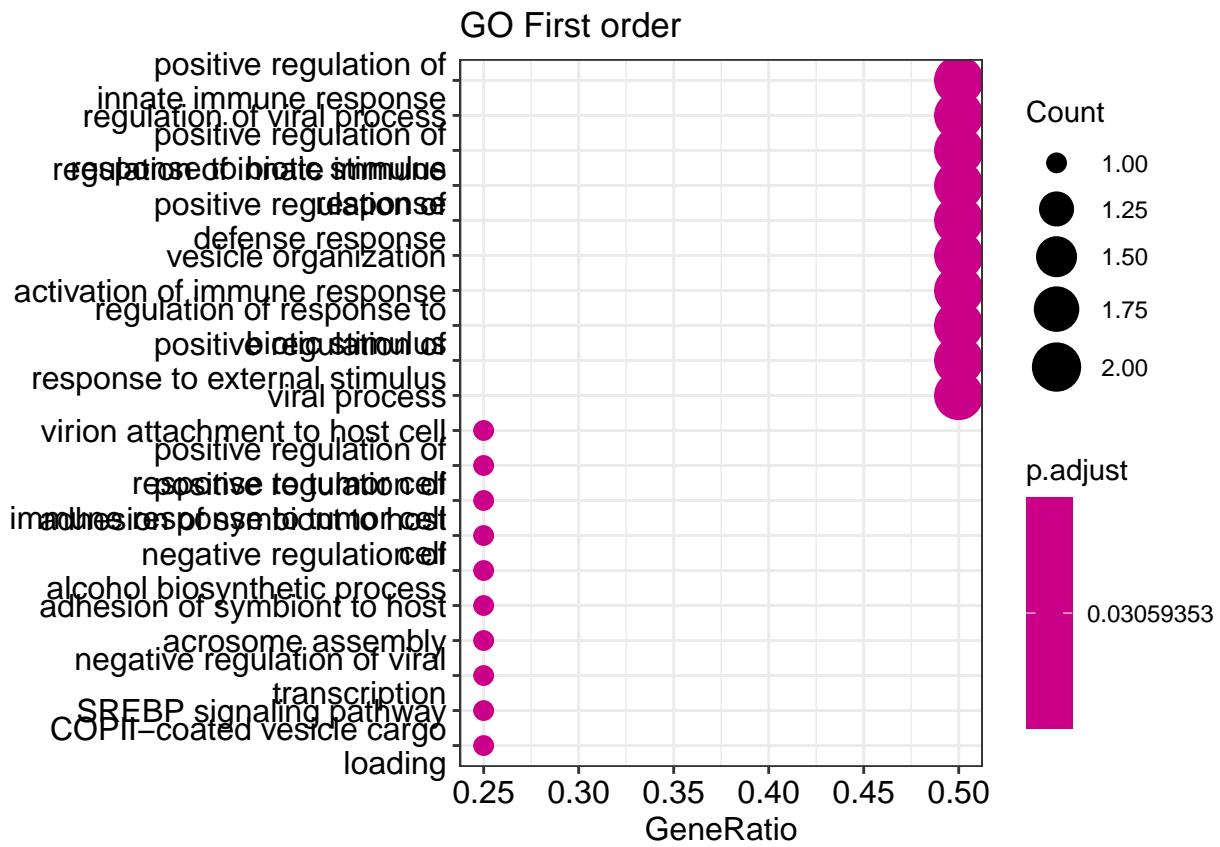
## GSE25088_ROSIGLITAZONE_VS_IL4_AND_ROSIGLITAZONE_STIM_MACROPHAGE_DAY10_UP      GSE25088_ROSIGLITAZONE_VS...
## GSE27859_CD11C_INT_F480_HI_MACROPHAGE_VS_CD11C_ING_F480_INT_DC_UP          GSE27859_CD11C_INT_F480_HI...
## GSE17974_CTRL_VS_ACT_IL4_AND_ANTI_IL12_0.5H_CD4_TCELL_DN                   GSE17974_CTRL_VS_ACT...
## GSE17322_CD103_POS_VS_CD11B_HIGH_LUNG_DC_DN                                GSE17322_CD103_POS_VS...
## GSE19401_RETINOIC_ACID_VS_RETINOIC_ACID_AND_PAM2CSK4_STIM_FOLLICULAR_DC_DN  GSE19401_RETINOIC_ACID_VS...
## GSE25088_ROSIGLITAZONE_VS_IL4_AND_ROSIGLITAZONE_STIM_MACROPHAGE_DAY10_UP      GSE25088_ROSIGLITAZONE_VS...
## GSE27859_CD11C_INT_F480_HI_MACROPHAGE_VS_CD11C_ING_F480_INT_DC_UP          GSE27859_CD11C_INT_F480_HI...
## GSE17974_CTRL_VS_ACT_IL4_AND_ANTI_IL12_0.5H_CD4_TCELL_DN                   GSE17974_CTRL_VS_ACT...
## GSE17322_CD103_POS_VS_CD11B_HIGH_LUNG_DC_DN                                GSE17322_CD103_POS_VS...
## GSE19401_RETINOIC_ACID_VS_RETINOIC_ACID_AND_PAM2CSK4_STIM_FOLLICULAR_DC_DN  GSE19401_RETINOIC_ACID_VS...
## GeneRatio
## GSE25088_ROSIGLITAZONE_VS_IL4_AND_ROSIGLITAZONE_STIM_MACROPHAGE_DAY10_UP      3/6
## GSE27859_CD11C_INT_F480_HI_MACROPHAGE_VS_CD11C_ING_F480_INT_DC_UP          2/6
## GSE17974_CTRL_VS_ACT_IL4_AND_ANTI_IL12_0.5H_CD4_TCELL_DN                   2/6
## GSE17322_CD103_POS_VS_CD11B_HIGH_LUNG_DC_DN                                2/6
## GSE19401_RETINOIC_ACID_VS_RETINOIC_ACID_AND_PAM2CSK4_STIM_FOLLICULAR_DC_DN  2/6
## BgRatio
## GSE25088_ROSIGLITAZONE_VS_IL4_AND_ROSIGLITAZONE_STIM_MACROPHAGE_DAY10_UP      199/21355
## GSE27859_CD11C_INT_F480_HI_MACROPHAGE_VS_CD11C_ING_F480_INT_DC_UP          178/21355
## GSE17974_CTRL_VS_ACT_IL4_AND_ANTI_IL12_0.5H_CD4_TCELL_DN                   191/21355
## GSE17322_CD103_POS_VS_CD11B_HIGH_LUNG_DC_DN                                199/21355
## GSE19401_RETINOIC_ACID_VS_RETINOIC_ACID_AND_PAM2CSK4_STIM_FOLLICULAR_DC_DN  199/21355
## pvalue
## GSE25088_ROSIGLITAZONE_VS_IL4_AND_ROSIGLITAZONE_STIM_MACROPHAGE_DAY10_UP      1.561636e-05
## GSE27859_CD11C_INT_F480_HI_MACROPHAGE_VS_CD11C_ING_F480_INT_DC_UP          1.013779e-03
## GSE17974_CTRL_VS_ACT_IL4_AND_ANTI_IL12_0.5H_CD4_TCELL_DN                   1.165814e-03
## GSE17322_CD103_POS_VS_CD11B_HIGH_LUNG_DC_DN                                1.264518e-03
## GSE19401_RETINOIC_ACID_VS_RETINOIC_ACID_AND_PAM2CSK4_STIM_FOLLICULAR_DC_DN  1.264518e-03

```

Summary

First order:

```
# GO
dotplot(ans.go.fo, showCategory = 20) + ggtitle("GO First order")
```



```
# KEGG
x2 <- pairwise_termsim(ans.kegg.fo)
emapplot(x2)
```

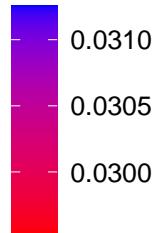
Adherens junction

hesion molecules

number of genes



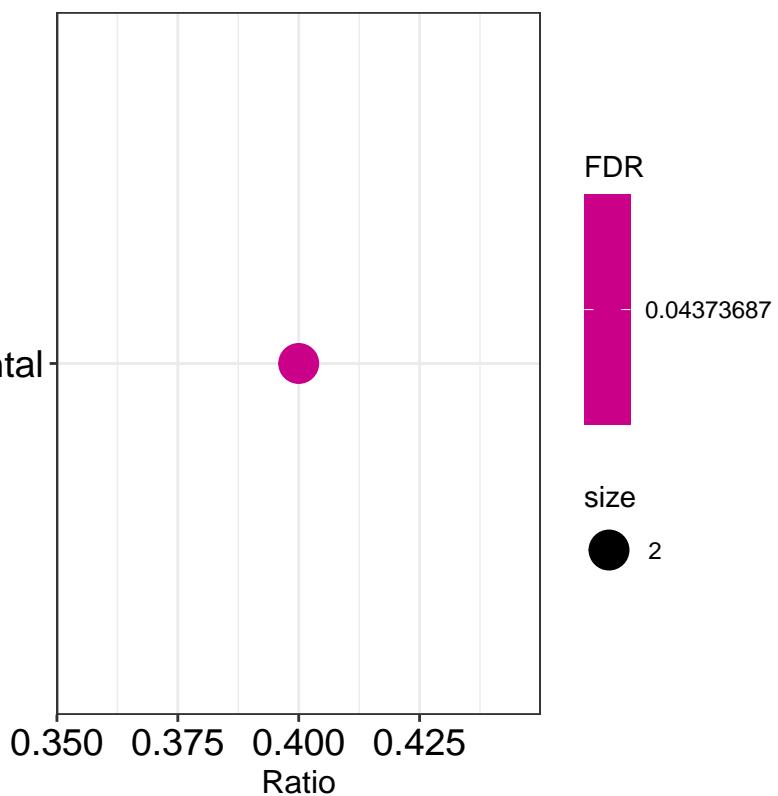
p.adjust



```
# Disgenet plot() function only displays diseases from ratios > 0.4.  
plot(res_enrich.fo, class = "Enrichment", cutoff = 0.05)
```

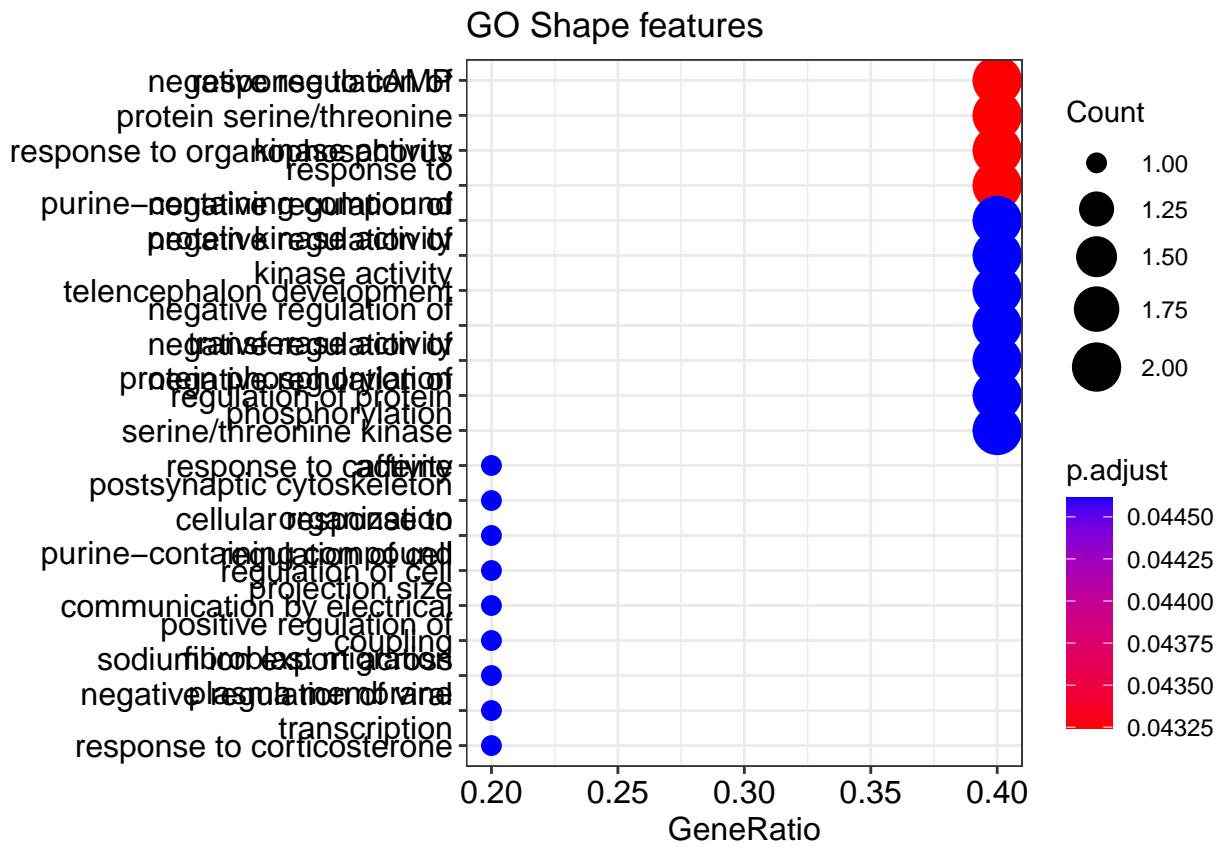
DisGeNET enrichment

Liver Cirrhosis, Experimental



Shape:

```
# GO  
dotplot(ans.go.sh, showCategory = 20) + ggtitle("GO Shape features")
```



```
# KEGG WARNING <- p.value not significant x3 <- pairwise_termsim(ans.kegg.sh)
# emapplot(x3)
```

GlcM:

```
# GO WARNING <- p.value not significant dotplot(ans.go.glcM, showCategory=20) +
# ggtitle('GO GLCM features')

# KEGG WARNING <- p.value not significant x4 <- pairwise_termsim(ans.kegg.glcM)
# emapplot(x4)
```