# PEC 2: ANÁLISIS DE DATOS DE ULTRASECUENCIACIÓN

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# Contents

# Abstract

En el estudio presentado a continuación se muestra un análisis de datos de contajes obtenidos mediante RNA-Seq para el estudio de genes diferencialmente expresados en muestras de tejido de tiroides con y sin infiltraciones. Además, los genes seleccionados están anotados y se realiza un breve análisis de significación biológica mediante términos GO.

# **Objetivos**

En este estudio se analizan datos de expresión de diferentes genes mediante el análisis de datos obtenidos por RNA-Seq. En el estudio contamos con tres grupos de muestras de tiroides divididos según el tipo de infiltración que presenten: los tejidos sin infiltración (NIT), los tejidos con pequeñas infiltraciones focalizadas (SFI) y los tejidos con infiltraciones linfoides extensas (ELI). El objetivo es comparar los genes diferencialmente expresados entre estos grupos de muestras de tiroides para definir patrones de alteraciones de expresión con significancia biológica, en el caso de que existan.

### Materiales y métodos

#### Descripción de los materiales

En este estudio trabajaré con 10 muestras aleatorias de expresión (RNA-seq) de tres tipos de tejido de tiroides distintos; not infiltrated tissues (NIT), small focal infiltrates (SFI) y extensive lymphoid infiltrates (ELI). Se realizarán tres comparaciones distintas, SFI vs NIT, ELI vs NIT y ELI vs SFI para observar los patrones de genes diferencialmente expresados entre los grupos. De cada grupo se seleccionarán 10 muestras aleatorias y se asociarán con sus respectivos counts para obtener los datos a analizar.

#### Métodos: pipeline del análisis

#### a. Definición de los datos

La selección de datos se ha hecho en base a aquellas muestras con datos de tipo RNA seq (NGS) ya que el análisis a realizar será el de genes diferencialmente expresados con Bioconductor. El dataset lo he separado en función de los tres grupos definidos; ELI, NIT y SFI. El grupo ELI solo contaba con 8 muestras de RNA Seq (NGS) por lo que se han seleccionado todas y en cuanto a NIT y SFI, he hecho la asociación de números aleatorios con las muestras, de forma que 10 muestras aleatorias de cada uno de estos grupos han sido seleccionadas. Luego he unificado los datasets de los diferentes grupos en uno de datos seleccionados que, como se puede observar en la tabla, cumplen los requisitos del ejercicio.

```
##
## Attaching package: 'readr'
## The following object is masked from 'package:genefilter':
##
##
       spec
## Parsed with column specification:
## cols(
##
     Experiment = col_character(),
##
     SRA_Sample = col_character(),
##
     Sample_Name = col_character(),
     Grupo_analisis = col_double();
##
##
     body_site = col_character(),
##
     molecular_data_type = col_character(),
##
     sex = col_character(),
##
     Group = col_character(),
##
     ShortName = col_character()
## )
## Parsed with column specification:
## cols(
##
     .default = col double(),
##
     ens = col character()
## )
## See spec(...) for full column specifications.
targets RNAseq<-targets[targets$molecular data type=="RNA Seq (NGS)",]
table(targets_RNAseq$Group)
##
## ELI NIT SFI
     8 119
targets_ELI<-targets_RNAseq[targets_RNAseq$Group=="ELI",]</pre>
targets_NIT<-targets_RNAseq[targets_RNAseq$Group=="NIT",]
```

```
targets_SFI<-targets_RNAseq[targets_RNAseq$Group=="SFI",]

set.seed(123)
select_sampleNIT<-sample(119,10)
select_sampleSFI<-sample(24,10)

targets_NIT_sel<-targets_NIT[select_sampleNIT,]
targets_SFI_sel<-targets_SFI[select_sampleSFI,]

targets_RNAseqS<-rbind(targets_ELI,targets_NIT_sel,targets_SFI_sel)
table(targets_RNAseqS$Group)</pre>
```

```
##
## ELI NIT SFI
## 8 10 10
```

A continuación, se han asociado los datos de "counts" correspondientes a las muestras seleccionadas para proceder al preprocesado y filtraje.

Para que el análisis resulte más fácil, se han cambiado los nombres según el tipo de muestra que sean, pese a que en targets\_RNAseqS se mantienen los originales para consultar (en el mismo orden).

```
## [1] "GTEX-111VG-0526-SM-5N9BW" "GTEX-11NV4-0626-SM-5N9BR"
## [3] "GTEX-11XUK-0226-SM-5EQLW" "GTEX-13NZ9-1126-SM-5MR37"
## [5] "GTEX-14AS3-0226-SM-5Q5B6" "GTEX-PLZ4-1226-SM-2I5FE"
## [7] "GTEX-R55G-0726-SM-2TC6J" "GTEX-YJ89-0726-SM-5P9F7"
## [1] "GTEX-111VG-0526-SM-5N9BW" "GTEX-11NV4-0626-SM-5N9BR"
## [3] "GTEX-11XUK-0226-SM-5EQLW" "GTEX-13NZ9-1126-SM-5MR37"
## [5] "GTEX-14AS3-0226-SM-5Q5B6" "GTEX-PLZ4-1226-SM-2I5FE"
  [7] "GTEX-R55G-0726-SM-2TC6J" "GTEX-YJ89-0726-SM-5P9F7"
   [1] "ELI 1" "ELI 2" "ELI 3" "ELI 4" "ELI 5" "ELI 6" "ELI 7" "ELI 8"
##
    [1] "GTEX-1399R-0126-SM-5IFEV" "GTEX-RNOR-0926-SM-2TF56"
##
    [3] "GTEX-13W46-0926-SM-5LU3T" "GTEX-11P7K-0226-SM-5986Z"
##
    [5] "GTEX-14ICL-0426-SM-5RQJ3" "GTEX-13061-0226-SM-5KM52"
##
    [7] "GTEX-13VXT-0626-SM-5SIA1" "GTEX-130W6-0726-SM-5L3FX"
##
    [9] "GTEX-ZA64-0426-SM-5HL96" "GTEX-ZYFG-0626-SM-5GZYA"
##
    [1] "GTEX-1399R-0126-SM-5IFEV" "GTEX-RNOR-0926-SM-2TF56"
##
##
    [3] "GTEX-13W46-0926-SM-5LU3T" "GTEX-11P7K-0226-SM-5986Z"
    [5] "GTEX-14ICL-0426-SM-5RQJ3" "GTEX-13061-0226-SM-5KM52"
##
##
    [7] "GTEX-13VXT-0626-SM-5SIA1" "GTEX-130W6-0726-SM-5L3FX"
    [9] "GTEX-ZA64-0426-SM-5HL96" "GTEX-ZYFG-0626-SM-5GZYA"
##
##
    [1] "NIT 1"
                "NIT 2" "NIT 3"
                                   "NIT 4" "NIT 5" "NIT 6" "NIT 7" "NIT 8"
                "NIT 10"
##
    [9] "NIT 9"
##
    [1] "GTEX-WYVS-0326-SM-3NM9V" "GTEX-11072-2326-SM-5BC7H"
##
    [3] "GTEX-S341-0226-SM-5S2VG"
                                   "GTEX-12ZZX-1226-SM-5EGHS"
    [5] "GTEX-11EQ9-0626-SM-5A5K1" "GTEX-12WSG-0226-SM-5EGIF"
##
    [7] "GTEX-12584-0826-SM-5FQSK" "GTEX-12ZZY-0826-SM-5EQMT"
##
    [9] "GTEX-TSE9-0626-SM-3DB8B"
                                   "GTEX-13NYC-2426-SM-5MR3K"
##
    [1] "GTEX-WYVS-0326-SM-3NM9V"
                                   "GTEX-11072-2326-SM-5BC7H"
##
    [3] "GTEX-S341-0226-SM-5S2VG" "GTEX-12ZZX-1226-SM-5EGHS"
##
    [5] "GTEX-11EQ9-0626-SM-5A5K1" "GTEX-12WSG-0226-SM-5EGIF"
##
   [7] "GTEX-12584-0826-SM-5FQSK" "GTEX-12ZZY-0826-SM-5EQMT"
```

```
## [9] "GTEX-TSE9-0626-SM-3DB8B" "GTEX-13NYC-2426-SM-5MR3K"

## [1] "SFI 1" "SFI 2" "SFI 3" "SFI 4" "SFI 5" "SFI 6" "SFI 7" "SFI 8"

## [9] "SFI 9" "SFI 10"
```

#### b. Preprocesado: filtraje y normalización

Los datos de contajes aportados pueden requerir su normalización y filtraje y para ello, se han representado varios gráficos que ilustran su distribución. A continuación encontramos el plot MDS o de escalamiento multidimensional que muestra como se distribuyen los datos en dos dimesiones. A simple vista, pese a que podemos agrupar algunos grupos en secciones características. No se observa ningún patrón claro de agrupación.

```
group<-substr(colnames(counts_sel),1,3)
dgList <- DGEList(counts=counts_sel, genes=counts_data$ens, group = group)
plotMDS(dgList)</pre>
```

```
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak \ \land \land \land \land \land \ \Para ilustrar los datos sin normalizar se adjunta también un boxplot.
```

```
##
## Attaching package: 'reshape'
## The following object is masked from 'package:dplyr':
##
## rename
## The following objects are masked from 'package:S4Vectors':
##
## expand, rename
## Using as id variables
```

```
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak \ \l
```

Como podemos observar, los datos no están normalizados y presentan diferencias de distribución. Para disminuir la variabilidad debida a factores casuales, a continuación se filtrarán y normalizarán los datos.

```
## [1] 56202 28
## [1] 19388 28
```

Para el filtraje, se eliminan aquellos genes cuyos contajes por millón sean inferiores a 1 y se mantienen todos aquellos mayores o iguales a 2. Con este filtro nos permitimos eliminar aquellos genes cuya secuenciación no haya resultado fructífera y que por lo tanto, no tendrán relevancia en un análisis de genes diferencialmente expresados. Como se puede observar, el número de genes después del filtraje pasa de los 56202 totales a 19388, reduciendo el número de genes a analizar en futuros pasos.

Una vez filtrados, los resultados de los genes seleccionados son normalizados mediante el método "Trimmed Mean of M-values" en el que las observaciones o muestras que tienen las expressiones medias más cerca de la media de todas las muestras son consideradas como "referencia" y todas las demás, muestras test. En este caso para cada muestra de test, el factor de escalada calculado para la normalización se basa en el peso de

la media de los log ratio entre el test y la referencia, retirando de un conjunto de genes aquellos que están mucho más o mucho menos expressados y los que tienen mayores y menores log ratios.

Lopez\_Andrea\_ADO\_PEC2\_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak \\ \lambda \lambda \\ \text{Como podemos observar, la distribución de los datos en dos dimensiones varía ligeramente con y sin normalización. Para ilustrarlo mejor, se adjuntan dos gráficos de intensidad en los que se muestran las diferencias entre los datos filtrados y normalizados, así como las diferencias de distribución de densidades de datos de contajes crudos y normalizados.

Lopez\_Andrea\_Allopez\_Andressi\_Allope

#### c. Identificación de genes diferencialmente expresados

El análisis de genes diferencialmente expresados lo he realizado con EdgeR, creando un objeto DGE a partir del cuál he realizado el análisis de genes diferencialmente expresados, especificando las tres comparaciones de interés, NIT vs ELI, NIT vs SFI y SFI vs ELI.

```
#En un principio se define la matriz de diseño en la que se basará el análisis.

designMat <- model.matrix(~group)

#En función de esta matriz se hace un análisis de dispersiones gracias al cual obtenemos un gráfico de 
dgList <- estimateGLMCommonDisp(dgList, design=designMat)

dgList <- estimateGLMTrendedDisp(dgList, design=designMat)

dgList <- estimateGLMTagwiseDisp(dgList, design=designMat)

plotBCV(dgList, main= "Dispersión de las muestras normalizadas")
```

 $\hbox{\it\#Una vez calculadas las dispersiones, se procede al modelo de an\'alisis de genes diferencialmente expres} \\ \hbox{\it fit} <- glmFit (dgList, designMat)$ 

En el gráfico se muestra la dispersión de las muestras normalizadas en el modelo, lo que nos muestra los valores más comunes así como la tendencia, valores entre los cuales de muestran diferencias, lo que demuestra que el modelo comprende genes diferencialmente expresados.

```
## Coefficient: groupNIT

## genes logFC logCPM LR PValue FDR

## 48230 ENSG00000167483 -7.239925 3.774220 88.17577 5.988910e-21 1.161130e-16

## 3379 ENSG00000143297 -8.019151 4.609100 81.79179 1.512053e-19 1.465785e-15

## 49407 ENSG00000104894 -4.347653 5.494380 80.31945 3.185183e-19 1.880011e-15

## 49477 ENSG00000269404 -6.540817 2.628305 79.93021 3.878710e-19 1.880011e-15

## 25262 ENSG00000245164 -5.030760 3.572782 78.70927 7.195723e-19 2.790214e-15

## 45681 ENSG00000007312 -4.444605 3.977842 76.93160 1.769827e-18 5.718899e-15
```

```
## 42101 ENSG00000177455 -8.318779 4.215559 76.19077 2.575423e-18 6.853243e-15 ## 43621 ENSG00000083454 -6.414179 3.878615 76.00615 2.827829e-18 6.853243e-15 ## 3725 ENSG00000188404 -4.038760 3.888494 74.53405 5.960148e-18 1.283948e-14 ## 43771 ENSG00000072818 -3.681394 5.486126 73.39884 1.059283e-17 2.053737e-14
```

Lopez\_Andrea\_ADO\_PEC2\_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak

En la tabla se muestran los genes diferencialmente epxresados entre las muestras ELI y NIT con sus p-valores sin y con ajuste (FDR) y ordenados de más significativo a menos. En el gráfico se representa las veces que la expresión de un gen es mayor o menor en base a la referencia en función de la media de contajes por millón, lo que nos permite ver que algunos se expresan con "fold-changes" de entre -10 y 5, lo que nos muestra que a modo general que la expresión de los genes seleccionados es menor en las muestras NIT que ELI. Como podemos observar, las mayores diferencias se encuentran entre los genes cuyos contajes por millón son más bajos.

```
## Coefficient: groupSFI
                   genes
                             logFC
                                     logCPM
                                                           PValue
                                                                           FDR
## 45499 ENSG00000265206 -3.948208 1.598581 49.19632 2.315850e-12 2.749481e-08
## 17962 ENSG00000111913 -2.308750 4.453070 48.35250 3.560898e-12 2.749481e-08
## 38705 ENSG00000100721 -6.993576 2.651936 47.60813 5.205218e-12 2.749481e-08
## 31641 ENSG00000068831 -2.656732 5.768233 47.43959 5.672543e-12 2.749481e-08
## 45681 ENSG00000007312 -3.254789 3.977842 45.57067 1.472298e-11 5.708982e-08
## 47726 ENSG00000104921 -5.149591 2.678307 42.84492 5.925564e-11 1.620990e-07
## 40218 ENSG00000247982 -3.015343 4.825448 42.77675 6.135706e-11 1.620990e-07
## 43702 ENSG00000161929 -2.880761 1.788777 42.60797 6.688631e-11 1.620990e-07
## 35404 ENSG00000122986 -2.154999 2.592503 41.99089 9.169964e-11 1.878057e-07
## 33354 ENSG00000111679 -1.698638 5.862422 41.88370 9.686700e-11 1.878057e-07
```

| Lopez\_Andrea\_ADO\_PEC2\_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak \ddot \

En la tabla se muestran los genes diferencialmente epxresados entre las muestras ELI y SFI con sus p-valores sin y con ajuste (FDR) y ordenados de más significativo a menos. En el gráfico se representa las veces que la expresión de un gen es mayor o menor en base a la referencia en función de la media de contajes por millón., lo que nos permite ver que algunos se expresan con "fold-changes" de entre -5 y 5, lo que nos muestra el tamaño de la diferencia de expresión. Como podemos observar, las mayores diferencias se encuentran entre los genes cuyos contajes por millón son más bajos.

```
## Coefficient:
                 -1*groupNIT 1*groupSFI
                                                           PValue
                                                                           FDR
##
                   genes
                            logFC
                                     logCPM
                                                  LR
         ENSG00000143297 5.781504
## 3379
                                  4.609100 52.74560 3.796737e-13 7.361115e-09
         ENSG00000211594 6.841402
                                   5.634395 50.00989 1.529731e-12 1.482921e-08
  6695
## 6717
         ENSG00000239951 6.751912
                                   6.967605 47.96849 4.331238e-12 2.109597e-08
## 39069 ENSG00000253755 7.700656
                                   6.227506 47.59976 5.227498e-12 2.109597e-08
## 39193 ENSG00000211959 7.205524
                                   4.718070 47.52147 5.440470e-12 2.109597e-08
## 6725
        ENSG00000244116 6.483556
                                   3.704490 46.71526 8.208710e-12 2.652508e-08
## 39245 ENSG00000211973 6.908995
                                   5.484819 46.17324 1.082455e-11 2.980691e-08
## 39075 ENSG00000211896 7.468970 11.627693 45.92304 1.229912e-11 2.980691e-08
## 39076 ENSG00000211897 6.420177
                                   8.621137 45.08465 1.886990e-11 4.064996e-08
## 16760 ENSG00000170476 5.869610 4.699122 44.66791 2.334519e-11 4.526165e-08
```

Lopez\_Andrea\_ADO\_PEC2\_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak

En la tabla se muestran los genes diferencialmente epxresados entre las muestras SFI y NIT con sus p-valores sin y con ajuste (FDR) y ordenados de más significativo a menos. En el gráfico se representa las veces que la expresión de un gen es mayor o menor en base a la referencia en función de la media de contajes por millón., lo que nos permite ver que algunos se expresan con "fold-changes" de entre -4 y 8, lo que nos indica que generalmente los genes seleccionados están sobreexpresados en las muestras NIT comparadas con las SFI. Como podemos observar, las mayores diferencias se encuentran entre los genes cuyos contajes por millón son más bajos.

#### d. Anotación de los resultados

Para la anotación he elegido mapIds para relacionar los términos de ENSEMBL de los genes diferencialmente expresados con mayor significancia estadística con sus respectivos símbolos y EntrezID. En las tablas siguientes se muestran, por orden, los genes de las comparaciones NIT vs ELI, SFI vs ELI y SFI vs NIT.

```
## 'select()' returned 1:1 mapping between keys and columns
   'select()' returned 1:1 mapping between keys and columns
##
  Coefficient:
                 groupNIT
##
                              logFC
                                      logCPM
                                                   LR
                                                            PValue
                                                                             FDR
                   genes
## 48230 ENSG00000167483 -7.239925 3.774220 88.17577 5.988910e-21 1.161130e-16
         ENSG00000143297 -8.019151 4.609100 81.79179 1.512053e-19 1.465785e-15
## 49407 ENSG00000104894 -4.347653 5.494380 80.31945 3.185183e-19 1.880011e-15
## 49477 ENSG00000269404 -6.540817 2.628305 79.93021 3.878710e-19 1.880011e-15
  25262 ENSG00000245164 -5.030760 3.572782 78.70927 7.195723e-19 2.790214e-15
  45681 ENSG00000007312 -4.444605 3.977842 76.93160 1.769827e-18 5.718899e-15
##
##
            symbol
                      entrez
## 48230
            NIBAN3
                      199786
## 3379
             FCRL5
                       83416
## 49407
              CD37
                         951
## 49477
              SPIB
                         6689
## 25262 LINC00861 100130231
## 45681
             CD79B
                         974
  'select()' returned 1:1 mapping between keys and columns
   'select()' returned 1:1 mapping between keys and columns
## Coefficient:
                 groupSFI
##
                                      logCPM
                                                                             FDR
                             logFC
                                                   T.R.
                                                            PValue
                   genes
## 45499 ENSG00000265206 -3.948208 1.598581 49.19632 2.315850e-12 2.749481e-08
## 17962 ENSG00000111913 -2.308750 4.453070 48.35250 3.560898e-12 2.749481e-08
  38705 ENSG00000100721 -6.993576 2.651936 47.60813 5.205218e-12 2.749481e-08
## 31641 ENSG00000068831 -2.656732 5.768233 47.43959 5.672543e-12 2.749481e-08
## 45681 ENSG00000007312 -3.254789 3.977842 45.57067 1.472298e-11 5.708982e-08
## 47726 ENSG00000104921 -5.149591 2.678307 42.84492 5.925564e-11 1.620990e-07
##
          symbol entrez
## 45499
            <NA>
                   <NA>
## 17962
          RIPOR2
                   9750
## 38705
           TCL1A
                   8115
## 31641 RASGRP2
                  10235
## 45681
           CD79B
                    974
## 47726
           FCER2
                   2208
```

```
## 'select()' returned 1:1 mapping between keys and columns
## 'select()' returned 1:1 mapping between keys and columns
## Coefficient:
                 groupNIT
                                                                             FDR
##
                   genes
                             logFC
                                      logCPM
                                                            PValue
## 48230 ENSG00000167483 -7.239925 3.774220 88.17577 5.988910e-21 1.161130e-16
## 3379 ENSG00000143297 -8.019151 4.609100 81.79179 1.512053e-19 1.465785e-15
## 49407 ENSG00000104894 -4.347653 5.494380 80.31945 3.185183e-19 1.880011e-15
## 49477 ENSG00000269404 -6.540817 2.628305 79.93021 3.878710e-19 1.880011e-15
## 25262 ENSG00000245164 -5.030760 3.572782 78.70927 7.195723e-19 2.790214e-15
## 45681 ENSG00000007312 -4.444605 3.977842 76.93160 1.769827e-18 5.718899e-15
##
            symbol
                      entrez
## 48230
            NIBAN3
                      199786
## 3379
             FCRL5
                       83416
## 49407
              CD37
                         951
                        6689
## 49477
              SPIB
## 25262 LINC00861 100130231
## 45681
             CD79B
                         974
e. Análisis de significancia biológica
## clusterProfiler v3.16.0 For help: https://guangchuangyu.github.io/software/clusterProfiler
## If you use clusterProfiler in published research, please cite:
## Guangchuang Yu, Li-Gen Wang, Yanyan Han, Qing-Yu He. clusterProfiler: an R package for comparing bio
## Attaching package: 'clusterProfiler'
## The following object is masked from 'package:reshape':
##
##
       rename
## The following object is masked from 'package:DelayedArray':
##
##
       simplify
## The following object is masked from 'package:AnnotationDbi':
##
##
       select
## The following object is masked from 'package:XVector':
##
##
       slice
## The following object is masked from 'package: IRanges':
##
##
       slice
## The following object is masked from 'package:S4Vectors':
##
##
       rename
## The following object is masked from 'package:stats':
##
##
       filter
                      ID
## GD:0050853 GD:0050853
```

```
## GD:0042113 GD:0042113
## GD:0010522 GD:0010522
## GD:0002920 GD:0002920
## GD:0050864 GD:0050864
## GD:0030183 GD:0030183
## GD:0002923 GD:0002923
## GD:0016064 GD:0016064
## G0:0019724 G0:0019724
## GD:0060402 GD:0060402
## G0:0060401 G0:0060401
## GD:0010524 GD:0010524
## G0:0051924 G0:0051924
## GD:0002712 GD:0002712
## GD:0002889 GD:0002889
## GD:0050854 GD:0050854
## GD:0006959 GD:0006959
## GD:0045123 GD:0045123
## GD:0002455 GD:0002455
## GD:0007204 GD:0007204
## GD:0046651 GD:0046651
## G0:0051279 G0:0051279
## GD:0032943 GD:0032943
## GD:0050851 GD:0050851
## GD:0002460 GD:0002460
## GD:0070661 GD:0070661
## GD:0051480 GD:0051480
## GD:0030098 GD:0030098
## GD:0042100 GD:0042100
## G0:0051260 G0:0051260
## GD:0007159 GD:0007159
## GD:0010959 GD:0010959
## GD:0002449 GD:0002449
## GO:0051209 GO:0051209
## GD:0051283 GD:0051283
## GD:0051928 GD:0051928
## GD:0051282 GD:0051282
## GD:0006816 GD:0006816
## GD:0050868 GD:0050868
## GD:0051208 GD:0051208
## GD:0006874 GD:0006874
## GO:0097553 GO:0097553
## GD:1903038 GD:1903038
## GO:1903169 GO:1903169
## GD:0001768 GD:0001768
## GD:0002713 GD:0002713
## GD:0002890 GD:0002890
## GD:0010918 GD:0010918
## GD:0051250 GD:0051250
## GD:0001767 GD:0001767
## GO:0071248 GO:0071248
## GD:0002921 GD:0002921
## GD:0060088 GD:0060088
## GO:1904424 GO:1904424
## GD:0002822 GD:0002822
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## GD:0022408 GD:0022408
## GD:0002093 GD:0002093
## GO:0051712 GO:0051712
## GD:0072672 GD:0072672
## GD:0002695 GD:0002695
## G0:0051651 G0:0051651
## GD:0045838 GD:0045838
## GD:0051770 GD:0051770
## G0:0071241 G0:0071241
## G0:0002819 G0:0002819
## GD:2000402 GD:2000402
## G0:0051709 G0:0051709
## GD:0050866 GD:0050866
## GD:0002925 GD:0002925
## GD:0060117 GD:0060117
## G0:0051767 G0:0051767
## GD:0051769 GD:0051769
## GD:0050670 GD:0050670
## GD:0033622 GD:0033622
## GD:0033630 GD:0033630
## GD:0045663 GD:0045663
## G0:0071294 G0:0071294
## GO:2000114 GO:2000114
## GD:0032944 GD:0032944
## GD:0035855 GD:0035855
## GD:0071467 GD:0071467
## GD:0002706 GD:0002706
## GD:0002693 GD:0002693
## G0:0035024 G0:0035024
## GD:0050860 GD:0050860
## GD:0090023 GD:0090023
## GD:0043270 GD:0043270
## GD:0070663 GD:0070663
## GD:0030220 GD:0030220
## GD:0032461 GD:0032461
## GD:0032878 GD:0032878
## G0:0071624 G0:0071624
## GO:1901741 GO:1901741
## GD:0002335 GD:0002335
## GD:0036344 GD:0036344
## GO:0051000 GO:0051000
## GO:1901739 GO:1901739
## G0:0045577 G0:0045577
## G0:1902624 G0:1902624
## GD:0051491 GD:0051491
## GD:0060122 GD:0060122
## GD:0090022 GD:0090022
## GD:0007162 GD:0007162
## G0:0051235 G0:0051235
## GO:0035590 GO:0035590
## GD:0043552 GD:0043552
## GD:0070588 GD:0070588
## GD:0002922 GD:0002922
## GD:0033198 GD:0033198
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## GD:0048741 GD:0048741
## GO:0050855 GO:0050855
## GD:0050901 GD:0050901
## GD:0070372 GD:0070372
## GD:0001906 GD:0001906
## GO:0071214 GO:0071214
## GD:0104004 GD:0104004
## GD:0002703 GD:0002703
## GD:0050858 GD:0050858
## G0:0042491 G0:0042491
## GD:0060143 GD:0060143
## GD:0002699 GD:0002699
## GD:1904062 GD:1904062
## GD:0014904 GD:0014904
## GD:0090218 GD:0090218
## GO:1902622 GO:1902622
## GD:0070371 GD:0070371
## GD:0032770 GD:0032770
## GD:0060142 GD:0060142
## GD:0007596 GD:0007596
## GD:0007599 GD:0007599
## G0:0050817 G0:0050817
## GD:0002691 GD:0002691
## GD:0060338 GD:0060338
## G0:0051281 G0:0051281
## GD:0010038 GD:0010038
## GO:1903037 GO:1903037
## GD:0070207 GD:0070207
## GD:0009268 GD:0009268
## GD:0050863 GD:0050863
## GD:0050856 GD:0050856
## GD:0060119 GD:0060119
## GO:0051489 GO:0051489
## GD:0071622 GD:0071622
## GD:0010831 GD:0010831
## GO:0032459 GO:0032459
## G0:0098751 G0:0098751
## GD:0033628 GD:0033628
## GO:1903727 GO:1903727
## GD:0007520 GD:0007520
## GD:0016339 GD:0016339
## GD:0002639 GD:0002639
## GD:0035315 GD:0035315
## GD:0061756 GD:0061756
## GD:0010043 GD:0010043
## GO:0050850 GO:0050850
## GD:2000404 GD:2000404
## GD:0043547 GD:0043547
## GD:0002686 GD:0002686
## G0:0002714 G0:0002714
## GD:0002891 GD:0002891
## GO:0031295 GO:0031295
## GD:0043551 GD:0043551
## GD:0046580 GD:0046580
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## GD:0050732 GD:0050732
## G0:0042391 G0:0042391
## GD:0031294 GD:0031294
## GD:0002066 GD:0002066
## GD:0002823 GD:0002823
## GD:0060113 GD:0060113
## GD:0060563 GD:0060563
## GD:0035036 GD:0035036
## GD:0045661 GD:0045661
## GO:0051353 GO:0051353
## GD:0032715 GD:0032715
## GO:0051058 GO:0051058
## GD:0007265 GD:0007265
## GD:0030888 GD:0030888
## GD:0046847 GD:0046847
## GD:0050999 GD:0050999
## GD:0070527 GD:0070527
## GD:0000768 GD:0000768
## GD:0043550 GD:0043550
## GD:0046626 GD:0046626
## GO:0140253 GO:0140253
## GD:0006949 GD:0006949
## GD:0070206 GD:0070206
## GD:0010830 GD:0010830
## GD:0033627 GD:0033627
## GD:0002820 GD:0002820
## GD:0042490 GD:0042490
## GD:0048747 GD:0048747
## GO:1904427 GO:1904427
## GD:0030449 GD:0030449
## GD:1900076 GD:1900076
## GD:0002312 GD:0002312
## G0:0042130 G0:0042130
## GD:2000401 GD:2000401
## GD:0032768 GD:0032768
## GD:0002637 GD:0002637
## GD:0072678 GD:0072678
## GD:0031640 GD:0031640
## GO:0045454 GO:0045454
## GD:0071260 GD:0071260
## G0:0051881 G0:0051881
## GD:0061515 GD:0061515
## GD:0009988 GD:0009988
## G0:0043407 G0:0043407
## GD:0071277 GD:0071277
## GO:0034109 GO:0034109
## GO:0051155 GO:0051155
## GO:1903725 GO:1903725
## GD:0032720 GD:0032720
## GD:0006956 GD:0006956
## GD:1903556 GD:1903556
## GO:0045445 GO:0045445
## GD:0014068 GD:0014068
## GD:0032945 GD:0032945
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## GD:0050672 GD:0050672
## GD:0030219 GD:0030219
## GD:0002690 GD:0002690
## GD:0060079 GD:0060079
## GD:0002707 GD:0002707
## G0:0032091 G0:0032091
## GD:0070664 GD:0070664
## GD:0042472 GD:0042472
## GD:0120034 GD:0120034
## GO:1990868 GO:1990868
## GD:1990869 GD:1990869
## GD:0050848 GD:0050848
## GD:0033138 GD:0033138
## GD:0099565 GD:0099565
## GD:0035335 GD:0035335
## GD:0002065 GD:0002065
## GD:0002704 GD:0002704
## GD:0030593 GD:0030593
## GD:0014902 GD:0014902
## G0:0051341 G0:0051341
## GD:0031343 GD:0031343
## GO:0051149 GO:0051149
## GD:0042471 GD:0042471
## GD:1903828 GD:1903828
## GD:0002377 GD:0002377
## GD:1990266 GD:1990266
## GD:0002688 GD:0002688
## GD:0051153 GD:0051153
## GD:0072676 GD:0072676
## GD:0071621 GD:0071621
## GD:0046683 GD:0046683
## GD:0014066 GD:0014066
## GD:0030010 GD:0030010
## GD:0060337 GD:0060337
## GD:0071357 GD:0071357
## GD:0034340 GD:0034340
## GO:1904064 GO:1904064
## GO:0033135 GO:0033135
## GD:0008286 GD:0008286
## GD:0060078 GD:0060078
## GD:0007605 GD:0007605
## GD:0002824 GD:0002824
## GD:0014074 GD:0014074
## G0:0045834 G0:0045834
## GD:0051592 GD:0051592
## GD:0071901 GD:0071901
## GD:0097530 GD:0097530
## GD:0035023 GD:0035023
## GD:0002821 GD:0002821
## G0:0050921 G0:0050921
## GD:0002687 GD:0002687
## GD:0034767 GD:0034767
## GD:0007338 GD:0007338
## GD:0002702 GD:0002702
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## GD:0008037 GD:0008037
## GO:0014065 GO:0014065
## GD:0007519 GD:0007519
## GD:0050954 GD:0050954
## GD:1902600 GD:1902600
## GD:0030168 GD:0030168
## GD:0051100 GD:0051100
## GD:0060538 GD:0060538
## GD:0120032 GD:0120032
## G0:0051897 G0:0051897
## GD:0032675 GD:0032675
## G0:0060491 G0:0060491
## GD:0055002 GD:0055002
## GD:0002244 GD:0002244
## GD:0043409 GD:0043409
## GO:0045619 GO:0045619
## GD:0051099 GD:0051099
## GD:0042267 GD:0042267
## GD:0032635 GD:0032635
## GD:0009566 GD:0009566
## GD:0002228 GD:0002228
## GO:0051147 GO:0051147
## GD:2000045 GD:2000045
## GD:0002285 GD:0002285
## GD:0048015 GD:0048015
## GD:0055001 GD:0055001
## GD:0002698 GD:0002698
## GD:0048017 GD:0048017
## GD:0048839 GD:0048839
## GD:0007219 GD:0007219
## GD:0001959 GD:0001959
## GD:0034764 GD:0034764
## GD:0032680 GD:0032680
## GD:0032640 GD:0032640
## GO:1903555 GO:1903555
## GD:0002708 GD:0002708
## GD:0009612 GD:0009612
## G0:0042129 G0:0042129
## GD:0002700 GD:0002700
## GD:0071706 GD:0071706
## GO:1902806 GO:1902806
## GO:0031341 GO:0031341
## GD:0007163 GD:0007163
## GD:0060759 GD:0060759
## GD:0007266 GD:0007266
## GD:0002064 GD:0002064
## GD:0043393 GD:0043393
## GD:0032869 GD:0032869
## GD:0060348 GD:0060348
## GD:0002685 GD:0002685
## GD:0019722 GD:0019722
## GO:0050777 GO:0050777
## GD:0043583 GD:0043583
## GD:0007584 GD:0007584
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## GD:0042098 GD:0042098
## GD:0097529 GD:0097529
## GD:0002705 GD:0002705
## GD:0050920 GD:0050920
## GD:0006469 GD:0006469
## GD:0070374 GD:0070374
## GD:0030595 GD:0030595
## GD:0050870 GD:0050870
## GD:0051896 GD:0051896
## GD:0001909 GD:0001909
## GD:0046578 GD:0046578
## GD:0050730 GD:0050730
## GD:0033673 GD:0033673
## GD:0098742 GD:0098742
## GD:0002440 GD:0002440
## GO:0031334 GO:0031334
## GD:0090596 GD:0090596
## GD:1903039 GD:1903039
## GD:0032868 GD:0032868
## G0:0043491 G0:0043491
## GD:0050852 GD:0050852
## GD:0000082 GD:0000082
## G0:0048562 G0:0048562
## GD:0051348 GD:0051348
## GD:0018105 GD:0018105
## GD:0044843 GD:0044843
## GO:1902105 GO:1902105
## GD:0051146 GD:0051146
## G0:0022409 G0:0022409
## GD:0051251 GD:0051251
## GD:0018209 GD:0018209
## GD:0071375 GD:0071375
## GD:0060326 GD:0060326
## GD:0071496 GD:0071496
## GD:0030336 GD:0030336
## GD:0001818 GD:0001818
## GD:0071356 GD:0071356
## GD:0006470 GD:0006470
## GD:0071902 GD:0071902
## GO:0051056 GO:0051056
## GO:2000146 GO:2000146
## GD:0043405 GD:0043405
## GD:0002696 GD:0002696
## GO:0034612 GO:0034612
## GD:0018108 GD:0018108
## GO:0018212 GO:0018212
## GD:0031346 GD:0031346
## GD:0050867 GD:0050867
## GD:0051098 GD:0051098
## GD:0042692 GD:0042692
## GD:0040013 GD:0040013
## GD:0014706 GD:0014706
## GD:0051271 GD:0051271
## GO:1901653 GO:1901653
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## GD:0009913 GD:0009913
## GD:0019216 GD:0019216
## GD:0060537 GD:0060537
## GD:0007517 GD:0007517
## GD:0001933 GD:0001933
## GD:0045088 GD:0045088
## GD:0043434 GD:0043434
## GD:0048568 GD:0048568
## GO:0001558 GO:0001558
## GD:0019932 GD:0019932
## GD:0043254 GD:0043254
## GD:0030099 GD:0030099
## GD:0045785 GD:0045785
## GD:0006644 GD:0006644
## GD:0042326 GD:0042326
## GO:0050853
## GO:0042113
## GD:0010522
## GD:0002920
## GO:0050864
## GD:0030183
## GD:0002923
                                                                                    regulation of humoral
## GD:0016064
## GO:0019724
## GD:0060402
## GD:0060401
## GD:0010524
                                                                                                        ро
## GO:0051924
## GD:0002712
## GD:0002889
## GD:0050854
                                                                                                        re
## GD:0006959
## GO:0045123
## GO:0002455
                                                                                                   humoral
## GD:0007204
                                                                                                       pos
## GO:0046651
## GO:0051279
                                                                                                    regula
## GD:0032943
## GD:0050851
## GD:0002460
                                      adaptive immune response based on somatic recombination of immune
## GD:0070661
## GD:0051480
## GD:0030098
## GD:0042100
## GO:0051260
## GD:0007159
## GO:0010959
## GD:0002449
## GO:0051209
## GO:0051283
## GO:0051928
## GO:0051282
```

## GD:0006816

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## GD:0050868
## GO:0051208
## GD:0006874
## GO:0097553
## GO:1903038
## GO:1903169
## GD:0001768
## GO:0002713
## GD:0002890
                                                                                                  negativ
## GO:0010918
## GO:0051250
## GD:0001767
## GD:0071248
## GD:0002921
## GD:0060088
## GO:1904424
## GD:0002822
                       regulation of adaptive immune response based on somatic recombination of immune
## GD:0022408
## GD:0002093
## GO:0051712
                                                                                                        ро
## GO:0072672
## GD:0002695
## GO:0051651
## GD:0045838
## GO:0051770
                                                                                               positive r
## GD:0071241
## GD:0002819
## GO:2000402
## GO:0051709
## GD:0050866
## GD:0002925
                                                                           positive regulation of humoral
## GO:0060117
## GD:0051767
## GO:0051769
                                                                                                         r
## GD:0050670
## GO:0033622
## GO:0033630
                                                                                                        ро
## GO:0045663
## GO:0071294
## GO:2000114
## GD:0032944
## GD:0035855
## GD:0071467
## GD:0002706
## GD:0002693
## GD:0035024
## GD:0050860
                                                                                                         n
## GD:0090023
## GO:0043270
## GD:0070663
## GO:0030220
## GD:0032461
## GO:0032878
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## GD:0071624
```

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## GO:1901741
## GD:0002335
## GD:0036344
## GO:0051000
## GO:1901739
## GO:0045577
## GD:1902624
## GO:0051491
## GD:0060122
## GD:0090022
## GD:0007162
## GO:0051235
## GD:0035590
## GO:0043552
## GD:0070588
## GO:0002922
## GO:0033198
## GO:0048741
## GO:0050855
## GD:0050901
## GO:0070372
## GD:0001906
## GO:0071214
## GD:0104004
## GD:0002703
## GD:0050858
## GD:0042491
## GD:0060143
                                                                                             positive regu
## GD:0002699
## GD:1904062
## GO:0014904
## GD:0090218
## GO:1902622
## GD:0070371
## GD:0032770
## GD:0060142
## GD:0007596
## GD:0007599
## GD:0050817
## GD:0002691
## GD:0060338
## GO:0051281
                                                                                           positive regula
## GD:0010038
## GD:1903037
## GD:0070207
## GD:0009268
## GD:0050863
## GO:0050856
## GD:0060119
## GO:0051489
## GO:0071622
## GD:0010831
## GD:0032459
```

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negative re

regu

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## GO:0098751

```
## GD:0033628
## GO:1903727
## GO:0007520
## GO:0016339
                                                                                calcium-dependent cell-ce
## GD:0002639
## GO:0035315
## GD:0061756
## GD:0010043
## GO:0050850
## GD:2000404
## GD:0043547
## GO:0002686
## GD:0002714
## GD:0002891
                                                                                                   positiv
## GO:0031295
## GO:0043551
## GO:0046580
## GO:0050732
                                                                                                         n
## GD:0042391
## GD:0031294
## GD:0002066
## G0:0002823 negative regulation of adaptive immune response based on somatic recombination of immune
## GO:0060113
## GD:0060563
## GD:0035036
## GD:0045661
## GO:0051353
## GD:0032715
## GO:0051058
                                                                                                 negative :
## GD:0007265
## GD:0030888
## GD:0046847
## GD:0050999
## GO:0070527
## GD:0000768
## GD:0043550
## GO:0046626
## GO:0140253
## GD:0006949
## GD:0070206
## GD:0010830
## GD:0033627
## GD:0002820
## GD:0042490
## GD:0048747
## GO:1904427
                                                                                                       pos
## GD:0030449
## GO:1900076
## GO:0002312
## GD:0042130
## GD:2000401
## GD:0032768
## GD:0002637
## GD:0072678
```

```
## GD:0031640
## GO:0045454
## GO:0071260
## GO:0051881
## GD:0061515
## GD:0009988
## GD:0043407
## GD:0071277
## GO:0034109
## GO:0051155
## GO:1903725
## GO:0032720
## GD:0006956
## GO:1903556
## GO:0045445
## GO:0014068
## GO:0032945
## GD:0050672
## GD:0030219
## GD:0002690
## GD:0060079
## GD:0002707
## GO:0032091
## GD:0070664
## GO:0042472
## GD:0120034
## GO:1990868
## GD:1990869
## GO:0050848
## GD:0033138
## GD:0099565
## GO:0035335
## GD:0002065
## GO:0002704
## GD:0030593
## GO:0014902
## GO:0051341
## GO:0031343
## GO:0051149
## GO:0042471
## GO:1903828
## GD:0002377
## GO:1990266
## GD:0002688
## GD:0051153
## GO:0072676
## GD:0071621
## GD:0046683
## GD:0014066
## GD:0030010
## GD:0060337
```

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positiv

negative regulation of

positive regulat

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## G0:0071357 ## G0:0034340 ## G0:1904064

```
## GD:0008286
## GO:0060078
## GO:0007605
## G0:0002824 positive regulation of adaptive immune response based on somatic recombination of immune
## GD:0014074
## GO:0045834
## GO:0051592
## GD:0071901
                                                                                                  negative
## GD:0097530
## GD:0035023
## GD:0002821
## GD:0050921
## GD:0002687
## GO:0034767
## GO:0007338
## GO:0002702
                                                                                      positive regulation
## GD:0008037
## GD:0014065
## GD:0007519
## GO:0050954
## GD:1902600
## GO:0030168
## GO:0051100
## GO:0060538
## GO:0120032
                                                                                                   regulat
## GO:0051897
## GD:0032675
## GD:0060491
## GD:0055002
## GD:0002244
## GO:0043409
## GD:0045619
## GO:0051099
## GD:0042267
## GD:0032635
## GD:0009566
## GD:0002228
## GO:0051147
## GO:2000045
## GD:0002285
## GD:0048015
## GD:0055001
## GD:0002698
## GD:0048017
## GD:0048839
## GD:0007219
## GD:0001959
## GO:0034764
## GD:0032680
## GD:0032640
## GO:1903555
                                                                                              regulation of
## GD:0002708
```

## GD:0033135

## GD:0009612

```
## GD:0042129
## GD:0002700
## GO:0071706
## GO:1902806
## GD:0031341
## GD:0007163
## GD:0060759
## GD:0007266
## GD:0002064
## GD:0043393
## GD:0032869
## GD:0060348
## GD:0002685
## GD:0019722
## GD:0050777
## GO:0043583
## GO:0007584
## GD:0042098
## GD:0097529
## GO:0002705
## GD:0050920
## GD:0006469
## GO:0070374
## GD:0030595
## GD:0050870
## GD:0051896
## GD:0001909
## GD:0046578
## GO:0050730
## GD:0033673
## GD:0098742
## GD:0002440
## GD:0031334
## GO:0090596
## GD:1903039
## GD:0032868
## GO:0043491
## GO:0050852
## GD:0000082
## GO:0048562
## GO:0051348
## GD:0018105
## GD:0044843
## GO:1902105
## GO:0051146
## GO:0022409
## GD:0051251
## GD:0018209
## GO:0071375
## GD:0060326
## GO:0071496
## GD:0030336
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regulation

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pos

## GO:0001818 ## GO:0071356

```
## GD:0006470
## GD:0071902
                                                                                                 positive
## GO:0051056
## GD:2000146
## GO:0043405
## GD:0002696
## GD:0034612
## GO:0018108
## GD:0018212
## GO:0031346
## GD:0050867
## GO:0051098
## GD:0042692
## GD:0040013
## GD:0014706
## GO:0051271
## GO:1901653
## GD:0009913
## GD:0019216
## GD:0060537
## GD:0007517
## GO:0001933
## GO:0045088
## GD:0043434
## GD:0048568
## GD:0001558
## GO:0019932
## GO:0043254
## GD:0030099
## GO:0045785
## GD:0006644
  GD:0042326
##
              GeneRatio
                          BgRatio
                                        pvalue
                                                   p.adjust
                         67/20536 1.177538e-05 0.003781448 0.002020544
## GD:0050853
                   3/14
## GO:0042113
                   4/14 249/20536 1.919517e-05 0.003781448 0.002020544
## GD:0010522
                   3/14 104/20536 4.410113e-05 0.004729007 0.002526854
## GD:0002920
                   3/14 107/20536 4.801022e-05 0.004729007 0.002526854
## GO:0050864
                   3/14 120/20536 6.757610e-05 0.005324997 0.002845309
## GO:0030183
                   3/14 136/20536 9.803107e-05 0.006437374 0.003439687
                   2/14 25/20536 1.283188e-04 0.007222515 0.003859212
## GD:0002923
                   3/14 159/20536 1.557109e-04 0.007345566 0.003924962
## GO:0016064
## GO:0019724
                   3/14 169/20536 1.864357e-04 0.007345566 0.003924962
## GD:0060402
                   3/14 169/20536 1.864357e-04 0.007345566 0.003924962
## GD:0060401
                   3/14 191/20536 2.673115e-04 0.009574613 0.005116010
## GO:0010524
                         54/20536 6.052058e-04 0.019870925 0.010617646
## GO:0051924
                   3/14 288/20536 8.859993e-04 0.024477424 0.013079040
## GD:0002712
                   2/14
                         72/20536 1.073447e-03 0.024477424 0.013079040
## GD:0002889
                   2/14
                         72/20536 1.073447e-03 0.024477424 0.013079040
## GO:0050854
                   2/14
                         74/20536 1.133459e-03 0.024477424 0.013079040
## GD:0006959
                   3/14 327/20536 1.278237e-03 0.024477424 0.013079040
                         81/20536 1.355948e-03 0.024477424 0.013079040
## GO:0045123
                   2/14
## GO:0002455
                         82/20536 1.389305e-03 0.024477424 0.013079040
## GD:0007204
                   3/14 337/20536 1.393878e-03 0.024477424 0.013079040
## GO:0046651
                   3/14 342/20536 1.454099e-03 0.024477424 0.013079040
```

```
## GO:0051279
                   2/14 84/20536 1.457196e-03 0.024477424 0.013079040
## GD:0032943
                   3/14 344/20536 1.478642e-03 0.024477424 0.013079040
## GO:0050851
                   3/14 345/20536 1.491011e-03 0.024477424 0.013079040
## GD:0002460
                   3/14 367/20536 1.779894e-03 0.027389529 0.014635068
## GD:0070661
                   3/14 370/20536 1.821815e-03 0.027389529 0.014635068
                   3/14 377/20536 1.922038e-03 0.027389529 0.014635068
## GO:0051480
                   3/14 383/20536 2.010652e-03 0.027389529 0.014635068
## GD:0030098
## GO:0042100
                   2/14 99/20536 2.015981e-03 0.027389529 0.014635068
## GD:0051260
                   3/14 415/20536 2.526611e-03 0.032775863 0.017513151
## GO:0007159
                   3/14 418/20536 2.578812e-03 0.032775863 0.017513151
## GD:0010959
                   3/14 434/20536 2.868597e-03 0.035319607 0.018872352
                   3/14 455/20536 3.278616e-03 0.038654132 0.020654091
## GD:0002449
## GD:0051209
                   2/14 132/20536 3.547265e-03 0.038654132 0.020654091
## GD:0051283
                   2/14 134/20536 3.653145e-03 0.038654132 0.020654091
## GO:0051928
                   2/14 134/20536 3.653145e-03 0.038654132 0.020654091
## GO:0051282
                   2/14 136/20536 3.760497e-03 0.038654132 0.020654091
                   3/14 483/20536 3.879290e-03 0.038654132 0.020654091
## GD:0006816
## GD:0050868
                   2/14 139/20536 3.924277e-03 0.038654132 0.020654091
## GO:0051208
                   2/14 139/20536 3.924277e-03 0.038654132 0.020654091
## GD:0006874
                   3/14 490/20536 4.039332e-03 0.038816995 0.020741114
## GO:0097553
                   2/14 150/20536 4.552869e-03 0.042710249 0.022821399
                   2/14 156/20536 4.914174e-03 0.045027547 0.024059603
## GO:1903038
                   2/14 161/20536 5.225112e-03 0.046788505 0.025000537
## GO:1903169
                         10/20536 6.797906e-03 0.055799475 0.029815375
## GD:0001768
## GO:0002713
                   1/14
                         10/20536 6.797906e-03 0.055799475 0.029815375
## GD:0002890
                         10/20536 6.797906e-03 0.055799475 0.029815375
## GO:0010918
                         10/20536 6.797906e-03 0.055799475 0.029815375
                   1/14
## GO:0051250
                   2/14 191/20536 7.275640e-03 0.058502087 0.031259464
                   1/14 11/20536 7.475331e-03 0.058905607 0.031475077
## GD:0001767
## GD:0071248
                   2/14 201/20536 8.028276e-03 0.059481793 0.031782951
## GD:0002921
                        12/20536 8.152327e-03 0.059481793 0.031782951
## GD:0060088
                   1/14
                         12/20536 8.152327e-03 0.059481793 0.031782951
## GO:1904424
                   1/14 12/20536 8.152327e-03 0.059481793 0.031782951
                   2/14 210/20536 8.734595e-03 0.062571462 0.033433856
## GO:0002822
## GD:0022408
                   2/14 218/20536 9.385196e-03 0.063474288 0.033916264
                   1/14 14/20536 9.505033e-03 0.063474288 0.033916264
## GD:0002093
## GD:0051712
                   1/14 14/20536 9.505033e-03 0.063474288 0.033916264
## GD:0072672
                   1/14 14/20536 9.505033e-03 0.063474288 0.033916264
## GO:0002695
                   2/14 223/20536 9.802599e-03 0.063497639 0.033928741
                   2/14 226/20536 1.005699e-02 0.063497639 0.033928741
## GO:0051651
                   1/14 15/20536 1.018074e-02 0.063497639 0.033928741
## GO:0045838
## GO:0051770
                        15/20536 1.018074e-02 0.063497639 0.033928741
                   1/14
## GD:0071241
                   2/14 229/20536 1.031434e-02 0.063497639 0.033928741
## GO:0002819
                   2/14 233/20536 1.066203e-02 0.064628324 0.034532901
## GD:2000402
                   1/14 16/20536 1.085603e-02 0.064807184 0.034628471
## GO:0051709
                        17/20536 1.153088e-02 0.067808461 0.036232146
## GD:0050866
                   2/14 247/20536 1.191973e-02 0.069064319 0.036903189
## GD:0002925
                        19/20536 1.287931e-02 0.072492100 0.038734758
## GO:0060117
                   1/14
                        19/20536 1.287931e-02 0.072492100 0.038734758
## GO:0051767
                   1/14
                         20/20536 1.355288e-02 0.073814512 0.039441363
                         20/20536 1.355288e-02 0.073814512 0.039441363
## GO:0051769
## GO:0050670
                   2/14 277/20536 1.482395e-02 0.073814512 0.039441363
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GD:0033622
## GD:0033630
                   1/14 22/20536 1.489874e-02 0.073814512 0.039441363
```

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## GD:0045663
                   1/14
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GD:0071294
                         22/20536 1.489874e-02 0.073814512 0.039441363
                   1/14
## GO:2000114
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GO:0032944
                   2/14 278/20536 1.492557e-02 0.073814512 0.039441363
## GO:0035855
                         23/20536 1.557104e-02 0.073814512 0.039441363
                   1/14
                         23/20536 1.557104e-02 0.073814512 0.039441363
## GO:0071467
                   2/14 286/20536 1.574957e-02 0.073814512 0.039441363
## GD:0002706
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0002693
                   1/14
## GD:0035024
                   1/14
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0050860
                   1/14
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0090023
                         24/20536 1.624290e-02 0.073814512 0.039441363
                   2/14 293/20536 1.648649e-02 0.073814512 0.039441363
## GO:0043270
## GD:0070663
                   2/14 293/20536 1.648649e-02 0.073814512 0.039441363
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GD:0030220
## GO:0032461
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GD:0032878
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GD:0071624
                   1/14
## GO:1901741
                         26/20536 1.758536e-02 0.074501423 0.039808401
                         27/20536 1.825595e-02 0.076270515 0.040753682
## GD:0002335
                   1/14
## GD:0036344
                   1/14
                         28/20536 1.892612e-02 0.076270515 0.040753682
## GO:0051000
                   1/14
                         28/20536 1.892612e-02 0.076270515 0.040753682
                         28/20536 1.892612e-02 0.076270515 0.040753682
## GO:1901739
## GO:0045577
                   1/14
                         29/20536 1.959586e-02 0.076270515 0.040753682
                         29/20536 1.959586e-02 0.076270515 0.040753682
## GD:1902624
                   1/14
## GD:0051491
                   1/14
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0060122
                   1/14
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0090022
                   1/14
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0007162
                   2/14 334/20536 2.109402e-02 0.076270515 0.040753682
                   2/14 338/20536 2.156957e-02 0.076270515 0.040753682
## GO:0051235
## GD:0035590
                   1/14
                         32/20536 2.160253e-02 0.076270515 0.040753682
## GO:0043552
                   1/14
                         32/20536 2.160253e-02 0.076270515 0.040753682
## GO:0070588
                   2/14 343/20536 2.217037e-02 0.076270515 0.040753682
## GD:0002922
                         33/20536 2.227057e-02 0.076270515 0.040753682
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GO:0033198
                   1/14
## GO:0048741
                   1/14
                         33/20536 2.227057e-02 0.076270515 0.040753682
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GD:0050855
                   1/14
## GD:0050901
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GD:0070372
                   2/14 344/20536 2.229137e-02 0.076270515 0.040753682
## GD:0001906
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
## GO:0071214
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
## GO:0104004
## GD:0002703
                   2/14 349/20536 2.290060e-02 0.076270515 0.040753682
## GD:0050858
                   1/14
                         34/20536 2.293819e-02 0.076270515 0.040753682
## GO:0042491
                   1/14
                         35/20536 2.360539e-02 0.076270515 0.040753682
## GD:0060143
                         35/20536 2.360539e-02 0.076270515 0.040753682
## GD:0002699
                   2/14 356/20536 2.376521e-02 0.076270515 0.040753682
## GO:1904062
                   2/14 357/20536 2.388983e-02 0.076270515 0.040753682
## GD:0014904
                   1/14
                         36/20536 2.427217e-02 0.076270515 0.040753682
## GO:0090218
                   1/14
                         36/20536 2.427217e-02 0.076270515 0.040753682
## GD:1902622
                   1/14
                         36/20536 2.427217e-02 0.076270515 0.040753682
                   2/14 361/20536 2.439108e-02 0.076270515 0.040753682
## GD:0070371
## GO:0032770
                         37/20536 2.493852e-02 0.076763869 0.041017296
## GD:0060142
                         37/20536 2.493852e-02 0.076763869 0.041017296
## GD:0007596
                   2/14 369/20536 2.540671e-02 0.077598795 0.041463422
```

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## GD:0007599
                   2/14 375/20536 2.617984e-02 0.077822257 0.041582825
## GD:0050817
                   2/14 375/20536 2.617984e-02 0.077822257 0.041582825
## GD:0002691
                         39/20536 2.626995e-02 0.077822257 0.041582825
## GD:0060338
                   1/14
                         39/20536 2.626995e-02 0.077822257 0.041582825
## GO:0051281
                         40/20536 2.693503e-02 0.079197038 0.042317413
                   2/14 384/20536 2.735767e-02 0.079256775 0.042349332
## GO:0010038
                   2/14 384/20536 2.735767e-02 0.079256775 0.042349332
## GD:1903037
## GD:0070207
                   1/14
                         41/20536 2.759970e-02 0.079374306 0.042412132
## GD:0009268
                   1/14
                         42/20536 2.826394e-02 0.080695584 0.043118132
## GD:0050863
                   2/14 393/20536 2.855702e-02 0.080833583 0.043191869
## GD:0050856
                   1/14
                         43/20536 2.892775e-02 0.080833583 0.043191869
                         43/20536 2.892775e-02 0.080833583 0.043191869
## GO:0060119
                   1/14
  GO:0051489
                   1/14
                         44/20536 2.959115e-02 0.082105028 0.043871241
                         45/20536 3.025413e-02 0.083357531 0.044540492
## GD:0071622
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## GD:0010831
                         46/20536 3.091669e-02 0.084591487 0.045199833
                   1/14
## GD:0032459
                   1/14
                         47/20536 3.157882e-02 0.085219559 0.045535431
                         47/20536 3.157882e-02 0.085219559 0.045535431
## GD:0098751
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## GD:0033628
                         48/20536 3.224054e-02 0.085829539 0.045861362
                         48/20536 3.224054e-02 0.085829539 0.045861362
## GD:1903727
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## GD:0007520
                   1/14
                         49/20536 3.290183e-02 0.086422149 0.046178012
## GO:0016339
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                         49/20536 3.290183e-02 0.086422149 0.046178012
                         50/20536 3.356271e-02 0.086998077 0.046485748
## GD:0002639
                         50/20536 3.356271e-02 0.086998077 0.046485748
## GO:0035315
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                         52/20536 3.488320e-02 0.089829952 0.047998906
## GD:0061756
                   1/14
## GD:0010043
                   1/14
                         53/20536 3.554282e-02 0.090934237 0.048588959
## GD:0050850
                   1/14
                         54/20536 3.620202e-02 0.091433317 0.048855633
## GD:2000404
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                         54/20536 3.620202e-02 0.091433317 0.048855633
## GO:0043547
                   2/14 457/20536 3.768336e-02 0.091527949 0.048906198
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GD:0002686
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## GD:0002714
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GD:0002891
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                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0031295
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                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0043551
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0046580
                         57/20536 3.817712e-02 0.091527949 0.048906198
                   1/14
## GD:0050732
                         57/20536 3.817712e-02 0.091527949 0.048906198
                   2/14 464/20536 3.874277e-02 0.091527949 0.048906198
## GD:0042391
## GD:0031294
                         58/20536 3.883464e-02 0.091527949 0.048906198
## GD:0002066
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                         59/20536 3.949175e-02 0.091527949 0.048906198
## GD:0002823
                         59/20536 3.949175e-02 0.091527949 0.048906198
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                         59/20536 3.949175e-02 0.091527949 0.048906198
                   1/14
## GD:0060113
                         59/20536 3.949175e-02 0.091527949 0.048906198
## GD:0060563
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## GO:0035036
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                         62/20536 4.146058e-02 0.094144112 0.050304094
## GD:0045661
                   1/14
                         62/20536 4.146058e-02 0.094144112 0.050304094
## GO:0051353
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                         62/20536 4.146058e-02 0.094144112 0.050304094
## GO:0032715
                   1/14
                         63/20536 4.211603e-02 0.094144112 0.050304094
## GO:0051058
                         63/20536 4.211603e-02 0.094144112 0.050304094
                   1/14
## GD:0007265
                   2/14 489/20536 4.262051e-02 0.094144112 0.050304094
## GD:0030888
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
## GO:0046847
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
## GD:0050999
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
                         65/20536 4.342567e-02 0.094388402 0.050434626
## GD:0070527
                   1/14
## GD:0000768
                   1/14
                         66/20536 4.407986e-02 0.094388402 0.050434626
                         66/20536 4.407986e-02 0.094388402 0.050434626
## GD:0043550
                   1/14
## GD:0046626
                         66/20536 4.407986e-02 0.094388402 0.050434626
```

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## GO:0140253
                   1/14
                         66/20536 4.407986e-02 0.094388402 0.050434626
                         68/20536 4.538701e-02 0.096662061 0.051649512
## GD:0006949
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## GD:0070206
                         69/20536 4.603996e-02 0.097155094 0.051912955
## GD:0010830
                   1/14
                         70/20536 4.669249e-02 0.097155094 0.051912955
## GD:0033627
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                         70/20536 4.669249e-02 0.097155094 0.051912955
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                         71/20536 4.734461e-02 0.097155094 0.051912955
## GD:0002820
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GD:0042490
## GO:0048747
                   1/14
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GD:1904427
                   1/14
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GD:0030449
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                         74/20536 4.929849e-02 0.100121681 0.053498093
## GD:1900076
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                         74/20536 4.929849e-02 0.100121681 0.053498093
                   1/14
                         77/20536 5.124865e-02 0.102497298 0.054767458
## GD:0002312
## GD:0042130
                   1/14
                         77/20536 5.124865e-02 0.102497298 0.054767458
## GD:2000401
                   1/14
                         77/20536 5.124865e-02 0.102497298 0.054767458
## GD:0032768
                         78/20536 5.189788e-02 0.103271529 0.055181154
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## GD:0002637
                   1/14
                         79/20536 5.254669e-02 0.103516977 0.055312304
## GD:0072678
                         79/20536 5.254669e-02 0.103516977 0.055312304
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## GO:0031640
                         80/20536 5.319509e-02 0.103756760 0.055440427
                         80/20536 5.319509e-02 0.103756760 0.055440427
## GD:0045454
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## GO:0071260
                   1/14
                         81/20536 5.384308e-02 0.104503317 0.055839336
## GO:0051881
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                         82/20536 5.449066e-02 0.104728384 0.055959596
                         82/20536 5.449066e-02 0.104728384 0.055959596
## GO:0061515
## GD:0009988
                         83/20536 5.513782e-02 0.105457777 0.056349333
                   1/14
                         84/20536 5.578458e-02 0.106179340 0.056734887
## GD:0043407
                   1/14
## GD:0071277
                   1/14
                         88/20536 5.836749e-02 0.110561489 0.059076404
## GD:0034109
                   1/14
                         89/20536 5.901219e-02 0.110718106 0.059160088
                   1/14
                         89/20536 5.901219e-02 0.110718106 0.059160088
## GO:0051155
## GO:1903725
                   1/14
                         92/20536 6.094383e-02 0.113800335 0.060807018
                   1/14
                         93/20536 6.158690e-02 0.114458668 0.061158786
## GD:0032720
## GD:0006956
                   1/14
                         94/20536 6.222955e-02 0.115110063 0.061506846
## GD:1903556
                   1/14
                         95/20536 6.287180e-02 0.115754618 0.061851252
## GO:0045445
                   1/14
                         97/20536 6.415506e-02 0.117567884 0.062820136
## GD:0014068
                         99/20536 6.543670e-02 0.118266326 0.063193335
## GO:0032945
                   1/14
                         99/20536 6.543670e-02 0.118266326 0.063193335
## GD:0050672
                         99/20536 6.543670e-02 0.118266326 0.063193335
                   1/14 103/20536 6.799508e-02 0.122329046 0.065364171
## GD:0030219
## GD:0002690
                   1/14 104/20536 6.863366e-02 0.122916640 0.065678141
## GD:0060079
                   1/14 105/20536 6.927183e-02 0.122965984 0.065704506
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
## GD:0002707
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
## GO:0032091
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
## GD:0070664
## GO:0042472
                   1/14 108/20536 7.118391e-02 0.124099382 0.066310116
## GD:0120034
                   1/14 108/20536 7.118391e-02 0.124099382 0.066310116
                   1/14 111/20536 7.309234e-02 0.126308696 0.067490620
## GO:1990868
## GD:1990869
                   1/14 111/20536 7.309234e-02 0.126308696 0.067490620
## GO:0050848
                   1/14 112/20536 7.372768e-02 0.126850238 0.067779983
## GO:0033138
                   1/14 113/20536 7.436261e-02 0.127386378 0.068066459
## GD:0099565
                   1/14 114/20536 7.499713e-02 0.127917186 0.068350086
## GO:0035335
                   1/14 115/20536 7.563125e-02 0.128442733 0.068630902
## GD:0002065
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
## GD:0002704
## GD:0030593
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
## GD:0014902
                   1/14 122/20536 8.005882e-02 0.133093563 0.071115984
## GO:0051341
                   1/14 122/20536 8.005882e-02 0.133093563 0.071115984
```

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## GO:0031343
                   1/14 124/20536 8.132022e-02 0.134622541 0.071932964
                   1/14 127/20536 8.320930e-02 0.137063268 0.073237119
## GD:0051149
                   1/14 128/20536 8.383819e-02 0.137063268 0.073237119
## GO:0042471
## GO:1903828
                   1/14 128/20536 8.383819e-02 0.137063268 0.073237119
## GD:0002377
                   1/14 129/20536 8.446668e-02 0.137520138 0.073481239
                   1/14 134/20536 8.760314e-02 0.142039664 0.075896160
## GO:1990266
                   1/14 135/20536 8.822924e-02 0.142468521 0.076125312
## GD:0002688
## GO:0051153
                   1/14 136/20536 8.885493e-02 0.142893236 0.076352250
## GD:0072676
                   1/14 137/20536 8.948023e-02 0.143313859 0.076577002
## GO:0071621
                   1/14 138/20536 9.010512e-02 0.143730440 0.076799594
## GD:0046683
                   1/14 139/20536 9.072962e-02 0.144143029 0.077020053
                   1/14 143/20536 9.322364e-02 0.146727713 0.078401129
## GD:0014066
## GD:0030010
                   1/14 143/20536 9.322364e-02 0.146727713 0.078401129
## GD:0060337
                   1/14 144/20536 9.384615e-02 0.146727713 0.078401129
## GO:0071357
                   1/14 144/20536 9.384615e-02 0.146727713 0.078401129
## GD:0034340
                   1/14 148/20536 9.633223e-02 0.149428734 0.079844368
                   1/14 148/20536 9.633223e-02 0.149428734 0.079844368
## GD:1904064
## GO:0033135
                   1/14 149/20536 9.695276e-02 0.149801517 0.080043557
                   1/14 151/20536 9.819263e-02 0.151124595 0.080750518
## GD:0008286
## GD:0060078
                   1/14 152/20536 9.881197e-02 0.151385676 0.080890022
## GD:0007605
                   1/14 153/20536 9.943092e-02 0.151385676 0.080890022
                   1/14 154/20536 1.000495e-01 0.151385676 0.080890022
## GD:0002824
                   1/14 154/20536 1.000495e-01 0.151385676 0.080890022
## GO:0014074
                   1/14 155/20536 1.006676e-01 0.151385676 0.080890022
## GD:0045834
## GO:0051592
                   1/14 155/20536 1.006676e-01 0.151385676 0.080890022
## GD:0071901
                   1/14 157/20536 1.019028e-01 0.151964651 0.081199386
                   1/14 157/20536 1.019028e-01 0.151964651 0.081199386
## GD:0097530
## GD:0035023
                   1/14 158/20536 1.025197e-01 0.151964651 0.081199386
                   1/14 159/20536 1.031363e-01 0.151964651 0.081199386
## GO:0002821
## GD:0050921
                   1/14 159/20536 1.031363e-01 0.151964651 0.081199386
## GD:0002687
                   1/14 160/20536 1.037525e-01 0.151964651 0.081199386
## GD:0034767
                   1/14 160/20536 1.037525e-01 0.151964651 0.081199386
## GD:0007338
                   1/14 163/20536 1.055987e-01 0.154095918 0.082338188
                   1/14 165/20536 1.068276e-01 0.154742877 0.082683878
## GO:0002702
## GD:0008037
                   1/14 165/20536 1.068276e-01 0.154742877 0.082683878
                   1/14 168/20536 1.086679e-01 0.156832057 0.083800191
## GD:0014065
## GD:0007519
                   1/14 171/20536 1.105047e-01 0.158900923 0.084905650
## GO:0050954
                   1/14 173/20536 1.117273e-01 0.160074731 0.085532851
                   1/14 176/20536 1.135582e-01 0.162108498 0.086619555
## GO:1902600
                   1/14 178/20536 1.147769e-01 0.163256706 0.087233078
## GO:0030168
## GO:0051100
                   1/14 179/20536 1.153857e-01 0.163532226 0.087380297
                   1/14 181/20536 1.166020e-01 0.164663806 0.087984935
## GD:0060538
## GD:0120032
                   1/14 186/20536 1.196361e-01 0.168246423 0.089899237
## GO:0051897
                   1/14 187/20536 1.202418e-01 0.168246423 0.089899237
## GD:0032675
                   1/14 188/20536 1.208470e-01 0.168246423 0.089899237
                   1/14 188/20536 1.208470e-01 0.168246423 0.089899237
## GO:0060491
## GD:0055002
                   1/14 189/20536 1.214519e-01 0.168493173 0.090031084
## GD:0002244
                   1/14 190/20536 1.220564e-01 0.168632356 0.090105454
## GD:0043409
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
## GD:0045619
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
## GD:0051099
## GO:0042267
                   1/14 195/20536 1.250731e-01 0.170514907 0.091111358
## GD:0032635
                   1/14 197/20536 1.262771e-01 0.171562674 0.091671213
## GD:0009566
                   1/14 198/20536 1.268785e-01 0.171787395 0.091791288
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## GD:0002228
                   1/14 199/20536 1.274795e-01 0.172010058 0.091910263
## GO:0051147
                   1/14 201/20536 1.286804e-01 0.172298463 0.092064367
## GD:2000045
                   1/14 201/20536 1.286804e-01 0.172298463 0.092064367
## GD:0002285
                   1/14 202/20536 1.292803e-01 0.172298463 0.092064367
## GO:0048015
                   1/14 203/20536 1.298798e-01 0.172298463 0.092064367
                   1/14 203/20536 1.298798e-01 0.172298463 0.092064367
## GO:0055001
## GD:0002698
                   1/14 204/20536 1.304789e-01 0.172512391 0.092178675
## GO:0048017
                   1/14 206/20536 1.316760e-01 0.172934459 0.092404199
## GD:0048839
                   1/14 206/20536 1.316760e-01 0.172934459 0.092404199
## GD:0007219
                   1/14 207/20536 1.322739e-01 0.173142638 0.092515436
## GD:0001959
                   1/14 209/20536 1.334687e-01 0.173553383 0.092734910
                   1/14 209/20536 1.334687e-01 0.173553383 0.092734910
## GO:0034764
## GD:0032680
                   1/14 210/20536 1.340655e-01 0.173755986 0.092843167
## GD:0032640
                   1/14 213/20536 1.358537e-01 0.174922719 0.093466588
## GO:1903555
                   1/14 213/20536 1.358537e-01 0.174922719 0.093466588
## GD:0002708
                   1/14 214/20536 1.364490e-01 0.175116924 0.093570357
                   1/14 215/20536 1.370439e-01 0.175309381 0.093673193
## GD:0009612
## GO:0042129
                   1/14 216/20536 1.376384e-01 0.175500107 0.093775104
                   1/14 217/20536 1.382326e-01 0.175689119 0.093876099
## GD:0002700
## GD:0071706
                   1/14 218/20536 1.388263e-01 0.175876433 0.093976187
## GO:1902806
                   1/14 219/20536 1.394197e-01 0.176062068 0.094075377
                   1/14 221/20536 1.406053e-01 0.176992029 0.094572284
## GO:0031341
                   1/14 222/20536 1.411976e-01 0.177171500 0.094668181
## GD:0007163
                   1/14 223/20536 1.417895e-01 0.177349357 0.094763215
## GD:0060759
## GD:0007266
                   1/14 225/20536 1.429721e-01 0.178262636 0.095251208
## GD:0002064
                   1/14 231/20536 1.465108e-01 0.181525957 0.096994901
                   1/14 231/20536 1.465108e-01 0.181525957 0.096994901
## GD:0043393
## GD:0032869
                   1/14 234/20536 1.482751e-01 0.182563683 0.097549390
                   1/14 234/20536 1.482751e-01 0.182563683 0.097549390
## GD:0060348
## GD:0002685
                   1/14 237/20536 1.500360e-01 0.183731070 0.098173161
                   1/14 238/20536 1.506222e-01 0.183731070 0.098173161
## GO:0019722
## GO:0050777
                   1/14 238/20536 1.506222e-01 0.183731070 0.098173161
## GD:0043583
                   1/14 240/20536 1.517935e-01 0.184588352 0.098631233
## GO:0007584
                   1/14 241/20536 1.523786e-01 0.184729692 0.098706755
## GD:0042098
                   1/14 244/20536 1.541316e-01 0.186281702 0.099536042
                   1/14 248/20536 1.564637e-01 0.188521974 0.100733088
## GD:0097529
## GD:0002705
                   1/14 250/20536 1.576275e-01 0.188769690 0.100865450
## GD:0050920
                   1/14 250/20536 1.576275e-01 0.188769690 0.100865450
                   1/14 259/20536 1.628462e-01 0.193841115 0.103575268
## GD:0006469
                   1/14 259/20536 1.628462e-01 0.193841115 0.103575268
## GO:0070374
## GO:0030595
                   1/14 263/20536 1.651560e-01 0.195409805 0.104413468
                   1/14 263/20536 1.651560e-01 0.195409805 0.104413468
## GD:0050870
## GD:0051896
                   1/14 264/20536 1.657325e-01 0.195504833 0.104464244
                   1/14 271/20536 1.697578e-01 0.199061268 0.106364557
## GD:0001909
## GD:0046578
                   1/14 271/20536 1.697578e-01 0.199061268 0.106364557
                   1/14 279/20536 1.743361e-01 0.203823215 0.108909011
## GO:0050730
## GD:0033673
                   1/14 283/20536 1.766164e-01 0.205489855 0.109799549
## GD:0098742
                   1/14 284/20536 1.771856e-01 0.205489855 0.109799549
## GD:0002440
                   1/14 286/20536 1.783228e-01 0.205489855 0.109799549
## GD:0031334
                   1/14 286/20536 1.783228e-01 0.205489855 0.109799549
                   1/14 287/20536 1.788909e-01 0.205489855 0.109799549
## GD:0090596
## GO:1903039
                   1/14 287/20536 1.788909e-01 0.205489855 0.109799549
## GD:0032868
                   1/14 291/20536 1.811596e-01 0.207490894 0.110868765
## GO:0043491
                   1/14 292/20536 1.817258e-01 0.207536147 0.110892945
```

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## GD:0050852
                   1/14 294/20536 1.828572e-01 0.208224703 0.111260862
## GD:0000082
                   1/14 298/20536 1.851157e-01 0.210189003 0.112310448
## GD:0048562
                   1/14 306/20536 1.896153e-01 0.214679340 0.114709773
## GO:0051348
                   1/14 313/20536 1.935334e-01 0.218487601 0.116744644
## GO:0018105
                   1/14 314/20536 1.940917e-01 0.218491839 0.116746908
                   1/14 317/20536 1.957645e-01 0.219746061 0.117417078
## GO:0044843
## GD:1902105
                   1/14 318/20536 1.963214e-01 0.219746061 0.117417078
## GO:0051146
                   1/14 320/20536 1.974340e-01 0.220365444 0.117748033
## GD:0022409
                   1/14 334/20536 2.051827e-01 0.228335192 0.122006515
## GO:0051251
                   1/14 335/20536 2.057335e-01 0.228335192 0.122006515
## GD:0018209
                   1/14 337/20536 2.068340e-01 0.228911831 0.122314630
                   1/14 349/20536 2.134077e-01 0.235525571 0.125848555
## GO:0071375
## GD:0060326
                   1/14 353/20536 2.155876e-01 0.237266841 0.126778969
## GD:0071496
                   1/14 362/20536 2.204720e-01 0.241726479 0.129161891
## GD:0030336
                   1/14 363/20536 2.210130e-01 0.241726479 0.129161891
## GO:0001818
                   1/14 364/20536 2.215536e-01 0.241726479 0.129161891
## GO:0071356
                   1/14 365/20536 2.220939e-01 0.241726479 0.129161891
## GD:0006470
                   1/14 369/20536 2.242515e-01 0.243402407 0.130057391
                   1/14 371/20536 2.253282e-01 0.243899166 0.130322825
## GD:0071902
## GD:0051056
                   1/14 378/20536 2.290857e-01 0.247187776 0.132080030
## GD:2000146
                   1/14 379/20536 2.296211e-01 0.247187776 0.132080030
                   1/14 381/20536 2.306909e-01 0.247662728 0.132333811
## GO:0043405
                   1/14 387/20536 2.338920e-01 0.250416978 0.133805492
## GD:0002696
                   1/14 394/20536 2.376110e-01 0.253709267 0.135564663
## GD:0034612
## GD:0018108
                   1/14 399/20536 2.402571e-01 0.255841339 0.136703895
## GD:0018212
                   1/14 402/20536 2.418407e-01 0.256833496 0.137234035
## GO:0031346
                   1/14 407/20536 2.444732e-01 0.258653407 0.138206469
## GD:0050867
                   1/14 409/20536 2.455238e-01 0.258653407 0.138206469
                   1/14 409/20536 2.455238e-01 0.258653407 0.138206469
## GO:0051098
## GD:0042692
                   1/14 414/20536 2.481444e-01 0.260571813 0.139231532
## GD:0040013
                   1/14 415/20536 2.486675e-01 0.260571813 0.139231532
## GD:0014706
                   1/14 417/20536 2.497127e-01 0.260680974 0.139289860
## GO:0051271
                   1/14 418/20536 2.502348e-01 0.260680974 0.139289860
                   1/14 419/20536 2.507566e-01 0.260680974 0.139289860
## GO:1901653
## GD:0009913
                   1/14 424/20536 2.533603e-01 0.262694631 0.140365819
                   1/14 429/20536 2.559556e-01 0.264689027 0.141431486
## GD:0019216
## GD:0060537
                   1/14 436/20536 2.595750e-01 0.267729210 0.143055950
## GD:0007517
                   1/14 438/20536 2.606061e-01 0.268090897 0.143249210
## GD:0001933
                   1/14 456/20536 2.698262e-01 0.276852973 0.147931057
                   1/14 459/20536 2.713525e-01 0.277695821 0.148381416
## GO:0045088
## GO:0043434
                   1/14 466/20536 2.749023e-01 0.279874685 0.149545651
## GO:0048568
                   1/14 466/20536 2.749023e-01 0.279874685 0.149545651
## GD:0001558
                   1/14 470/20536 2.769235e-01 0.281205842 0.150256929
## GD:0019932
                   1/14 478/20536 2.809503e-01 0.284338857 0.151930995
## GD:0043254
                   1/14 479/20536 2.814522e-01 0.284338857 0.151930995
## GD:0030099
                   1/14 487/20536 2.854555e-01 0.287181991 0.153450169
## GO:0045785
                   1/14 488/20536 2.859545e-01 0.287181991 0.153450169
## GD:0006644
                   1/14 489/20536 2.864531e-01 0.287181991 0.153450169
  GD:0042326
                   1/14 497/20536 2.904306e-01 0.290430559 0.155185979
                                                                        geneID
## GD:0050853
                              ENSG00000007312/ENSG00000177455/ENSG00000111679
## GD:0042113 ENSG00000007312/ENSG00000177455/ENSG00000111679/ENSG00000170476
## GD:0010522
                              ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0002920
                              ENSG00000177455/ENSG00000104921/ENSG00000111679
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## <b>GD</b> 00500G4	TNGG000004774FF /TNGG00000444670 /TNGG00000470476
## GD:0050864	ENSG00000177455/ENSG00000111679/ENSG00000170476
## GD:0030183	ENSG0000007312/ENSG00000177455/ENSG00000111679
## GD:0002923	ENSG00000104921/ENSG00000111679
## GD:0016064	ENSG00000177455/ENSG00000104921/ENSG00000111679
## GO:0019724	ENSG00000177455/ENSG00000104921/ENSG00000111679
## GD:0060402	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0060401	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GO:0010524	ENSG00000177455/ENSG00000083454
## GO:0051924	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0002712	ENSG00000104921/ENSG00000111679
## GD:0002889	ENSG00000104921/ENSG00000111679
## GO:0050854	ENSG00000177455/ENSG00000111679
## GD:0006959	ENSG00000177455/ENSG00000104921/ENSG00000111679
## GO:0045123	ENSG00000188404/ENSG00000111913
## GD:0002455	ENSG00000104921/ENSG00000111679
## GD:0007204	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GO:0046651	ENSG00000177455/ENSG00000111679/ENSG00000170476
## GO:0051279	ENSG00000177455/ENSG00000111679
## GO:0032943	ENSG00000177455/ENSG00000111679/ENSG00000170476
## GD:0050851	ENSG00000007312/ENSG00000177455/ENSG00000111679
## GD:0002460	ENSG00000177455/ENSG00000104921/ENSG00000111679
## GD:0070661	ENSG00000177455/ENSG00000111679/ENSG00000170476
## GO:0051480	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0030098	ENSG00000007312/ENSG00000177455/ENSG00000111679
## GD:0042100	ENSG00000177455/ENSG00000170476
## GD:0051260	ENSG00000007312/ENSG00000111913/ENSG00000100721
## GD:0007159	ENSG00000188404/ENSG00000111913/ENSG00000111679
## GO:0010959	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0002449	ENSG00000177455/ENSG00000104921/ENSG00000111679
## GD:0051209	ENSG00000177455/ENSG00000111679
## GO:0051283	ENSG00000177455/ENSG00000111679
## GO:0051928	ENSG00000177455/ENSG00000083454
## GO:0051282	ENSG00000177455/ENSG00000111679
## GD:0006816	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GD:0050868	ENSG00000111913/ENSG00000111679
## GO:0051208	ENSG00000177455/ENSG00000111679
## GD:0006874	ENSG00000177455/ENSG00000083454/ENSG00000111679
## GO:0097553	ENSG00000177455/ENSG00000111679
## GO:1903038	ENSG00000111913/ENSG00000111679
## GO:1903169	ENSG00000177455/ENSG00000111679
## GD:0001768	ENSG00000111913
## GD:0002713	ENSG00000111679
## GD:0002890	ENSG00000111679
## GD:0010918	ENSG00000100721
## GO:0051250	ENSG00000111913/ENSG00000111679
## GD:0001767	ENSG00000111913
## GO:0071248	ENSG00000068831/ENSG00000122986
## GO:0002921	ENSG00000111679
## GD:0060088	ENSG00000111913
## GO:1904424	ENSG00000111913
## GD:0002822	ENSG00000104921/ENSG00000111679
## GD:0022408	ENSG00000111913/ENSG00000111679
## GD:0002093	ENSG00000111913
## GO:0051712	ENSG00000104921

## GD:0072672	ENSG00000111913
## GD:0002695	ENSG00000111913/ENSG00000111679
## GO:0051651	ENSG00000177455/ENSG00000111679
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## GD:0051770	ENSG00000104921
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## GD:0002819	ENSG00000104921/ENSG00000111679
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## GD:0051709	ENSG00000104921
## GD:0050866	ENSG00000111913/ENSG00000111679
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## GD:0045577 ## GD:1902624	ENSG00000111679
## G0:1902624 ## G0:0051491	ENSG00000111913
## G0:0051491 ## G0:0060122	ENSG00000111913
## G0:0060122 ## G0:0090022	ENSG00000111913
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## G0:0007162	ENSG00000111913/ENSG00000111679
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## GD:0035590 ## GD:0043552	ENSG00000083454 ENSG00000177455
## G0:0070588	ENSG00000177455/ENSG00000111679
## G0:0002922	ENSG00000104921
## G0:0033198 ## C0:0048741	ENSG00000083454
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## GD:0007599	ENSG00000083454/ENSG00000111679
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## G0:0018108 ## G0:0018212	ENSG00000111679 ENSG00000111679
## G0:0018212 ## G0:0031346	ENSG00000111679 ENSG00000111913
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## G0:0051098	ENSG00000111079 ENSG00000111913
## GD:0042692	ENSG00000111313
## G0:0042092 ## G0:0040013	ENSG00000111913 ENSG00000111913
## G0:0014706	ENSG00000111913 ENSG00000111913
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## G0:1901033 ## G0:0009913	ENSG00000170470
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##	<b>40</b> 0050050	Count
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## GO:0043409
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## GD:0045619
                   1
## GO:0051099
                   1
## GD:0042267
                   1
## GO:0032635
                   1
## GD:0009566
                   1
## GD:0002228
                   1
## GO:0051147
                   1
## GD:2000045
                   1
## GO:0002285
                   1
## GO:0048015
                   1
## GO:0055001
                   1
## GD:0002698
                   1
## GD:0048017
                   1
## GD:0048839
                   1
## GD:0007219
                   1
## GO:0001959
                   1
## GO:0034764
                   1
## GD:0032680
                   1
## GO:0032640
                   1
## GO:1903555
                   1
## GD:0002708
                   1
## GO:0009612
                   1
## GO:0042129
                   1
## GD:0002700
                   1
## GO:0071706
                   1
```

```
## GD:1902806
                   1
## GO:0031341
                   1
## GO:0007163
## GD:0060759
                   1
## GD:0007266
                   1
## GD:0002064
                   1
## GD:0043393
                   1
## GD:0032869
                   1
## GD:0060348
                   1
## GD:0002685
                   1
## GO:0019722
                   1
## GD:0050777
                   1
## GD:0043583
                   1
## GO:0007584
                   1
## GO:0042098
                   1
## GO:0097529
                   1
## GO:0002705
                   1
## GD:0050920
                   1
## GD:0006469
                   1
## GO:0070374
                   1
## GO:0030595
                   1
## GO:0050870
                   1
## GO:0051896
                   1
## GD:0001909
                   1
## GO:0046578
                   1
## GD:0050730
                   1
## GO:0033673
                   1
## GD:0098742
                   1
## GO:0002440
                   1
## GD:0031334
                   1
## GD:0090596
                   1
## GO:1903039
                   1
## GO:0032868
                   1
## GO:0043491
                   1
## GD:0050852
                   1
## GD:0000082
                   1
## GO:0048562
## GO:0051348
                   1
## GO:0018105
                   1
## GO:0044843
                   1
## GO:1902105
                   1
## GO:0051146
                   1
## GD:0022409
                   1
## GO:0051251
                   1
## GD:0018209
                   1
## GO:0071375
                   1
## GD:0060326
                   1
## GO:0071496
                   1
## GD:0030336
                   1
## GO:0001818
                   1
## GO:0071356
                   1
## GD:0006470
                   1
## GO:0071902
                   1
## GO:0051056
                   1
```

```
## GD:2000146
                  1
## GD:0043405
                  1
## GD:0002696
## GO:0034612
                  1
## GO:0018108
                  1
## GO:0018212
                  1
## GD:0031346
                  1
## GD:0050867
                  1
## GD:0051098
                  1
## GO:0042692
                  1
## GD:0040013
                  1
## GD:0014706
                  1
## GO:0051271
                  1
## GO:1901653
                  1
## GO:0009913
                  1
## GO:0019216
                  1
## GD:0060537
                  1
## GD:0007517
                  1
## GO:0001933
                  1
## GO:0045088
                  1
## GO:0043434
                  1
## GO:0048568
## GO:0001558
                  1
## GD:0019932
                  1
## GO:0043254
                  1
## GD:0030099
                  1
## GO:0045785
                  1
## GD:0006644
                  1
## GO:0042326
                  1
                       ID
##
## GD:0010524 GD:0010524
## GD:0050853 GD:0050853
## GD:0010522 GD:0010522
## GD:0051928 GD:0051928
## GD:0030183 GD:0030183
## GD:0060402 GD:0060402
## GD:0060401 GD:0060401
## G0:0042113 G0:0042113
## G0:0051924 G0:0051924
## GD:0043270 GD:0043270
## GD:0007204 GD:0007204
## GO:0050851 GO:0050851
## GD:0051480 GD:0051480
## GD:0030098 GD:0030098
## GD:0010959 GD:0010959
## GD:0006816 GD:0006816
## GD:0002335 GD:0002335
## GD:0006874 GD:0006874
## GD:0035590 GD:0035590
## GD:0043552 GD:0043552
## GD:0033198 GD:0033198
## GO:0050855 GO:0050855
## G0:0050901 G0:0050901
```

```
## GD:0090218 GD:0090218
## G0:0051281 G0:0051281
## GO:1903727 GO:1903727
## GD:0016339 GD:0016339
## GD:0061756 GD:0061756
## GD:0050850 GD:0050850
## G0:0043551 G0:0043551
## GD:0043550 GD:0043550
## GO:1904427 GO:1904427
## GO:0030449 GO:0030449
## GD:0050854 GD:0050854
## GD:0002312 GD:0002312
## GD:0045123 GD:0045123
## G0:0051279 G0:0051279
## GD:1903725 GD:1903725
## GD:0006956 GD:0006956
## GD:0042100 GD:0042100
## GD:0060079 GD:0060079
## GD:0002920 GD:0002920
## GD:0050848 GD:0050848
## GD:0099565 GD:0099565
## GD:0050864 GD:0050864
## G0:0051209 G0:0051209
## GD:0051283 GD:0051283
## GD:0051282 GD:0051282
## GD:0046683 GD:0046683
## GD:0051208 GD:0051208
## GD:1904064 GD:1904064
## GO:0097553 GO:0097553
## GD:0060078 GD:0060078
## GD:0014074 GD:0014074
## GD:0045834 GD:0045834
## G0:0016064 G0:0016064
## GD:0034767 GD:0034767
## GD:1903169 GD:1903169
## G0:0019724 G0:0019724
## G0:0051897 G0:0051897
## GD:0002285 GD:0002285
## GD:0034764 GD:0034764
## G0:0051651 G0:0051651
## G0:0019722 G0:0019722
## GD:0007584 GD:0007584
## GD:0051896 GD:0051896
## G0:0098742 G0:0098742
## GD:0043491 GD:0043491
## GD:0006959 GD:0006959
## GD:0051235 GD:0051235
## GD:0046651 GD:0046651
## GD:0070588 GD:0070588
## GD:0032943 GD:0032943
## GD:1904062 GD:1904062
## GD:0002460 GD:0002460
## GD:0007596 GD:0007596
## GD:0070661 GD:0070661
```

```
## GD:0007599 GD:0007599
## GD:0050817 GD:0050817
## GD:0051260 GD:0051260
## GD:0007159 GD:0007159
## GD:0019216 GD:0019216
## GD:0002449 GD:0002449
## GD:0043547 GD:0043547
## GD:0042391 GD:0042391
## GD:0019932 GD:0019932
## GD:0006644 GD:0006644
##
## GD:0010524
## GO:0050853
## GO:0010522
## GO:0051928
## GD:0030183
## GD:0060402
## GD:0060401
## GD:0042113
## GD:0051924
## GO:0043270
## GD:0007204
## GD:0050851
## GD:0051480
## GD:0030098
## GD:0010959
## GO:0006816
## GD:0002335
## GD:0006874
## GD:0035590
## GO:0043552
## GD:0033198
## GO:0050855
## GD:0050901
## GD:0090218
## GD:0051281
## GO:1903727
## GD:0016339
## GO:0061756
## GD:0050850
## GO:0043551
## GD:0043550
## GD:1904427
## GO:0030449
## GO:0050854
## GO:0002312
## GO:0045123
## GO:0051279
## GO:1903725
## GD:0006956
## GD:0042100
## GD:0060079
## GD:0002920
```

## GD:0050848

positive regulation of ca regulation of ca positive reg positive regulation of cyt antigen rec regulation of cyt purinergic nucle positive regulation of phosph regulation of B positive reg positive regulation of release of sequence positive regulation of calcium-dependent cell-cell adhesion via plasma leukocyte adhes positive regulati regulation of phosph

positive regulation of cal

regulation of antigen rec

regulation of release of sequence

B cell activa

regulation of

regul

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```
## GD:0099565
                                                                                              chemical syn
## GD:0050864
## GD:0051209
                                                                                           release of sequ
## GD:0051283
                                                                                       negative regulation
## GO:0051282
                                                                                                 regulation
## GD:0046683
## GD:0051208
## GO:1904064
                                                                                    positive regulation of
## GD:0097553
                                                                                             calcium ion t
## GO:0060078
                                                                                             regulation of
## GD:0014074
                                                                                                    respon
## GO:0045834
                                                                                            positive regula
## GD:0016064
                                                                                                   immunog
## GD:0034767
                                                                                        positive regulation
## GO:1903169
                                                                                         regulation of cal
## GO:0019724
## GO:0051897
                                                                                         positive regulati
## GD:0002285
                                                                                        lymphocyte activa
## GO:0034764
                                                                                            positive regul
## GO:0051651
## GO:0019722
## GO:0007584
## GO:0051896
                                                                                                  regulati
                                                                                cell-cell adhesion via pl
## GD:0098742
## GO:0043491
## GD:0006959
## GO:0051235
## GD:0046651
## GO:0070588
                                                                                                       cal
## GD:0032943
## GD:1904062
                                                                                              regulation of
## GO:0002460 adaptive immune response based on somatic recombination of immune receptors built from im
## GO:0007596
## GD:0070661
## GD:0007599
## GO:0050817
## GO:0051260
## GO:0007159
## GO:0019216
                                                                                                     regul
## GO:0002449
## GO:0043547
                                                                                                    positi
## GO:0042391
## GD:0019932
                                                                                                       sec
## GD:0006644
              GeneRatio
                           BgRatio
                                         pvalue
                                                   p.adjust
## GO:0010524
                    2/6
                         54/20536 0.0001011151 0.006784535 0.002298451
## GD:0050853
                    2/6 67/20536 0.0001559663 0.006784535 0.002298451
                    2/6 104/20536 0.0003760038 0.010904109 0.003694072
## GO:0010522
## GO:0051928
                    2/6 134/20536 0.0006231347 0.011166944 0.003783115
## GO:0030183
                    2/6 136/20536 0.0006417784 0.011166944 0.003783115
## GD:0060402
                    2/6 169/20536 0.0009881922 0.014328787 0.004854277
                    2/6 191/20536 0.0012594678 0.015653385 0.005303022
## GD:0060401
## GO:0042113
                    2/6 249/20536 0.0021269893 0.023131008 0.007836276
                    2/6 288/20536 0.0028325467 0.025491110 0.008635827
## GO:0051924
```

```
## GD:0043270
                    2/6 293/20536 0.0029300127 0.025491110 0.008635827
## GD:0007204
                    2/6 337/20536 0.0038555893 0.029267310 0.009915120
## GD:0050851
                    2/6 345/20536 0.0040368704 0.029267310 0.009915120
## GO:0051480
                    2/6 377/20536 0.0048015169 0.030772418 0.010425018
  GD:0030098
                    2/6 383/20536 0.0049518833 0.030772418 0.010425018
                    2/6 434/20536 0.0063180887 0.036328624 0.012307338
## GO:0010959
## GD:0006816
                    2/6 483/20536 0.0077770168 0.036328624 0.012307338
## GO:0002335
                         27/20536 0.0078636564 0.036328624 0.012307338
  GD:0006874
                    2/6 490/20536 0.0079969637 0.036328624 0.012307338
## GO:0035590
                    1/6
                         32/20536 0.0093142186 0.036328624 0.012307338
## GD:0043552
                    1/6
                         32/20536 0.0093142186 0.036328624 0.012307338
                         33/20536 0.0096041189 0.036328624 0.012307338
## GO:0033198
                    1/6
  GD:0050855
                         33/20536 0.0096041189 0.036328624 0.012307338
                    1/6
## GD:0050901
                         33/20536 0.0096041189 0.036328624 0.012307338
## GO:0090218
                         36/20536 0.0104733955 0.037966059 0.012862065
                    1/6
## GO:0051281
                    1/6
                         40/20536 0.0116314419 0.040477418 0.013712858
                         48/20536 0.0139441467 0.045861623 0.015536908
## GO:1903727
                    1/6
  GO:0016339
                         49/20536 0.0142329174 0.045861623 0.015536908
                         52/20536 0.0150988069 0.046914150 0.015893481
## GD:0061756
                    1/6
## GO:0050850
                         54/20536 0.0156757143 0.047027143 0.015931760
## GO:0043551
                    1/6
                         57/20536 0.0165405474 0.047967587 0.016250362
                         66/20536 0.0191312485 0.053690923 0.018189302
## GO:0043550
                         71/20536 0.0205680677 0.054833841 0.018576498
## GO:1904427
                    1/6
                         74/20536 0.0214293170 0.054833841 0.018576498
## GD:0030449
                    1/6
## GD:0050854
                    1/6
                         74/20536 0.0214293170 0.054833841 0.018576498
## GD:0002312
                    1/6
                         77/20536 0.0222899351 0.055406410 0.018770472
                         81/20536 0.0234364448 0.056638075 0.019187733
## GO:0045123
                    1/6
## GO:0051279
                    1/6
                         84/20536 0.0242955915 0.057127472 0.019353530
                         92/20536 0.0265835708 0.060576241 0.020521896
## GO:1903725
                    1/6
## GD:0006956
                         94/20536 0.0271548665 0.060576241 0.020521896
                    1/6
## GD:0042100
                         99/20536 0.0285818833 0.062165596 0.021060335
  GD:0060079
                    1/6 105/20536 0.0302920006 0.063927355 0.021657180
## GD:0002920
                    1/6 107/20536 0.0308614819 0.063927355 0.021657180
## GO:0050848
                    1/6 112/20536 0.0322839659 0.064958297 0.022006441
  GD:0099565
                    1/6 114/20536 0.0328524721 0.064958297 0.022006441
                    1/6 120/20536 0.0345563211 0.066808888 0.022633380
## GD:0050864
## GD:0051209
                    1/6 132/20536 0.0379565156 0.069198712 0.023443000
## GO:0051283
                    1/6 134/20536 0.0385222433 0.069198712 0.023443000
                    1/6 136/20536 0.0390876937 0.069198712 0.023443000
## GO:0051282
                    1/6 139/20536 0.0399353497 0.069198712 0.023443000
## GD:0046683
                    1/6 139/20536 0.0399353497 0.069198712 0.023443000
## GO:0051208
                    1/6 148/20536 0.0424745798 0.069198712 0.023443000
## GD:1904064
## GD:0097553
                    1/6 150/20536 0.0430380925 0.069198712 0.023443000
                    1/6 152/20536 0.0436013287 0.069198712 0.023443000
## GD:0060078
## GO:0014074
                    1/6 154/20536 0.0441642887 0.069198712 0.023443000
                    1/6 155/20536 0.0444456651 0.069198712 0.023443000
## GO:0045834
## GD:0016064
                    1/6 159/20536 0.0455704807 0.069198712 0.023443000
## GD:0034767
                    1/6 160/20536 0.0458515121 0.069198712 0.023443000
## GO:1903169
                    1/6 161/20536 0.0461324745 0.069198712 0.023443000
## GO:0019724
                    1/6 169/20536 0.0483776932 0.071336598 0.024167269
                    1/6 187/20536 0.0534133372 0.077449339 0.026238131
## GO:0051897
## GD:0002285
                    1/6 202/20536 0.0575927262 0.082140446 0.027827374
                    1/6 209/20536 0.0595378386 0.083545032 0.028303217
## GD:0034764
## GO:0051651
                    1/6 226/20536 0.0642477588 0.088723096 0.030057431
```

```
## GO:0019722
                    1/6 238/20536 0.0675605600 0.091533679 0.031009595
## GD:0007584
                    1/6 241/20536 0.0683872313 0.091533679 0.031009595
## GO:0051896
                    1/6 264/20536 0.0747047784 0.098474481 0.033360986
## GD:0098742
                    1/6 284/20536 0.0801692393 0.104100355 0.035266908
  GO:0043491
                    1/6 292/20536 0.0823474803 0.105356335 0.035692406
                    1/6 327/20536 0.0918268131 0.114889497 0.038922031
## GD:0006959
                    1/6 338/20536 0.0947891230 0.114889497 0.038922031
## GD:0051235
## GO:0046651
                    1/6 342/20536 0.0958643282 0.114889497 0.038922031
  GD:0070588
                    1/6 343/20536 0.0961329631 0.114889497 0.038922031
## GD:0032943
                    1/6 344/20536 0.0964015316 0.114889497 0.038922031
## GO:1904062
                    1/6 357/20536 0.0998868741 0.115296180 0.039059807
                    1/6 367/20536 0.1025602770 0.115296180 0.039059807
## GD:0002460
  GD:0007596
                    1/6 369/20536 0.1030941627 0.115296180 0.039059807
                    1/6 370/20536 0.1033610063 0.115296180 0.039059807
## GD:0070661
## GO:0007599
                    1/6 375/20536 0.1046942322 0.115296180 0.039059807
## GO:0050817
                    1/6 375/20536 0.1046942322 0.115296180 0.039059807
                    1/6 415/20536 0.1153006901 0.124691337 0.042242679
  GD:0051260
## GD:0007159
                    1/6 418/20536 0.1160919346 0.124691337 0.042242679
                    1/6 429/20536 0.1189881210 0.126243494 0.042768516
## GD:0019216
## GD:0002449
                    1/6 455/20536 0.1258022307 0.130836160 0.044324410
  GO:0043547
                    1/6 457/20536 0.1263245686 0.130836160 0.044324410
                    1/6 464/20536 0.1281507035 0.131166014 0.044436157
## GD:0042391
                    1/6 478/20536 0.1317934321 0.133325914 0.045167884
## GO:0019932
                    1/6 489/20536 0.1346466704 0.134646670 0.045615327
  GD:0006644
##
                                        geneID Count
  GD:0010524 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0050853 ENSG00000007312/ENSG00000177455
                                                   2
                                                   2
   GO:0010522 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0051928 ENSG00000177455/ENSG00000083454
  GO:0030183 ENSG00000007312/ENSG00000177455
                                                   2
  GO:0060402 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0060401 ENSG00000177455/ENSG00000083454
                                                   2
   GO:0042113 ENSG00000007312/ENSG00000177455
  GO:0051924 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0043270 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0007204 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0050851 ENSG00000007312/ENSG00000177455
  GO:0051480 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0030098 ENSG00000007312/ENSG00000177455
                                                   2
  GO:0010959 ENSG00000177455/ENSG00000083454
                                                   2
  GO:0006816 ENSG00000177455/ENSG00000083454
## GO:0002335
                              ENSG00000177455
                                                   1
  GD:0006874 ENSG00000177455/ENSG00000083454
                                                   2
## GO:0035590
                              ENSG00000083454
                                                   1
## GD:0043552
                              ENSG00000177455
                                                   1
## GO:0033198
                              ENSG00000083454
                                                   1
  GO:0050855
                              ENSG00000177455
                                                   1
## GD:0050901
                              ENSG00000188404
                                                   1
## GD:0090218
                              ENSG00000177455
                                                   1
## GO:0051281
                              ENSG00000177455
                                                   1
  GD:1903727
                              ENSG00000177455
                                                   1
## GO:0016339
                              ENSG00000188404
                                                   1
## GD:0061756
                              ENSG00000188404
                                                   1
## GD:0050850
                              ENSG00000083454
```

##	GO:0043551	ENSG00000177455	1
##	GD:0043550	ENSG00000177455	1
##	GO:1904427	ENSG00000177455	1
##	GO:0030449	ENSG00000177455	1
##	GO:0050854	ENSG00000177455	1
##	GO:0002312	ENSG00000177455	1
##	GO:0045123	ENSG00000188404	1
##	GO:0051279	ENSG00000177455	1
##	GO:1903725	ENSG00000177455	1
##	GD:0006956	ENSG00000177455	1
##	GD:0042100	ENSG00000177455	1
##	GD:0060079	ENSG00000083454	1
##	GD:0002920	ENSG00000177455	1
##	GO:0050848	ENSG00000083454	1
##	GD:0099565	ENSG00000083454	1
##	GD:0050864	ENSG00000177455	1
##	GO:0051209	ENSG00000177455	1
##	GO:0051283	ENSG00000177455	1
##	GO:0051282	ENSG00000177455	1
##	GD:0046683	ENSG00000083454	1
##	GD:0051208	ENSG00000177455	1
##	GO:1904064	ENSG00000177455	1
##	GO:0097553	ENSG00000177455	1
##	GD:0060078	ENSG00000083454	1
##	GO:0014074	ENSG00000083454	1
##	GO:0045834	ENSG00000177455	1
##	GD:0016064	ENSG00000177455	1
##	GD:0034767	ENSG00000177455	1
##	GO:1903169	ENSG00000177455	1
##	GO:0019724	ENSG00000177455	1
##	GO:0051897	ENSG00000177455	1
##	GD:0002285	ENSG00000177455	1
##	GD:0034764	ENSG00000177455	1
##	GO:0051651	ENSG00000177455	1
##	GO:0019722	ENSG00000083454	1
##	GO:0007584	ENSG00000083454	1
##	GD:0051896	ENSG00000177455	1
##	GO:0098742	ENSG00000188404	1
##	GO:0043491	ENSG00000177455	1
##	GO:0006959	ENSG00000177455	1
##	GO:0051235	ENSG00000177455	1
##	GO:0046651	ENSG00000177455	1
##	GO:0070588	ENSG00000177455	1
##	GO:0032943	ENSG00000177455	1
##	GO:1904062	ENSG00000177455	1
##	GO:0002460	ENSG00000177455	1
##	GO:0007596	ENSG00000083454	1
##	GO:0070661	ENSG00000177455	1
##	GO:0007599	ENSG00000083454	1
##	GO:0050817	ENSG00000083454	1
##	GO:0051260	ENSG00000007312	1
##	GD:0007159	ENSG00000188404	1
##	GO:0019216	ENSG00000177455	1
##	GD:0002449	ENSG00000177455	1

```
## GO:0043547
                              ENSG00000072818
                                                   1
## GO:0042391
                                                   1
                              ENSG00000083454
## GO:0019932
                              ENSG00000083454
## GD:0006644
                              ENSG00000177455
                                                   1
##
                      ID
## GD:0002923 GD:0002923
## GD:0050853 GD:0050853
## GD:0002712 GD:0002712
## GD:0002889 GD:0002889
## G0:0051260 G0:0051260
## GD:0002455 GD:0002455
## GD:0002920 GD:0002920
## GD:0030183 GD:0030183
## GD:0050868 GD:0050868
## GD:1903038 GD:1903038
## GD:0016064 GD:0016064
## G0:0019724 G0:0019724
## GD:0051250 GD:0051250
## GD:0071248 GD:0071248
## GD:0002822 GD:0002822
## GD:0022408 GD:0022408
## GD:0002695 GD:0002695
## G0:0071241 G0:0071241
## GD:0002819 GD:0002819
## GD:0050866 GD:0050866
## GD:0001768 GD:0001768
## GD:0002713 GD:0002713
## GD:0002890 GD:0002890
## GD:0010918 GD:0010918
## GD:0042113 GD:0042113
## GD:0001767 GD:0001767
## GD:0002921 GD:0002921
## GD:0060088 GD:0060088
## GD:1904424 GD:1904424
## GD:0002706 GD:0002706
## GD:0002093 GD:0002093
## GD:0051712 GD:0051712
## GD:0072672 GD:0072672
## GD:0045838 GD:0045838
## GD:0051770 GD:0051770
## GD:2000402 GD:2000402
## GD:0051709 GD:0051709
## GD:0006959 GD:0006959
## GD:0007162 GD:0007162
## GD:0070372 GD:0070372
## G0:0050851 G0:0050851
## GD:0002925 GD:0002925
## GD:0060117 GD:0060117
## GD:0001906 GD:0001906
## GD:0071214 GD:0071214
## GD:0104004 GD:0104004
## GD:0002703 GD:0002703
## G0:0051767 G0:0051767
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## GD:0051769 GD:0051769
## G0:0070371 G0:0070371
## GD:0002460 GD:0002460
## GD:0033630 GD:0033630
## GD:0045663 GD:0045663
## G0:0071294 G0:0071294
## GD:2000114 GD:2000114
## GO:0035855 GO:0035855
## GD:0071467 GD:0071467
## GD:0030098 GD:0030098
## GD:0010038 GD:0010038
## GO:1903037 GO:1903037
## GD:0002693 GD:0002693
## GD:0035024 GD:0035024
## GD:0050860 GD:0050860
## GD:0090023 GD:0090023
## GD:0050863 GD:0050863
## GD:0030220 GD:0030220
## G0:0032461 G0:0032461
## GD:0032878 GD:0032878
## G0:0071624 G0:0071624
## GO:1901741 GO:1901741
## GO:0007159 GO:0007159
## GD:0036344 GD:0036344
## GO:0051000 GO:0051000
## GO:1901739 GO:1901739
## GO:0045577 GO:0045577
## GD:1902624 GD:1902624
## G0:0051491 G0:0051491
## GD:0060122 GD:0060122
## GD:0090022 GD:0090022
## GD:0002449 GD:0002449
## GD:0002922 GD:0002922
## GD:0048741 GD:0048741
## GD:0050858 GD:0050858
## G0:0042491 G0:0042491
## GD:0060143 GD:0060143
## GD:0014904 GD:0014904
## GO:1902622 GO:1902622
## GD:0032770 GD:0032770
## GD:0060142 GD:0060142
## GD:0007265 GD:0007265
## GD:0002691 GD:0002691
## GD:0060338 GD:0060338
## GD:0070207 GD:0070207
## GD:0009268 GD:0009268
## GD:0050856 GD:0050856
## GD:0060119 GD:0060119
## G0:0051489 G0:0051489
## GO:0071622 GO:0071622
## GD:0010831 GD:0010831
## GO:0032459 GO:0032459
## GD:0098751 GD:0098751
## GD:0033628 GD:0033628
```

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## GD:0007520 GD:0007520
## GD:0035315 GD:0035315
## GD:0010043 GD:0010043
## GD:2000404 GD:2000404
## GD:0002686 GD:0002686
## G0:0002714 G0:0002714
## GD:0002891 GD:0002891
## GO:0031295 GO:0031295
## GD:0046580 GD:0046580
## G0:0050732 G0:0050732
## GD:0031294 GD:0031294
## GD:0002066 GD:0002066
## GD:0002823 GD:0002823
## GD:0060113 GD:0060113
## GD:0060563 GD:0060563
## GD:0035036 GD:0035036
## GD:0045661 GD:0045661
## GD:0051353 GD:0051353
## GD:0032715 GD:0032715
## GD:0051058 GD:0051058
## GD:0046847 GD:0046847
## GD:0050999 GD:0050999
## GD:0070527 GD:0070527
## GD:0000768 GD:0000768
## GO:0140253 GO:0140253
## GD:0006949 GD:0006949
## GD:0070206 GD:0070206
## GD:0010830 GD:0010830
## GD:0033627 GD:0033627
## GD:0002820 GD:0002820
## GD:0042490 GD:0042490
## GD:0048747 GD:0048747
## G0:0050854 G0:0050854
## GD:0042130 GD:0042130
## GD:2000401 GD:2000401
## GD:0032768 GD:0032768
## GD:0072678 GD:0072678
## GD:0031640 GD:0031640
## GO:0045454 GO:0045454
## G0:0045123 G0:0045123
## GD:0071260 GD:0071260
## G0:0051881 G0:0051881
## GD:0061515 GD:0061515
## GD:0009988 GD:0009988
## GD:0043407 GD:0043407
## G0:0051279 G0:0051279
## G0:0071277 G0:0071277
## GD:0034109 GD:0034109
## GO:0051155 GO:0051155
## GD:0032720 GD:0032720
## GD:1903556 GD:1903556
## GO:0045445 GO:0045445
## GD:0014068 GD:0014068
## GD:0032945 GD:0032945
```

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## GD:0050672 GD:0050672
## GD:0030219 GD:0030219
## GD:0002690 GD:0002690
## GD:0010522 GD:0010522
## GD:0002707 GD:0002707
## G0:0032091 G0:0032091
## GD:0070664 GD:0070664
## GD:0042472 GD:0042472
## GD:0120034 GD:0120034
## GO:1990868 GO:1990868
## GD:1990869 GD:1990869
## GD:0033138 GD:0033138
## GD:0035335 GD:0035335
## GD:0002065 GD:0002065
## GD:0002704 GD:0002704
## GD:0030593 GD:0030593
## GD:0050864 GD:0050864
## GD:0014902 GD:0014902
## G0:0051341 G0:0051341
## GD:0031343 GD:0031343
## GO:0051149 GO:0051149
## G0:0042471 G0:0042471
## GD:1903828 GD:1903828
## GD:0051209 GD:0051209
## GD:0051283 GD:0051283
## GD:1990266 GD:1990266
## GD:0002688 GD:0002688
## GD:0051153 GD:0051153
## GO:0051282 GO:0051282
## GD:0072676 GD:0072676
## GD:0071621 GD:0071621
## GD:0051208 GD:0051208
## GD:0014066 GD:0014066
## GD:0030010 GD:0030010
## GD:0060337 GD:0060337
## GO:0071357 GO:0071357
## GD:0034340 GD:0034340
## GO:0033135 GO:0033135
## GO:0097553 GO:0097553
## GD:0007605 GD:0007605
## GD:0002824 GD:0002824
## G0:0051592 G0:0051592
## GD:0071901 GD:0071901
## GO:0097530 GO:0097530
## GD:0035023 GD:0035023
## GD:0002821 GD:0002821
## GD:0050921 GD:0050921
## GD:0002687 GD:0002687
## GD:1903169 GD:1903169
## GD:0007338 GD:0007338
## GD:0008037 GD:0008037
## GD:0014065 GD:0014065
## GD:0060402 GD:0060402
## GD:0007519 GD:0007519
```

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## GD:0050954 GD:0050954
## GD:1902600 GD:1902600
## GD:0030168 GD:0030168
## GD:0051100 GD:0051100
## GD:0060538 GD:0060538
## GD:0120032 GD:0120032
## GD:0032675 GD:0032675
## GD:0060491 GD:0060491
## GD:0055002 GD:0055002
## G0:0002244 G0:0002244
## GD:0060401 GD:0060401
## GO:0043409 GO:0043409
## GD:0045619 GD:0045619
## GD:0051099 GD:0051099
## GD:0042267 GD:0042267
## GD:0032635 GD:0032635
## GD:0009566 GD:0009566
## GD:0002228 GD:0002228
## GO:0051147 GO:0051147
## GD:2000045 GD:2000045
## GO:0048015 GO:0048015
## G0:0055001 G0:0055001
## GD:0002698 GD:0002698
## GD:0048017 GD:0048017
## GD:0048839 GD:0048839
## GD:0007219 GD:0007219
## GO:0001959 GO:0001959
## GD:0032680 GD:0032680
## GD:0032640 GD:0032640
## GO:1903555 GO:1903555
## GD:0002708 GD:0002708
## GD:0009612 GD:0009612
## GD:0042129 GD:0042129
## GD:0071706 GD:0071706
## GD:1902806 GD:1902806
## G0:0031341 G0:0031341
## GD:0007163 GD:0007163
## GD:0060759 GD:0060759
## GD:0007266 GD:0007266
## G0:0051651 G0:0051651
## GD:0002064 GD:0002064
## GD:0043393 GD:0043393
## GD:0060348 GD:0060348
## GD:0002685 GD:0002685
## GD:0050777 GD:0050777
## GD:0043583 GD:0043583
## GD:0042098 GD:0042098
## GD:0097529 GD:0097529
## GD:0002705 GD:0002705
## G0:0050920 G0:0050920
## GD:0006469 GD:0006469
## GD:0070374 GD:0070374
## GD:0030595 GD:0030595
## GD:0050870 GD:0050870
```

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## GD:0001909 GD:0001909
## GD:0046578 GD:0046578
## GD:0050670 GD:0050670
## G0:0032944 G0:0032944
## GD:0050730 GD:0050730
## GD:0033673 GD:0033673
## GD:0031334 GD:0031334
## GD:0090596 GD:0090596
## GD:1903039 GD:1903039
## G0:0051924 G0:0051924
## GD:0070663 GD:0070663
## GD:0050852 GD:0050852
## GD:0000082 GD:0000082
## GD:0048562 GD:0048562
## GD:0051348 GD:0051348
## GO:0018105 GO:0018105
## GD:0044843 GD:0044843
## GO:1902105 GO:1902105
## GO:0051146 GO:0051146
## GD:0022409 GD:0022409
## G0:0051251 G0:0051251
## GD:0007204 GD:0007204
## GD:0018209 GD:0018209
## GD:0051235 GD:0051235
## GD:0046651 GD:0046651
## GD:0070588 GD:0070588
## GD:0032943 GD:0032943
## GD:0060326 GD:0060326
## GD:0002699 GD:0002699
## GD:1904062 GD:1904062
## GD:0071496 GD:0071496
## GD:0030336 GD:0030336
## GD:0001818 GD:0001818
## GD:0071356 GD:0071356
## GD:0006470 GD:0006470
## GD:0007596 GD:0007596
## GD:0070661 GD:0070661
## GD:0071902 GD:0071902
## GD:0007599 GD:0007599
## GD:0050817 GD:0050817
## GO:0051480 GO:0051480
## GD:0051056 GD:0051056
## GD:2000146 GD:2000146
## GO:0043405 GO:0043405
## GD:0002696 GD:0002696
## GO:0034612 GO:0034612
## GD:0018108 GD:0018108
## GD:0018212 GD:0018212
## GD:0031346 GD:0031346
## GD:0050867 GD:0050867
## GD:0051098 GD:0051098
## GD:0042692 GD:0042692
## GD:0040013 GD:0040013
## GD:0014706 GD:0014706
```

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## G0:0051271 G0:0051271
## GD:0009913 GD:0009913
## GD:0010959 GD:0010959
## GD:0060537 GD:0060537
## G0:0007517 G0:0007517
## GD:0001933 GD:0001933
## GD:0043547 GD:0043547
## GD:0045088 GD:0045088
## G0:0042391 G0:0042391
## GD:0048568 GD:0048568
## GD:0001558 GD:0001558
## G0:0043254 G0:0043254
## GD:0006816 GD:0006816
## GD:0030099 GD:0030099
## GD:0045785 GD:0045785
## GD:0006874 GD:0006874
## GD:0042326 GD:0042326
##
## GD:0002923
                                                                                    regulation of humoral
## GO:0050853
## GO:0002712
## GD:0002889
## GO:0051260
## GD:0002455
                                                                                                   humoral
## GD:0002920
## GD:0030183
## GO:0050868
## GO:1903038
## GO:0016064
## GD:0019724
## GO:0051250
## GO:0071248
## GO:0002822
                       regulation of adaptive immune response based on somatic recombination of immune
## GD:0022408
## GD:0002695
## GO:0071241
## GO:0002819
## GD:0050866
## GD:0001768
## GD:0002713
## GD:0002890
                                                                                                   negativ
## GD:0010918
## GO:0042113
## GD:0001767
## GD:0002921
## GD:0060088
## GO:1904424
## GD:0002706
## GD:0002093
## GO:0051712
                                                                                                        ро
## GO:0072672
## GD:0045838
## GD:0051770
                                                                                                positive r
```

## GD:2000402

```
## GD:0051709
## GD:0006959
## GO:0007162
## GO:0070372
## GD:0050851
## GO:0002925
                                                                           positive regulation of humoral
## GD:0060117
## GD:0001906
## GO:0071214
## GD:0104004
## GO:0002703
## GO:0051767
## GD:0051769
                                                                                                         r
## GD:0070371
## GD:0002460
                                      adaptive immune response based on somatic recombination of immune
## GD:0033630
                                                                                                        ро
## GO:0045663
## GO:0071294
## GD:2000114
## GO:0035855
## GD:0071467
## GD:0030098
## GO:0010038
## GD:1903037
## GD:0002693
## GD:0035024
## GD:0050860
                                                                                                         n
## GD:0090023
## GO:0050863
## GD:0030220
## GD:0032461
## GO:0032878
                                                                                                      regu
## GD:0071624
## GO:1901741
## GD:0007159
## GD:0036344
## GO:0051000
## GO:1901739
## GD:0045577
## GO:1902624
## GO:0051491
## GO:0060122
## GD:0090022
## GD:0002449
## GO:0002922
## GO:0048741
## GD:0050858
                                                                                              negative re
## GD:0042491
                                                                                            positive regu
## GO:0060143
## GD:0014904
## GO:1902622
## GD:0032770
## GO:0060142
                                                                                                      regu
## GD:0007265
```

```
## GD:0002691
## GD:0060338
                                                                                                       reg
## GO:0070207
## GD:0009268
## GO:0050856
## GD:0060119
## GO:0051489
## GO:0071622
## GD:0010831
## GO:0032459
## GO:0098751
## GD:0033628
## GO:0007520
## GD:0035315
## GD:0010043
## GD:2000404
## GD:0002686
## GO:0002714
## GO:0002891
                                                                                                   positiv
## GO:0031295
## GD:0046580
## GO:0050732
                                                                                                         n
## GO:0031294
## GD:0002066
## G0:0002823 negative regulation of adaptive immune response based on somatic recombination of immune
## GD:0060113
## GD:0060563
## GD:0035036
## GD:0045661
## GD:0051353
## GD:0032715
## GO:0051058
                                                                                                negative
## GD:0046847
## GO:0050999
## GO:0070527
## GD:0000768
## GO:0140253
## GD:0006949
## GD:0070206
## GD:0010830
## GD:0033627
## GD:0002820
## GD:0042490
## GD:0048747
## GO:0050854
                                                                                                        re
## GD:0042130
## GD:2000401
## GD:0032768
## GD:0072678
## GD:0031640
## GO:0045454
## GO:0045123
## GD:0071260
## GO:0051881
```

```
## GD:0061515
## GD:0009988
## GD:0043407
## GO:0051279
                                                                                                    regula
## GD:0071277
## GD:0034109
## GO:0051155
                                                                                                      posi
## GD:0032720
## GO:1903556
                                                                                    negative regulation of
## GO:0045445
## GD:0014068
                                                                                                   positiv
## GD:0032945
## GD:0050672
## GD:0030219
## GD:0002690
## GO:0010522
## GD:0002707
## GD:0032091
## GD:0070664
## GO:0042472
## GD:0120034
                                                                                         positive regulat
## GD:1990868
## GO:1990869
## GD:0033138
## GD:0035335
## GD:0002065
## GD:0002704
## GO:0030593
## GO:0050864
## GD:0014902
## GO:0051341
## GO:0031343
## GO:0051149
## GO:0042471
## GO:1903828
## GD:0051209
## GO:0051283
## GD:1990266
## GD:0002688
## GO:0051153
## GO:0051282
## GD:0072676
## GO:0071621
## GO:0051208
## GD:0014066
## GD:0030010
## GD:0060337
## GD:0071357
## GO:0034340
## GO:0033135
## GD:0097553
## GD:0007605
## GO:0002824 positive regulation of adaptive immune response based on somatic recombination of immune
## GO:0051592
```

```
## GD:0071901
                                                                                                   negative
## GD:0097530
## GO:0035023
## GO:0002821
## GD:0050921
## GD:0002687
## GD:1903169
## GD:0007338
## GD:0008037
## GD:0014065
## GO:0060402
## GO:0007519
## GD:0050954
## GD:1902600
## GD:0030168
## GO:0051100
## GO:0060538
## GD:0120032
                                                                                                    regulat
## GD:0032675
## GD:0060491
## GD:0055002
## GD:0002244
## GD:0060401
## GD:0043409
## GD:0045619
## GD:0051099
## GD:0042267
## GD:0032635
## GO:0009566
## GD:0002228
## GD:0051147
## GO:2000045
## GD:0048015
## GO:0055001
## GD:0002698
## GD:0048017
## GO:0048839
## GD:0007219
## GD:0001959
## GO:0032680
## GD:0032640
## GO:1903555
                                                                                              regulation of
## GD:0002708
## GD:0009612
## GD:0042129
## GO:0071706
## GD:1902806
## GD:0031341
## GO:0007163
```

## GD:0060759 ## GD:0007266 ## GD:0051651 ## GD:0002064 ## GD:0043393

```
## GD:0060348
## GO:0002685
## GO:0050777
## GO:0043583
## GO:0042098
## GD:0097529
## GD:0002705
## GD:0050920
## GD:0006469
## GD:0070374
## GD:0030595
## GD:0050870
## GD:0001909
## GO:0046578
## GD:0050670
## GD:0032944
## GO:0050730
## GD:0033673
## GD:0031334
## GO:0090596
## GO:1903039
## GO:0051924
## GD:0070663
## GD:0050852
## GD:0000082
## GO:0048562
## GO:0051348
## GO:0018105
## GO:0044843
## GD:1902105
## GO:0051146
## GD:0022409
## GD:0051251
## GD:0007204
## GD:0018209
## GO:0051235
## GO:0046651
## GO:0070588
## GO:0032943
## GD:0060326
## GD:0002699
## GO:1904062
## GO:0071496
## GD:0030336
## GO:0001818
## GO:0071356
## GD:0006470
## GO:0007596
## GD:0070661
## GO:0071902
                                                                                                  positive
```

pos

pos

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## GD:0007599 ## GD:0050817 ## GO:0051480 ## GO:0051056

```
## GD:2000146
## GD:0043405
## GD:0002696
## GD:0034612
## GO:0018108
## GO:0018212
## GD:0031346
## GO:0050867
## GD:0051098
## GD:0042692
## GD:0040013
## GO:0014706
  GO:0051271
## GD:0009913
## GO:0010959
## GD:0060537
## GO:0007517
## GD:0001933
## GO:0043547
## GD:0045088
## GD:0042391
## GO:0048568
## GO:0001558
## GD:0043254
## GD:0006816
## GD:0030099
## GO:0045785
  GD:0006874
##
  GD:0042326
##
              GeneRatio
                          BgRatio
                                         pvalue
                                                  p.adjust
                                                                qvalue
## GD:0002923
                    2/8
                         25/20536 3.965998e-05 0.01328609 0.006512586
  GD:0050853
                         67/20536 2.899109e-04 0.02424197 0.011882948
  GD:0002712
                         72/20536 3.348214e-04 0.02424197 0.011882948
## GO:0002889
                         72/20536 3.348214e-04 0.02424197 0.011882948
  GO:0051260
                    3/8 415/20536 4.254425e-04 0.02424197 0.011882948
                         82/20536 4.341846e-04 0.02424197 0.011882948
## GD:0002455
## GD:0002920
                    2/8 107/20536 7.378153e-04 0.03530973 0.017308148
## GD:0030183
                    2/8 136/20536 1.187609e-03 0.04615756 0.022625542
## GO:0050868
                    2/8 139/20536 1.240054e-03 0.04615756 0.022625542
                    2/8 156/20536 1.557981e-03 0.04826631 0.023659212
## GO:1903038
## GO:0016064
                    2/8 159/20536 1.617729e-03 0.04826631 0.023659212
## GO:0019724
                    2/8 169/20536 1.824735e-03 0.04826631 0.023659212
## GD:0051250
                    2/8 191/20536 2.322338e-03 0.04826631 0.023659212
## GO:0071248
                    2/8 201/20536 2.567535e-03 0.04826631 0.023659212
## GD:0002822
                    2/8 210/20536 2.798290e-03 0.04826631 0.023659212
## GO:0022408
                    2/8 218/20536 3.011374e-03 0.04826631 0.023659212
## GD:0002695
                    2/8 223/20536 3.148344e-03 0.04826631 0.023659212
## GD:0071241
                    2/8 229/20536 3.316543e-03 0.04826631 0.023659212
## GO:0002819
                    2/8 233/20536 3.430994e-03 0.04826631 0.023659212
## GD:0050866
                    2/8 247/20536 3.846097e-03 0.04826631 0.023659212
                         10/20536 3.889627e-03 0.04826631 0.023659212
## GD:0001768
## GD:0002713
                         10/20536 3.889627e-03 0.04826631 0.023659212
## GD:0002890
                         10/20536 3.889627e-03 0.04826631 0.023659212
                    1/8
## GO:0010918
                         10/20536 3.889627e-03 0.04826631 0.023659212
```

```
## GD:0042113
                    2/8 249/20536 3.907234e-03 0.04826631 0.023659212
## GD:0001767
                         11/20536 4.277861e-03 0.04826631 0.023659212
                    1/8
## GO:0002921
                         12/20536 4.665962e-03 0.04826631 0.023659212
## GD:0060088
                         12/20536 4.665962e-03 0.04826631 0.023659212
                    1/8
## GO:1904424
                         12/20536 4.665962e-03 0.04826631 0.023659212
                    2/8 286/20536 5.120224e-03 0.04826631 0.023659212
## GD:0002706
## GD:0002093
                         14/20536 5.441767e-03 0.04826631 0.023659212
## GO:0051712
                    1/8
                         14/20536 5.441767e-03 0.04826631 0.023659212
## GD:0072672
                    1/8
                         14/20536 5.441767e-03 0.04826631 0.023659212
## GO:0045838
                    1/8
                         15/20536 5.829471e-03 0.04826631 0.023659212
## GO:0051770
                    1/8
                         15/20536 5.829471e-03 0.04826631 0.023659212
## GD:2000402
                    1/8
                         16/20536 6.217043e-03 0.04826631 0.023659212
## GD:0051709
                         17/20536 6.604483e-03 0.04826631 0.023659212
                    1/8
## GD:0006959
                    2/8 327/20536 6.642967e-03 0.04826631 0.023659212
## GO:0007162
                    2/8 334/20536 6.921383e-03 0.04826631 0.023659212
## GD:0070372
                    2/8 344/20536 7.328335e-03 0.04826631 0.023659212
                    2/8 345/20536 7.369624e-03 0.04826631 0.023659212
## GO:0050851
## GO:0002925
                         19/20536 7.378966e-03 0.04826631 0.023659212
                         19/20536 7.378966e-03 0.04826631 0.023659212
## GD:0060117
## GD:0001906
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
## GO:0071214
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
## GO:0104004
## GD:0002703
                    2/8 349/20536 7.535857e-03 0.04826631 0.023659212
                         20/20536 7.766009e-03 0.04826631 0.023659212
## GD:0051767
## GD:0051769
                         20/20536 7.766009e-03 0.04826631 0.023659212
## GD:0070371
                    2/8 361/20536 8.044854e-03 0.04826631 0.023659212
                    2/8 367/20536 8.305119e-03 0.04826631 0.023659212
## GD:0002460
## GD:0033630
                         22/20536 8.539700e-03 0.04826631 0.023659212
                         22/20536 8.539700e-03 0.04826631 0.023659212
## GD:0045663
## GD:0071294
                         22/20536 8.539700e-03 0.04826631 0.023659212
                    1/8
## GD:2000114
                    1/8
                         22/20536 8.539700e-03 0.04826631 0.023659212
## GO:0035855
                    1/8
                         23/20536 8.926347e-03 0.04826631 0.023659212
## GO:0071467
                         23/20536 8.926347e-03 0.04826631 0.023659212
                    2/8 383/20536 9.017812e-03 0.04826631 0.023659212
## GD:0030098
  GD:0010038
                    2/8 384/20536 9.063252e-03 0.04826631 0.023659212
                    2/8 384/20536 9.063252e-03 0.04826631 0.023659212
## GD:1903037
## GD:0002693
                         24/20536 9.312863e-03 0.04826631 0.023659212
## GO:0035024
                         24/20536 9.312863e-03 0.04826631 0.023659212
                    1/8
## GO:0050860
                         24/20536 9.312863e-03 0.04826631 0.023659212
                         24/20536 9.312863e-03 0.04826631 0.023659212
## GD:0090023
                    1/8
                    2/8 393/20536 9.476932e-03 0.04826631 0.023659212
## GD:0050863
## GD:0030220
                         26/20536 1.008550e-02 0.04826631 0.023659212
                    1/8
## GD:0032461
                    1/8
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GO:0032878
                         26/20536 1.008550e-02 0.04826631 0.023659212
                    1/8
## GD:0071624
                         26/20536 1.008550e-02 0.04826631 0.023659212
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GO:1901741
## GD:0007159
                    2/8 418/20536 1.067029e-02 0.04915267 0.024093690
## GD:0036344
                         28/20536 1.085761e-02 0.04915267 0.024093690
## GO:0051000
                    1/8
                         28/20536 1.085761e-02 0.04915267 0.024093690
## GO:1901739
                         28/20536 1.085761e-02 0.04915267 0.024093690
                         29/20536 1.124346e-02 0.04931364 0.024172592
## GO:0045577
                    1/8
## GO:1902624
                         29/20536 1.124346e-02 0.04931364 0.024172592
## GO:0051491
                         30/20536 1.162919e-02 0.04931364 0.024172592
                    1/8
## GD:0060122
                         30/20536 1.162919e-02 0.04931364 0.024172592
```

```
## GD:0090022
                         30/20536 1.162919e-02 0.04931364 0.024172592
## GD:0002449
                    2/8 455/20536 1.255408e-02 0.05223373 0.025603965
## GD:0002922
                         33/20536 1.278557e-02 0.05223373 0.025603965
                         33/20536 1.278557e-02 0.05223373 0.025603965
## GO:0048741
                    1/8
  GO:0050858
                    1/8
                         34/20536 1.317077e-02 0.05315912 0.026057574
                         35/20536 1.355583e-02 0.05342593 0.026188361
## GO:0042491
                    1/8
## GD:0060143
                    1/8
                         35/20536 1.355583e-02 0.05342593 0.026188361
                    1/8
## GO:0014904
                         36/20536 1.394077e-02 0.05362364 0.026285273
  GD:1902622
                    1/8
                         36/20536 1.394077e-02 0.05362364 0.026285273
## GD:0032770
                    1/8
                         37/20536 1.432557e-02 0.05362364 0.026285273
## GD:0060142
                         37/20536 1.432557e-02 0.05362364 0.026285273
                    2/8 489/20536 1.440635e-02 0.05362364 0.026285273
## GD:0007265
  GO:0002691
                    1/8
                         39/20536 1.509479e-02 0.05496471 0.026942638
                         39/20536 1.509479e-02 0.05496471 0.026942638
## GD:0060338
## GD:0070207
                         41/20536 1.586347e-02 0.05714262 0.028010208
                    1/8
## GD:0009268
                    1/8
                         42/20536 1.624762e-02 0.05790375 0.028383301
                         43/20536 1.663164e-02 0.05803748 0.028448852
  GD:0050856
                    1/8
  GD:0060119
                         43/20536 1.663164e-02 0.05803748 0.028448852
                         44/20536 1.701552e-02 0.05876494 0.028805440
## GD:0051489
                    1/8
## GO:0071622
                         45/20536 1.739927e-02 0.05947711 0.029154531
## GO:0010831
                    1/8
                         46/20536 1.778290e-02 0.06017445 0.029496352
## GO:0032459
                         47/20536 1.816639e-02 0.06025485 0.029535764
## GO:0098751
                         47/20536 1.816639e-02 0.06025485 0.029535764
                    1/8
                         48/20536 1.854975e-02 0.06092319 0.029863372
## GD:0033628
                    1/8
## GD:0007520
                    1/8
                         49/20536 1.893298e-02 0.06157813 0.030184410
## GO:0035315
                    1/8
                         50/20536 1.931608e-02 0.06222005 0.030499067
                         53/20536 2.046459e-02 0.06516201 0.031941158
## GO:0010043
                    1/8
## GD:2000404
                    1/8
                         54/20536 2.084716e-02 0.06516201 0.031941158
                         57/20536 2.199410e-02 0.06516201 0.031941158
## GD:0002686
                    1/8
## GD:0002714
                         57/20536 2.199410e-02 0.06516201 0.031941158
                    1/8
## GD:0002891
                    1/8
                         57/20536 2.199410e-02 0.06516201 0.031941158
  GO:0031295
                    1/8
                         57/20536 2.199410e-02 0.06516201 0.031941158
## GD:0046580
                         57/20536 2.199410e-02 0.06516201 0.031941158
                         57/20536 2.199410e-02 0.06516201 0.031941158
## GO:0050732
                    1/8
  GO:0031294
                         58/20536 2.237615e-02 0.06516201 0.031941158
                         59/20536 2.275808e-02 0.06516201 0.031941158
## GD:0002066
                    1/8
## GD:0002823
                         59/20536 2.275808e-02 0.06516201 0.031941158
## GD:0060113
                         59/20536 2.275808e-02 0.06516201 0.031941158
                    1/8
## GD:0060563
                         59/20536 2.275808e-02 0.06516201 0.031941158
                    1/8
                         62/20536 2.390306e-02 0.06663724 0.032664289
## GD:0035036
                    1/8
                         62/20536 2.390306e-02 0.06663724 0.032664289
## GO:0045661
## GO:0051353
                         62/20536 2.390306e-02 0.06663724 0.032664289
                    1/8
## GD:0032715
                    1/8
                         63/20536 2.428446e-02 0.06663724 0.032664289
## GO:0051058
                         63/20536 2.428446e-02 0.06663724 0.032664289
                    1/8
## GD:0046847
                    1/8
                         64/20536 2.466573e-02 0.06663724 0.032664289
## GO:0050999
                         64/20536 2.466573e-02 0.06663724 0.032664289
                    1/8
## GD:0070527
                    1/8
                         65/20536 2.504686e-02 0.06707352 0.032878145
## GD:0000768
                    1/8
                         66/20536 2.542787e-02 0.06707352 0.032878145
## GO:0140253
                    1/8
                         66/20536 2.542787e-02 0.06707352 0.032878145
## GD:0006949
                    1/8
                         68/20536 2.618950e-02 0.06832740 0.033492773
                         69/20536 2.657012e-02 0.06832740 0.033492773
## GD:0070206
                    1/8
## GO:0010830
                         70/20536 2.695060e-02 0.06832740 0.033492773
## GD:0033627
                         70/20536 2.695060e-02 0.06832740 0.033492773
                    1/8
## GD:0002820
                         71/20536 2.733096e-02 0.06832740 0.033492773
```

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## GD:0042490
                         71/20536 2.733096e-02 0.06832740 0.033492773
## GD:0048747
                         71/20536 2.733096e-02 0.06832740 0.033492773
                    1/8
## GO:0050854
                         74/20536 2.847125e-02 0.07065089 0.034631700
## GO:0042130
                         77/20536 2.961038e-02 0.07240493 0.035491499
                    1/8
## GD:2000401
                         77/20536 2.961038e-02 0.07240493 0.035491499
## GD:0032768
                    1/8
                         78/20536 2.998982e-02 0.07279045 0.035680473
                         79/20536 3.036914e-02 0.07279045 0.035680473
## GD:0072678
## GO:0031640
                    1/8
                         80/20536 3.074833e-02 0.07279045 0.035680473
## GO:0045454
                    1/8
                         80/20536 3.074833e-02 0.07279045 0.035680473
## GO:0045123
                    1/8
                         81/20536 3.112739e-02 0.07279045 0.035680473
## GD:0071260
                    1/8
                         81/20536 3.112739e-02 0.07279045 0.035680473
                         82/20536 3.150632e-02 0.07279045 0.035680473
## GO:0051881
                    1/8
## GD:0061515
                    1/8
                         82/20536 3.150632e-02 0.07279045 0.035680473
                         83/20536 3.188511e-02 0.07302951 0.035797654
## GD:0009988
## GD:0043407
                         84/20536 3.226378e-02 0.07302951 0.035797654
                    1/8
## GO:0051279
                    1/8
                         84/20536 3.226378e-02 0.07302951 0.035797654
## GO:0071277
                         88/20536 3.377716e-02 0.07577475 0.037143318
                    1/8
## GD:0034109
                         89/20536 3.415519e-02 0.07577475 0.037143318
                         89/20536 3.415519e-02 0.07577475 0.037143318
## GO:0051155
                    1/8
## GD:0032720
                         93/20536 3.566598e-02 0.07860594 0.038531111
## GO:1903556
                    1/8
                         95/20536 3.642060e-02 0.07974445 0.039089186
## GO:0045445
                         97/20536 3.717470e-02 0.08086704 0.039639463
                         99/20536 3.792829e-02 0.08092979 0.039670218
## GO:0014068
                    1/8
                         99/20536 3.792829e-02 0.08092979 0.039670218
## GD:0032945
                    1/8
## GO:0050672
                         99/20536 3.792829e-02 0.08092979 0.039670218
## GD:0030219
                    1/8 103/20536 3.943391e-02 0.08335218 0.040857630
## GD:0002690
                    1/8 104/20536 3.981000e-02 0.08335218 0.040857630
## GD:0010522
                    1/8 104/20536 3.981000e-02 0.08335218 0.040857630
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
## GD:0002707
## GD:0032091
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
## GD:0070664
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
## GO:0042472
                    1/8 108/20536 4.131305e-02 0.08387801 0.041115377
## GO:0120034
                    1/8 108/20536 4.131305e-02 0.08387801 0.041115377
                    1/8 111/20536 4.243898e-02 0.08513209 0.041730106
## GO:1990868
## GD:1990869
                    1/8 111/20536 4.243898e-02 0.08513209 0.041730106
## GD:0033138
                    1/8 113/20536 4.318896e-02 0.08612085 0.042214776
## GD:0035335
                    1/8 115/20536 4.393843e-02 0.08709689 0.042693211
## GD:0002065
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
## GD:0002704
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
## GD:0030593
                    1/8 120/20536 4.580985e-02 0.08870693 0.043482424
## GO:0050864
## GO:0014902
                    1/8 122/20536 4.655752e-02 0.08912439 0.043687055
## GD:0051341
                    1/8 122/20536 4.655752e-02 0.08912439 0.043687055
## GO:0031343
                    1/8 124/20536 4.730468e-02 0.09004015 0.044135941
## GO:0051149
                    1/8 127/20536 4.842445e-02 0.09132484 0.044765673
## GO:0042471
                    1/8 128/20536 4.879745e-02 0.09132484 0.044765673
## GO:1903828
                    1/8 128/20536 4.879745e-02 0.09132484 0.044765673
## GD:0051209
                    1/8 132/20536 5.028818e-02 0.09359190 0.045876939
## GD:0051283
                    1/8 134/20536 5.103278e-02 0.09375811 0.045958415
## GD:1990266
                    1/8 134/20536 5.103278e-02 0.09375811 0.045958415
                    1/8 135/20536 5.140489e-02 0.09375811 0.045958415
## GD:0002688
## GO:0051153
                    1/8 136/20536 5.177687e-02 0.09375811 0.045958415
## GD:0051282
                    1/8 136/20536 5.177687e-02 0.09375811 0.045958415
## GD:0072676
                    1/8 137/20536 5.214872e-02 0.09392377 0.046039618
```

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## GO:0071621
                    1/8 138/20536 5.252045e-02 0.09408743 0.046119839
## GD:0051208
                    1/8 139/20536 5.289204e-02 0.09424912 0.046199096
## GD:0014066
                    1/8 143/20536 5.437716e-02 0.09552406 0.046824046
## GD:0030010
                    1/8 143/20536 5.437716e-02 0.09552406 0.046824046
## GD:0060337
                    1/8 144/20536 5.474812e-02 0.09552406 0.046824046
                    1/8 144/20536 5.474812e-02 0.09552406 0.046824046
## GO:0071357
                    1/8 148/20536 5.623068e-02 0.09760248 0.047842849
## GD:0034340
## GO:0033135
                    1/8 149/20536 5.660100e-02 0.09773885 0.047909695
## GD:0097553
                    1/8 150/20536 5.697120e-02 0.09787360 0.047975748
## GD:0007605
                    1/8 153/20536 5.808103e-02 0.09927114 0.048660797
## GD:0002824
                    1/8 154/20536 5.845072e-02 0.09939589 0.048721943
                    1/8 155/20536 5.882028e-02 0.09950532 0.048775584
## GO:0051592
## GD:0071901
                    1/8 157/20536 5.955902e-02 0.09950532 0.048775584
## GD:0097530
                    1/8 157/20536 5.955902e-02 0.09950532 0.048775584
## GO:0035023
                    1/8 158/20536 5.992820e-02 0.09950532 0.048775584
## GD:0002821
                    1/8 159/20536 6.029725e-02 0.09950532 0.048775584
                    1/8 159/20536 6.029725e-02 0.09950532 0.048775584
## GD:0050921
## GD:0002687
                    1/8 160/20536 6.066618e-02 0.09962338 0.048833457
                    1/8 161/20536 6.103498e-02 0.09974009 0.048890664
## GD:1903169
## GD:0007338
                    1/8 163/20536 6.177220e-02 0.10045479 0.049240997
## GD:0008037
                    1/8 165/20536 6.250891e-02 0.10116177 0.049587543
## GO:0014065
                    1/8 168/20536 6.361303e-02 0.10245368 0.050220816
## GD:0060402
                    1/8 169/20536 6.398082e-02 0.10255299 0.050269495
                    1/8 171/20536 6.471602e-02 0.10323746 0.050605006
## GD:0007519
## GO:0050954
                    1/8 173/20536 6.545071e-02 0.10391463 0.050936944
## GD:1902600
                    1/8 176/20536 6.655180e-02 0.10516440 0.051549555
## GD:0030168
                    1/8 178/20536 6.728523e-02 0.10582418 0.051872968
## GO:0051100
                    1/8 179/20536 6.765175e-02 0.10590344 0.051911820
                    1/8 181/20536 6.838442e-02 0.10655247 0.052229963
## GD:0060538
## GD:0120032
                    1/8 186/20536 7.021390e-02 0.10828444 0.053078942
## GD:0032675
                    1/8 188/20536 7.094481e-02 0.10828444 0.053078942
## GO:0060491
                    1/8 188/20536 7.094481e-02 0.10828444 0.053078942
## GD:0055002
                    1/8 189/20536 7.131008e-02 0.10828444 0.053078942
## GO:0002244
                    1/8 190/20536 7.167522e-02 0.10828444 0.053078942
## GD:0060401
                    1/8 191/20536 7.204023e-02 0.10828444 0.053078942
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GD:0043409
## GD:0045619
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GO:0051099
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GD:0042267
                    1/8 195/20536 7.349904e-02 0.10943190 0.053641402
                    1/8 197/20536 7.422769e-02 0.11002777 0.053933484
## GD:0032635
                    1/8 198/20536 7.459182e-02 0.11008044 0.053959306
## GD:0009566
## GO:0002228
                    1/8 199/20536 7.495583e-02 0.11013248 0.053984812
## GD:0051147
                    1/8 201/20536 7.568348e-02 0.11023464 0.054034889
## GO:2000045
                    1/8 201/20536 7.568348e-02 0.11023464 0.054034889
## GO:0048015
                    1/8 203/20536 7.641063e-02 0.11033431 0.054083748
## GO:0055001
                    1/8 203/20536 7.641063e-02 0.11033431 0.054083748
## GD:0002698
                    1/8 204/20536 7.677401e-02 0.11038324 0.054107730
## GD:0048017
                    1/8 206/20536 7.750041e-02 0.11047931 0.054154821
## GD:0048839
                    1/8 206/20536 7.750041e-02 0.11047931 0.054154821
## GD:0007219
                    1/8 207/20536 7.786342e-02 0.11052646 0.054177937
                    1/8 209/20536 7.858906e-02 0.11108581 0.054452117
## GD:0001959
## GD:0032680
                    1/8 210/20536 7.895170e-02 0.11112949 0.054473530
## GD:0032640
                    1/8 213/20536 8.003886e-02 0.11172090 0.054763428
## GO:1903555
                    1/8 213/20536 8.003886e-02 0.11172090 0.054763428
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## GD:0002708
                    1/8 214/20536 8.040099e-02 0.11176072 0.054782943
## GD:0009612
                    1/8 215/20536 8.076300e-02 0.11180003 0.054802212
## GO:0042129
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## GO:1902806
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## GO:0031341
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## GD:0007266
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## GO:0051651
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## GD:0048562
                    1/8 306/20536 1.131886e-01 0.13639636 0.066858859
## GO:0051348
                    1/8 313/20536 1.156409e-01 0.13877465 0.068024654
                    1/8 314/20536 1.159908e-01 0.13877465 0.068024654
## GO:0018105
## GO:0044843
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## GD:0051146
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## GO:0022409
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## GO:0051251
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## GO:0007204
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## GO:0046651
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## GD:0070588
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## GD:0032943
## GD:0060326
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## GD:0002699
                    1/8 356/20536 1.305752e-01 0.14917745 0.073123905
## GO:1904062
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## GD:0030336
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                    1/8 364/20536 1.333292e-01 0.15026993 0.073659417
## GO:0001818
  GO:0071356
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  GD:0006470
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## GD:0070661
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## GO:0071902
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## GO:0050817
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## GD:0051480
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## GO:0051056
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  GD:2000146
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                    1/8 381/20536 1.391562e-01 0.15135491 0.074191252
## GD:0043405
## GD:0002696
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## GD:0034612
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  GO:0018212
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## GD:0031346
## GD:0050867
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  GO:0051098
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## GD:0042692
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## GO:0040013
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## GO:0051271
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## GO:0010959
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## GO:0007517
## GD:0001933
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## GD:0043547
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## GO:0048568
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	GD:0001909		1
	GD:0046578 GD:0050670	ENSG00000111913	1 1
	GD:0032944	ENSG00000111679 ENSG00000111679	1
	GD:0052944 GD:0050730	ENSG00000111679	1
	GD:0033673	ENSG00000111679	1
	GD:0033673	ENSG00000111679	1
	GD:0090596	ENSG00000100721 ENSG00000111913	1
	GD:1903039	ENSG00000111913	1
	GD:0051924	ENSG00000111679	1
	GD:0070663	ENSG00000111679	1
	GD:0070663	ENSG00000111679	1
	GD:000082	ENSG00000111679	1
	GD:0048562	ENSG00000111079 ENSG00000111913	1
	GD:0046562 GD:0051348	ENSG00000111913	1
	GD:0018105	ENSG00000111679 ENSG00000100721	1
	GD:0044843	ENSG00000100721 ENSG00000111679	1
	GD:1902105	ENSG00000111679	1
πĦ	40.1302100	TWDG00000111013	

	GO:0051146	ENSG00000111913	1
	GO:0022409	ENSG00000111679	1
##	GO:0051251	ENSG00000111679	1
##	GD:0007204	ENSG00000111679	1
##	GD:0018209	ENSG00000100721	1
##	GO:0051235	ENSG00000111679	1
##	GD:0046651	ENSG00000111679	1
##	GO:0070588	ENSG00000111679	1
##	GD:0032943	ENSG00000111679	1
##	GD:0060326	ENSG00000111913	1
##	GD:0002699	ENSG00000104921	1
	GO:1904062	ENSG00000111679	1
##	GO:0071496	ENSG00000111913	1
	GD:0030336	ENSG00000111913	1
	GD:0001818	ENSG00000111679	1
	GD:0071356	ENSG00000111070	1
	GD:0006470	ENSG00000111679	1
	GD:0007596	ENSG00000111679	1
	GD:0070661	ENSG00000111679 ENSG00000111679	1
	GD:0071902	ENSG00000111073 ENSG00000100721	1
	GD:00071902	ENSG00000100721 ENSG00000111679	1
	GD:0050817		
		ENSG00000111679	1
	GO:0051480	ENSG00000111679	1
	GD: 0051056	ENSG00000111913	1
	GD: 2000146	ENSG00000111913	1
	GD: 0043405	ENSG00000111679	1
	GD:0002696	ENSG00000111679	1
	GO:0034612	ENSG00000100721	1
	GO:0018108	ENSG00000111679	1
	GO:0018212	ENSG00000111679	1
	GD:0031346	ENSG00000111913	1
	GO:0050867	ENSG00000111679	1
##	GO:0051098	ENSG00000111913	1
##	GO:0042692	ENSG00000111913	1
##	GO:0040013	ENSG00000111913	1
##	GO:0014706	ENSG00000111913	1
##	GO:0051271	ENSG00000111913	1
##	GO:0009913	ENSG00000111913	1
##	GO:0010959	ENSG00000111679	1
##	GD:0060537	ENSG00000111913	1
##	GO:0007517	ENSG00000111913	1
##	GO:0001933	ENSG00000111679	1
##	GO:0043547	ENSG00000068831	1
##	GO:0045088	ENSG00000111679	1
##	GO:0042391	ENSG00000100721	1
##	GD:0048568	ENSG00000111913	1
	GD:0001558	ENSG00000068831	1
	GD:0043254	ENSG00000100721	1
	GD:0006816	ENSG00000111679	1
	GD:0030099	ENSG00000111679	1
	GD:0045785	ENSG00000111679	1
	GD:0006874	ENSG00000111679	1
##	GD:0042326	ENSG00000111679	1
ir m	45.0012020	2110400000111010	_

```
##
                      ID
## GD:0033622 GD:0033622
## GD:0002639 GD:0002639
## GD:0030888 GD:0030888
## GD:0046626 GD:0046626
## GO:1900076 GO:1900076
## GD:0002637 GD:0002637
## GD:0042100 GD:0042100
## GD:0050864 GD:0050864
## GD:0002377 GD:0002377
## GD:0008286 GD:0008286
## GD:0002702 GD:0002702
## GD:0002700 GD:0002700
## GD:0032869 GD:0032869
## GD:0042113 GD:0042113
## GD:0050670 GD:0050670
## GD:0032944 GD:0032944
## GD:0002440 GD:0002440
## GD:0032868 GD:0032868
## GD:0070663 GD:0070663
## GD:0046651 GD:0046651
## GD:0032943 GD:0032943
## GD:0071375 GD:0071375
## GD:0002699 GD:0002699
## GD:0070661 GD:0070661
## GO:1901653 GO:1901653
## GD:0043434 GD:0043434
                                                                              Description
## GD:0033622
                                                                      integrin activation
## GD:0002639
                                        positive regulation of immunoglobulin production
                                                       regulation of B cell proliferation
## GD:0030888
## GD:0046626
                                        regulation of insulin receptor signaling pathway
                                     regulation of cellular response to insulin stimulus
## GD:1900076
## GD:0002637
                                                  regulation of immunoglobulin production
## GD:0042100
                                                                     B cell proliferation
## GD:0050864
                                                          regulation of B cell activation
## GD:0002377
                                                                immunoglobulin production
## GD:0008286
                                                       insulin receptor signaling pathway
## G0:0002702 positive regulation of production of molecular mediator of immune response
## GD:0002700
                       regulation of production of molecular mediator of immune response
## GD:0032869
                                                    cellular response to insulin stimulus
## GD:0042113
                                                                        B cell activation
## GD:0050670
                                                   regulation of lymphocyte proliferation
## GD:0032944
                                             regulation of mononuclear cell proliferation
## GD:0002440
                                     production of molecular mediator of immune response
## GD:0032868
                                                                      response to insulin
## GD:0070663
                                                    regulation of leukocyte proliferation
## GD:0046651
                                                                 lymphocyte proliferation
## GD:0032943
                                                           mononuclear cell proliferation
                                            cellular response to peptide hormone stimulus
## GO:0071375
## GD:0002699
                                           positive regulation of immune effector process
## GD:0070661
                                                                  leukocyte proliferation
## GD:1901653
                                                             cellular response to peptide
## GD:0043434
                                                              response to peptide hormone
```

```
GeneRatio
                           BgRatio
                                        pvalue
                                                 p.adjust qvalue
                                                                           geneID
                    1/1
                         22/20536 0.001071289 0.01666991
                                                               NA ENSG00000170476
## GD:0033622
                         50/20536 0.002434749 0.01666991
  GD:0002639
                                                               NA ENSG00000170476
## GD:0030888
                    1/1
                         64/20536 0.003116478 0.01666991
                                                               NA ENSG00000170476
  GD:0046626
                    1/1
                         66/20536 0.003213868 0.01666991
                                                               NA ENSG00000170476
                    1/1
                         74/20536 0.003603428 0.01666991
  GO:1900076
                                                               NA ENSG00000170476
  GD:0002637
                         79/20536 0.003846903 0.01666991
                                                               NA ENSG00000170476
## GO:0042100
                    1/1
                         99/20536 0.004820802 0.01790584
                                                               NA ENSG00000170476
  GD:0050864
                    1/1 120/20536 0.005843397 0.01814699
                                                               NA ENSG00000170476
  GD:0002377
                    1/1 129/20536 0.006281652 0.01814699
                                                               NA ENSG00000170476
  GD:0008286
                    1/1 151/20536 0.007352941 0.01899104
                                                               NA ENSG00000170476
                    1/1 165/20536 0.008034671 0.01899104
  GD:0002702
                                                               NA ENSG00000170476
  GD:0002700
                    1/1 217/20536 0.010566810 0.01951857
                                                               NA ENSG00000170476
  GD:0032869
                    1/1 234/20536 0.011394624 0.01951857
                                                               NA ENSG00000170476
  GO:0042113
                    1/1 249/20536 0.012125049 0.01951857
                                                               NA ENSG00000170476
  GD:0050670
                    1/1 277/20536 0.013488508 0.01951857
                                                               NA ENSG00000170476
  GO:0032944
                    1/1 278/20536 0.013537203 0.01951857
                                                               NA ENSG00000170476
  GD:0002440
                    1/1 286/20536 0.013926763 0.01951857
                                                               NA ENSG00000170476
  GD:0032868
                    1/1 291/20536 0.014170238 0.01951857
                                                               NA ENSG00000170476
## GD:0070663
                    1/1 293/20536 0.014267628 0.01951857
                                                               NA ENSG00000170476
  GO:0046651
                    1/1 342/20536 0.016653681 0.01951857
                                                               NA ENSG00000170476
  GO:0032943
                    1/1 344/20536 0.016751071 0.01951857
                                                               NA ENSG00000170476
## GO:0071375
                    1/1 349/20536 0.016994546 0.01951857
                                                               NA ENSG00000170476
  GD:0002699
                    1/1 356/20536 0.017335411 0.01951857
                                                               NA ENSG00000170476
  GO:0070661
                                                               NA ENSG00000170476
                    1/1 370/20536 0.018017141 0.01951857
  GO:1901653
                    1/1 419/20536 0.020403194 0.02121932
                                                               NA ENSG00000170476
##
  GO:0043434
                    1/1 466/20536 0.022691858 0.02269186
                                                               NA ENSG00000170476
              Count
##
  GD:0033622
                  1
  GD:0002639
                  1
  GD:0030888
                  1
  GO:0046626
                  1
  GD:1900076
                  1
  GO:0002637
                  1
  GD:0042100
                  1
  GD:0050864
                  1
## GD:0002377
                  1
## GD:0008286
                  1
## GD:0002702
                  1
## GD:0002700
                  1
  GD:0032869
                  1
## GO:0042113
                  1
## GD:0050670
                  1
## GD:0032944
                  1
## GD:0002440
                  1
## GO:0032868
                  1
  GD:0070663
                  1
  GD:0046651
                  1
  GD:0032943
                  1
  GO:0071375
                  1
  GD:0002699
                  1
## GO:0070661
                  1
## GO:1901653
                  1
## GO:0043434
```

## Resultados

Los resultados de las tres comparaciones estudiadas: tejidos sin infiltración (NIT) vs tejidos con infiltración leucocitaria extensa (ELI), tejidos con infiltración focal pequeña (SFI) vs tejidos con infiltración leucocitaria extensa (ELI) y tejidos sin infiltración (NIT) vs tejidos con infiltración focal pequeña, nos muestran grupos de genes diferencialmente expresados cuyos procesos biológicos están, en gran parte, relacionados entre ellos.

A nivel de análisis de significancia biológica general, me parece interesante recalcar los resultados de la siguiente tabla:

```
##
                      ID
## GD:0050853 GD:0050853
## G0:0042113 G0:0042113
## GD:0010522 GD:0010522
## GD:0002920 GD:0002920
## GD:0050864 GD:0050864
## GD:0030183 GD:0030183
## GD:0002923 GD:0002923
## GD:0016064 GD:0016064
## G0:0019724 G0:0019724
## GD:0060402 GD:0060402
## GD:0060401 GD:0060401
## G0:0010524 G0:0010524
## G0:0051924 G0:0051924
## GD:0002712 GD:0002712
## GD:0002889 GD:0002889
## GD:0050854 GD:0050854
## GD:0006959 GD:0006959
## G0:0045123 G0:0045123
## GO:0002455 GO:0002455
## GD:0007204 GD:0007204
## G0:0046651 G0:0046651
## GD:0051279 GD:0051279
## GD:0032943 GD:0032943
## G0:0050851 G0:0050851
## GD:0002460 GD:0002460
## GD:0070661 GD:0070661
## GD:0051480 GD:0051480
## GD:0030098 GD:0030098
## GD:0042100 GD:0042100
## G0:0051260 G0:0051260
## GO:0007159 GO:0007159
## GO:0010959 GO:0010959
## GD:0002449 GD:0002449
## G0:0051209 G0:0051209
## GD:0051283 GD:0051283
## G0:0051928 G0:0051928
## GD:0051282 GD:0051282
## GD:0006816 GD:0006816
## GD:0050868 GD:0050868
## GD:0051208 GD:0051208
## GD:0006874 GD:0006874
## GD:0097553 GD:0097553
## GD:1903038 GD:1903038
## GO:1903169 GO:1903169
```

```
## GD:0001768 GD:0001768
## GD:0002713 GD:0002713
## GD:0002890 GD:0002890
## GD:0010918 GD:0010918
## GO:0051250 GO:0051250
## GD:0001767 GD:0001767
## GD:0071248 GD:0071248
## GD:0002921 GD:0002921
## GD:0060088 GD:0060088
## GO:1904424 GO:1904424
## GD:0002822 GD:0002822
## GD:0022408 GD:0022408
## GD:0002093 GD:0002093
## GD:0051712 GD:0051712
## GD:0072672 GD:0072672
## GD:0002695 GD:0002695
## GD:0051651 GD:0051651
## GD:0045838 GD:0045838
## GD:0051770 GD:0051770
## G0:0071241 G0:0071241
## GD:0002819 GD:0002819
## GD:2000402 GD:2000402
## G0:0051709 G0:0051709
## GD:0050866 GD:0050866
## GD:0002925 GD:0002925
## GD:0060117 GD:0060117
## GD:0051767 GD:0051767
## GD:0051769 GD:0051769
## GD:0050670 GD:0050670
## GD:0033622 GD:0033622
## GD:0033630 GD:0033630
## GD:0045663 GD:0045663
## G0:0071294 G0:0071294
## GD:2000114 GD:2000114
## GD:0032944 GD:0032944
## GD:0035855 GD:0035855
## G0:0071467 G0:0071467
## GD:0002706 GD:0002706
## GD:0002693 GD:0002693
## G0:0035024 G0:0035024
## GD:0050860 GD:0050860
## GD:0090023 GD:0090023
## GD:0043270 GD:0043270
## GD:0070663 GD:0070663
## GD:0030220 GD:0030220
## GO:0032461 GO:0032461
## GD:0032878 GD:0032878
## GD:0071624 GD:0071624
## GO:1901741 GO:1901741
## GD:0002335 GD:0002335
## GD:0036344 GD:0036344
## GD:0051000 GD:0051000
## GO:1901739 GO:1901739
## GO:0045577 GO:0045577
```

```
## GD:1902624 GD:1902624
## G0:0051491 G0:0051491
## GD:0060122 GD:0060122
## GD:0090022 GD:0090022
## GD:0007162 GD:0007162
## GO:0051235 GO:0051235
## GD:0035590 GD:0035590
## GO:0043552 GO:0043552
## GD:0070588 GD:0070588
## GD:0002922 GD:0002922
## GD:0033198 GD:0033198
## G0:0048741 G0:0048741
## GD:0050855 GD:0050855
## GD:0050901 GD:0050901
## GD:0070372 GD:0070372
## GD:0001906 GD:0001906
## GD:0071214 GD:0071214
## GD:0104004 GD:0104004
## GD:0002703 GD:0002703
## GD:0050858 GD:0050858
## G0:0042491 G0:0042491
## GD:0060143 GD:0060143
## GD:0002699 GD:0002699
## GD:1904062 GD:1904062
## GD:0014904 GD:0014904
## GD:0090218 GD:0090218
## GO:1902622 GO:1902622
## GD:0070371 GD:0070371
## GD:0032770 GD:0032770
## GD:0060142 GD:0060142
## GD:0007596 GD:0007596
## GD:0007599 GD:0007599
## G0:0050817 G0:0050817
## GD:0002691 GD:0002691
## GD:0060338 GD:0060338
## G0:0051281 G0:0051281
## GD:0010038 GD:0010038
## GO:1903037 GO:1903037
## GD:0070207 GD:0070207
## GD:0009268 GD:0009268
## GD:0050863 GD:0050863
## GD:0050856 GD:0050856
## GD:0060119 GD:0060119
## GO:0051489 GO:0051489
## GD:0071622 GD:0071622
## GD:0010831 GD:0010831
## GD:0032459 GD:0032459
## GD:0098751 GD:0098751
## GD:0033628 GD:0033628
## GO:1903727 GO:1903727
## GD:0007520 GD:0007520
## GD:0016339 GD:0016339
## GD:0002639 GD:0002639
## GO:0035315 GO:0035315
```

```
## GD:0061756 GD:0061756
## GD:0010043 GD:0010043
## GD:0050850 GD:0050850
## GD:2000404 GD:2000404
## G0:0043547 G0:0043547
## GD:0002686 GD:0002686
## GD:0002714 GD:0002714
## GD:0002891 GD:0002891
## GD:0031295 GD:0031295
## G0:0043551 G0:0043551
## GD:0046580 GD:0046580
## G0:0050732 G0:0050732
## GD:0042391 GD:0042391
## GD:0031294 GD:0031294
## GD:0002066 GD:0002066
## GD:0002823 GD:0002823
## GD:0060113 GD:0060113
## GD:0060563 GD:0060563
## GD:0035036 GD:0035036
## GD:0045661 GD:0045661
## GO:0051353 GO:0051353
## GO:0032715 GO:0032715
## GO:0051058 GO:0051058
## GD:0007265 GD:0007265
## GD:0030888 GD:0030888
## GD:0046847 GD:0046847
## GO:0050999 GO:0050999
## GD:0070527 GD:0070527
## GD:0000768 GD:0000768
## GD:0043550 GD:0043550
## GD:0046626 GD:0046626
## GO:0140253 GO:0140253
## GD:0006949 GD:0006949
## GD:0070206 GD:0070206
## GD:0010830 GD:0010830
## GD:0033627 GD:0033627
## GD:0002820 GD:0002820
## GD:0042490 GD:0042490
## G0:0048747 G0:0048747
## GD:1904427 GD:1904427
## GD:0030449 GD:0030449
## GD:1900076 GD:1900076
## GD:0002312 GD:0002312
## G0:0042130 G0:0042130
## GD:2000401 GD:2000401
## GD:0032768 GD:0032768
## GD:0002637 GD:0002637
## GD:0072678 GD:0072678
## GD:0031640 GD:0031640
## GO:0045454 GO:0045454
## GD:0071260 GD:0071260
## G0:0051881 G0:0051881
## GD:0061515 GD:0061515
## GD:0009988 GD:0009988
```

```
## GD:0043407 GD:0043407
## GO:0071277 GO:0071277
## GD:0034109 GD:0034109
## GO:0051155 GO:0051155
## GO:1903725 GO:1903725
## GD:0032720 GD:0032720
## GD:0006956 GD:0006956
## GO:1903556 GO:1903556
## GD:0045445 GD:0045445
## GD:0014068 GD:0014068
## GD:0032945 GD:0032945
## G0:0050672 G0:0050672
## GD:0030219 GD:0030219
## GD:0002690 GD:0002690
## GD:0060079 GD:0060079
## GD:0002707 GD:0002707
## GD:0032091 GD:0032091
## GD:0070664 GD:0070664
## GD:0042472 GD:0042472
## GD:0120034 GD:0120034
## GD:1990868 GD:1990868
## GO:1990869 GO:1990869
## GD:0050848 GD:0050848
## GD:0033138 GD:0033138
## GD:0099565 GD:0099565
## GD:0035335 GD:0035335
## GD:0002065 GD:0002065
## GD:0002704 GD:0002704
## GD:0030593 GD:0030593
## GD:0014902 GD:0014902
## G0:0051341 G0:0051341
## GD:0031343 GD:0031343
## GO:0051149 GO:0051149
## GD:0042471 GD:0042471
## GD:1903828 GD:1903828
## GD:0002377 GD:0002377
## GD:1990266 GD:1990266
## GD:0002688 GD:0002688
## GO:0051153 GO:0051153
## GD:0072676 GD:0072676
## G0:0071621 G0:0071621
## GD:0046683 GD:0046683
## GD:0014066 GD:0014066
## GD:0030010 GD:0030010
## GD:0060337 GD:0060337
## GD:0071357 GD:0071357
## GD:0034340 GD:0034340
## GD:1904064 GD:1904064
## GD:0033135 GD:0033135
## GD:0008286 GD:0008286
## GD:0060078 GD:0060078
## GD:0007605 GD:0007605
## GD:0002824 GD:0002824
## GO:0014074 GO:0014074
```

```
## GD:0045834 GD:0045834
## GD:0051592 GD:0051592
## G0:0071901 G0:0071901
## GD:0097530 GD:0097530
## GD:0035023 GD:0035023
## G0:0002821 G0:0002821
## GD:0050921 GD:0050921
## GD:0002687 GD:0002687
## GD:0034767 GD:0034767
## GD:0007338 GD:0007338
## GD:0002702 GD:0002702
## GD:0008037 GD:0008037
## GD:0014065 GD:0014065
## GD:0007519 GD:0007519
## GD:0050954 GD:0050954
## GD:1902600 GD:1902600
## GD:0030168 GD:0030168
## GD:0051100 GD:0051100
## GD:0060538 GD:0060538
## GD:0120032 GD:0120032
## G0:0051897 G0:0051897
## G0:0032675 G0:0032675
## GD:0060491 GD:0060491
## GD:0055002 GD:0055002
## GD:0002244 GD:0002244
## GD:0043409 GD:0043409
## GO:0045619 GO:0045619
## GD:0051099 GD:0051099
## GD:0042267 GD:0042267
## GD:0032635 GD:0032635
## GD:0009566 GD:0009566
## GD:0002228 GD:0002228
## G0:0051147 G0:0051147
## GD:2000045 GD:2000045
## GD:0002285 GD:0002285
## GD:0048015 GD:0048015
## GD:0055001 GD:0055001
## GD:0002698 GD:0002698
## G0:0048017 G0:0048017
## GD:0048839 GD:0048839
## GD:0007219 GD:0007219
## GO:0001959 GO:0001959
## GD:0034764 GD:0034764
## GD:0032680 GD:0032680
## GD:0032640 GD:0032640
## GO:1903555 GO:1903555
## GD:0002708 GD:0002708
## GD:0009612 GD:0009612
## GD:0042129 GD:0042129
## GD:0002700 GD:0002700
## GD:0071706 GD:0071706
## GD:1902806 GD:1902806
## GD:0031341 GD:0031341
## GD:0007163 GD:0007163
```

```
## GD:0060759 GD:0060759
## GD:0007266 GD:0007266
## GD:0002064 GD:0002064
## GD:0043393 GD:0043393
## GD:0032869 GD:0032869
## GD:0060348 GD:0060348
## GD:0002685 GD:0002685
## G0:0019722 G0:0019722
## GD:0050777 GD:0050777
## GD:0043583 GD:0043583
## GD:0007584 GD:0007584
## GD:0042098 GD:0042098
## GD:0097529 GD:0097529
## GD:0002705 GD:0002705
## GD:0050920 GD:0050920
## GD:0006469 GD:0006469
## GD:0070374 GD:0070374
## GD:0030595 GD:0030595
## GD:0050870 GD:0050870
## GD:0051896 GD:0051896
## GD:0001909 GD:0001909
## GD:0046578 GD:0046578
## GD:0050730 GD:0050730
## GD:0033673 GD:0033673
## GD:0098742 GD:0098742
## GD:0002440 GD:0002440
## G0:0031334 G0:0031334
## GD:0090596 GD:0090596
## GO:1903039 GO:1903039
## GD:0032868 GD:0032868
## GD:0043491 GD:0043491
## GD:0050852 GD:0050852
## GD:0000082 GD:0000082
## GD:0048562 GD:0048562
## GD:0051348 GD:0051348
## GO:0018105 GO:0018105
## GD:0044843 GD:0044843
## GO:1902105 GO:1902105
## GO:0051146 GO:0051146
## GD:0022409 GD:0022409
## G0:0051251 G0:0051251
## GD:0018209 GD:0018209
## GD:0071375 GD:0071375
## GD:0060326 GD:0060326
## GD:0071496 GD:0071496
## GD:0030336 GD:0030336
## GD:0001818 GD:0001818
## GD:0071356 GD:0071356
## GD:0006470 GD:0006470
## GD:0071902 GD:0071902
## GD:0051056 GD:0051056
## GD:2000146 GD:2000146
## GD:0043405 GD:0043405
## GD:0002696 GD:0002696
```

```
## GD:0034612 GD:0034612
## GD:0018108 GD:0018108
## GD:0018212 GD:0018212
## GD:0031346 GD:0031346
## GD:0050867 GD:0050867
## GD:0051098 GD:0051098
## GD:0042692 GD:0042692
## GD:0040013 GD:0040013
## GD:0014706 GD:0014706
## GD:0051271 GD:0051271
## GD:1901653 GD:1901653
## GD:0009913 GD:0009913
## GD:0019216 GD:0019216
## GD:0060537 GD:0060537
## GD:0007517 GD:0007517
## GD:0001933 GD:0001933
## GD:0045088 GD:0045088
## GD:0043434 GD:0043434
## GD:0048568 GD:0048568
## GD:0001558 GD:0001558
## GD:0019932 GD:0019932
## G0:0043254 G0:0043254
## GD:0030099 GD:0030099
## GD:0045785 GD:0045785
## GD:0006644 GD:0006644
## GD:0042326 GD:0042326
## GD:0050853
## GO:0042113
## GO:0010522
## GD:0002920
## GD:0050864
## GO:0030183
## GD:0002923
                                                                                    regulation of humoral
## GD:0016064
## GD:0019724
## GO:0060402
## GD:0060401
## GO:0010524
                                                                                                        ро
## GO:0051924
## GO:0002712
## GD:0002889
## GO:0050854
                                                                                                        re
## GD:0006959
## GO:0045123
## GO:0002455
                                                                                                   humoral
## GD:0007204
                                                                                                       pos
## GD:0046651
## GO:0051279
                                                                                                    regula
## GO:0032943
## GD:0050851
## GD:0002460
                                      adaptive immune response based on somatic recombination of immune
## GD:0070661
## GO:0051480
```

```
## GD:0030098
## GO:0042100
## GO:0051260
## GO:0007159
## GD:0010959
## GD:0002449
## GD:0051209
## GO:0051283
## GO:0051928
## GO:0051282
## GO:0006816
## GO:0050868
## GO:0051208
## GD:0006874
## GO:0097553
## GO:1903038
## GO:1903169
## GD:0001768
## GO:0002713
## GD:0002890
                                                                                                  negativ
## GO:0010918
## GO:0051250
## GO:0001767
## GD:0071248
## GD:0002921
## GD:0060088
## GO:1904424
## GO:0002822
                       regulation of adaptive immune response based on somatic recombination of immune
## GO:0022408
## GD:0002093
## GO:0051712
                                                                                                        ро
## GD:0072672
## GO:0002695
## GO:0051651
## GD:0045838
## GO:0051770
                                                                                               positive r
## GO:0071241
## GD:0002819
## GO:2000402
## GO:0051709
## GO:0050866
## GO:0002925
                                                                           positive regulation of humoral
## GD:0060117
## GD:0051767
## GD:0051769
                                                                                                         r
## GO:0050670
## GD:0033622
## GD:0033630
## GO:0045663
## GD:0071294
## GD:2000114
## GD:0032944
## GD:0035855
```

## GD:0071467

```
## GD:0002706
## GD:0002693
## GD:0035024
## GO:0050860
                                                                                                         n
## GD:0090023
## GD:0043270
## GD:0070663
## GD:0030220
## GD:0032461
## GO:0032878
                                                                                                      regu
## GD:0071624
## GD:1901741
## GD:0002335
## GD:0036344
## GO:0051000
## GO:1901739
## GO:0045577
## GO:1902624
## GO:0051491
## GO:0060122
## GD:0090022
## GO:0007162
## GO:0051235
## GD:0035590
## GO:0043552
                                                                                                    positi
## GD:0070588
## GO:0002922
## GO:0033198
## GO:0048741
## GD:0050855
## GD:0050901
## GD:0070372
## GO:0001906
## GO:0071214
## GO:0104004
## GD:0002703
## GD:0050858
                                                                                               negative re
## GO:0042491
## GO:0060143
                                                                                             positive regu
## GD:0002699
## GO:1904062
## GD:0014904
## GD:0090218
## GO:1902622
## GD:0070371
## GD:0032770
## GD:0060142
                                                                                                      regu
## GO:0007596
## GO:0007599
## GD:0050817
## GD:0002691
                                                                                                       reg
## GD:0060338
## GO:0051281
                                                                                           positive regula
```

## GD:0010038

```
## GD:1903037
## GO:0070207
## GD:0009268
## GO:0050863
## GO:0050856
## GO:0060119
## GD:0051489
## GO:0071622
## GD:0010831
## GO:0032459
## GO:0098751
## GD:0033628
## GO:1903727
## GD:0007520
## GD:0016339
                                                                                calcium-dependent cell-ce
## GD:0002639
## GO:0035315
## GD:0061756
## GO:0010043
## GO:0050850
## GD:2000404
## GD:0043547
## GD:0002686
## GD:0002714
## GD:0002891
                                                                                                  positiv
## GO:0031295
## GO:0043551
## GD:0046580
## GO:0050732
## GD:0042391
## GD:0031294
## GD:0002066
## G0:0002823 negative regulation of adaptive immune response based on somatic recombination of immune
## GO:0060113
## GD:0060563
## GO:0035036
## GO:0045661
## GO:0051353
## GO:0032715
## GO:0051058
                                                                                                negative :
## GD:0007265
## GD:0030888
## GD:0046847
## GO:0050999
## GD:0070527
## GD:0000768
## GO:0043550
## GD:0046626
## GO:0140253
## GD:0006949
## GO:0070206
## GD:0010830
## GD:0033627
## GD:0002820
```

```
## GD:0042490
## GD:0048747
## GO:1904427
## GD:0030449
## GO:1900076
## GO:0002312
## GD:0042130
## GD:2000401
## GD:0032768
## GD:0002637
## GD:0072678
## GD:0031640
## GD:0045454
## GD:0071260
## GO:0051881
## GO:0061515
## GD:0009988
## GD:0043407
## GD:0071277
## GO:0034109
## GO:0051155
## GO:1903725
## GO:0032720
## GD:0006956
## GO:1903556
                                                                                     negative regulation of
## GO:0045445
## GD:0014068
## GD:0032945
## GO:0050672
## GD:0030219
## GD:0002690
## GD:0060079
## GD:0002707
## GO:0032091
## GD:0070664
## GO:0042472
## GO:0120034
## GD:1990868
## GD:1990869
## GO:0050848
## GD:0033138
## GD:0099565
## GD:0035335
## GD:0002065
## GD:0002704
## GD:0030593
## GD:0014902
## GD:0051341
## GD:0031343
## GO:0051149
## GD:0042471
## GO:1903828
```

pos

posi

positiv

positive regulat

## GO:0002377 ## GD:1990266

```
## GD:0002688
## GO:0051153
## GD:0072676
## GO:0071621
## GO:0046683
## GO:0014066
## GD:0030010
## GD:0060337
## GD:0071357
## GO:0034340
## GD:1904064
## GO:0033135
## GD:0008286
## GD:0060078
## GO:0007605
## G0:0002824 positive regulation of adaptive immune response based on somatic recombination of immune
## GO:0014074
## GD:0045834
## GO:0051592
## GO:0071901
                                                                                                 negative
## GO:0097530
## GO:0035023
## GO:0002821
## GD:0050921
## GD:0002687
## GD:0034767
## GO:0007338
## GD:0002702
                                                                                      positive regulation
## GD:0008037
## GD:0014065
## GD:0007519
## GO:0050954
## GO:1902600
## GO:0030168
## GO:0051100
## GO:0060538
## GO:0120032
                                                                                                  regulat
## GO:0051897
## GO:0032675
## GD:0060491
## GO:0055002
## GD:0002244
## GD:0043409
## GO:0045619
## GO:0051099
## GD:0042267
## GD:0032635
## GD:0009566
## GD:0002228
## GO:0051147
## GO:2000045
## GD:0002285
## GD:0048015
## GD:0055001
```

```
## GD:0002698
## GD:0048017
## GO:0048839
## GO:0007219
## GD:0001959
## GD:0034764
## GD:0032680
## GO:0032640
## GO:1903555
                                                                                              regulation of
## GO:0002708
## GO:0009612
## GD:0042129
## GO:0002700
                                                                                                regulation
## GD:0071706
## GO:1902806
## GD:0031341
## GO:0007163
## GD:0060759
## GD:0007266
## GD:0002064
## GD:0043393
## GD:0032869
## GO:0060348
## GD:0002685
## GO:0019722
## GD:0050777
## GO:0043583
## GD:0007584
## GD:0042098
## GD:0097529
## GD:0002705
## GD:0050920
## GD:0006469
## GD:0070374
## GO:0030595
## GD:0050870
## GO:0051896
## GD:0001909
## GO:0046578
## GD:0050730
## GD:0033673
## GD:0098742
## GD:0002440
## GD:0031334
## GD:0090596
## GO:1903039
## GD:0032868
## GD:0043491
## GO:0050852
## GD:0000082
## GD:0048562
## GO:0051348
## GD:0018105
```

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## GD:0044843

```
## GO:1902105
## GO:0051146
## GD:0022409
## GO:0051251
## GO:0018209
## GO:0071375
## GD:0060326
## GO:0071496
## GD:0030336
## GO:0001818
## GD:0071356
## GO:0006470
## GD:0071902
## GD:0051056
## GD:2000146
## GO:0043405
## GD:0002696
## GD:0034612
## GO:0018108
## GO:0018212
## GO:0031346
## GD:0050867
## GO:0051098
## GD:0042692
## GO:0040013
## GD:0014706
## GO:0051271
## GO:1901653
## GO:0009913
## GD:0019216
## GD:0060537
## GD:0007517
## GO:0001933
## GO:0045088
## GD:0043434
## GD:0048568
## GO:0001558
## GO:0019932
## GO:0043254
## GD:0030099
## GO:0045785
## GD:0006644
## GD:0042326
##
              GeneRatio
                          BgRatio
                                         pvalue
                                                   p.adjust
## GD:0050853
                   3/14 67/20536 1.177538e-05 0.003781448 0.002020544
## GO:0042113
                   4/14 249/20536 1.919517e-05 0.003781448 0.002020544
## GO:0010522
                   3/14 104/20536 4.410113e-05 0.004729007 0.002526854
## GD:0002920
                   3/14 107/20536 4.801022e-05 0.004729007 0.002526854
## GD:0050864
                   3/14 120/20536 6.757610e-05 0.005324997 0.002845309
## GO:0030183
                   3/14 136/20536 9.803107e-05 0.006437374 0.003439687
                   2/14 25/20536 1.283188e-04 0.007222515 0.003859212
## GO:0002923
## GD:0016064
                   3/14 159/20536 1.557109e-04 0.007345566 0.003924962
## GD:0019724
                   3/14 169/20536 1.864357e-04 0.007345566 0.003924962
```

positive

3/14 169/20536 1.864357e-04 0.007345566 0.003924962

## GO:0060402

```
## GD:0060401
                   3/14 191/20536 2.673115e-04 0.009574613 0.005116010
## GD:0010524
                   2/14 54/20536 6.052058e-04 0.019870925 0.010617646
## GO:0051924
                   3/14 288/20536 8.859993e-04 0.024477424 0.013079040
## GO:0002712
                         72/20536 1.073447e-03 0.024477424 0.013079040
## GD:0002889
                         72/20536 1.073447e-03 0.024477424 0.013079040
                   2/14
                        74/20536 1.133459e-03 0.024477424 0.013079040
## GO:0050854
                   3/14 327/20536 1.278237e-03 0.024477424 0.013079040
## GD:0006959
## GO:0045123
                   2/14
                         81/20536 1.355948e-03 0.024477424 0.013079040
## GD:0002455
                         82/20536 1.389305e-03 0.024477424 0.013079040
## GD:0007204
                   3/14 337/20536 1.393878e-03 0.024477424 0.013079040
## GD:0046651
                   3/14 342/20536 1.454099e-03 0.024477424 0.013079040
                        84/20536 1.457196e-03 0.024477424 0.013079040
## GO:0051279
## GD:0032943
                   3/14 344/20536 1.478642e-03 0.024477424 0.013079040
## GD:0050851
                   3/14 345/20536 1.491011e-03 0.024477424 0.013079040
## GD:0002460
                   3/14 367/20536 1.779894e-03 0.027389529 0.014635068
## GD:0070661
                   3/14 370/20536 1.821815e-03 0.027389529 0.014635068
## GO:0051480
                   3/14 377/20536 1.922038e-03 0.027389529 0.014635068
## GD:0030098
                   3/14 383/20536 2.010652e-03 0.027389529 0.014635068
                   2/14 99/20536 2.015981e-03 0.027389529 0.014635068
## GO:0042100
## GD:0051260
                   3/14 415/20536 2.526611e-03 0.032775863 0.017513151
## GO:0007159
                   3/14 418/20536 2.578812e-03 0.032775863 0.017513151
## GO:0010959
                   3/14 434/20536 2.868597e-03 0.035319607 0.018872352
## GO:0002449
                   3/14 455/20536 3.278616e-03 0.038654132 0.020654091
                   2/14 132/20536 3.547265e-03 0.038654132 0.020654091
## GD:0051209
## GD:0051283
                   2/14 134/20536 3.653145e-03 0.038654132 0.020654091
## GO:0051928
                   2/14 134/20536 3.653145e-03 0.038654132 0.020654091
## GO:0051282
                   2/14 136/20536 3.760497e-03 0.038654132 0.020654091
## GD:0006816
                   3/14 483/20536 3.879290e-03 0.038654132 0.020654091
                   2/14 139/20536 3.924277e-03 0.038654132 0.020654091
## GO:0050868
## GO:0051208
                   2/14 139/20536 3.924277e-03 0.038654132 0.020654091
## GD:0006874
                   3/14 490/20536 4.039332e-03 0.038816995 0.020741114
## GO:0097553
                   2/14 150/20536 4.552869e-03 0.042710249 0.022821399
## GD:1903038
                   2/14 156/20536 4.914174e-03 0.045027547 0.024059603
                   2/14 161/20536 5.225112e-03 0.046788505 0.025000537
## GO:1903169
## GD:0001768
                         10/20536 6.797906e-03 0.055799475 0.029815375
                         10/20536 6.797906e-03 0.055799475 0.029815375
## GD:0002713
                   1/14
## GD:0002890
                         10/20536 6.797906e-03 0.055799475 0.029815375
## GO:0010918
                   1/14 10/20536 6.797906e-03 0.055799475 0.029815375
## GO:0051250
                   2/14 191/20536 7.275640e-03 0.058502087 0.031259464
                   1/14 11/20536 7.475331e-03 0.058905607 0.031475077
## GD:0001767
                   2/14 201/20536 8.028276e-03 0.059481793 0.031782951
## GO:0071248
## GO:0002921
                   1/14
                        12/20536 8.152327e-03 0.059481793 0.031782951
## GD:0060088
                   1/14 12/20536 8.152327e-03 0.059481793 0.031782951
                   1/14 12/20536 8.152327e-03 0.059481793 0.031782951
## GO:1904424
## GD:0002822
                   2/14 210/20536 8.734595e-03 0.062571462 0.033433856
## GO:0022408
                   2/14 218/20536 9.385196e-03 0.063474288 0.033916264
## GD:0002093
                   1/14
                         14/20536 9.505033e-03 0.063474288 0.033916264
## GO:0051712
                         14/20536 9.505033e-03 0.063474288 0.033916264
## GO:0072672
                   1/14 14/20536 9.505033e-03 0.063474288 0.033916264
## GD:0002695
                   2/14 223/20536 9.802599e-03 0.063497639 0.033928741
                   2/14 226/20536 1.005699e-02 0.063497639 0.033928741
## GO:0051651
## GO:0045838
                   1/14 15/20536 1.018074e-02 0.063497639 0.033928741
## GD:0051770
                   1/14 15/20536 1.018074e-02 0.063497639 0.033928741
## GO:0071241
                   2/14 229/20536 1.031434e-02 0.063497639 0.033928741
```

```
## GD:0002819
                   2/14 233/20536 1.066203e-02 0.064628324 0.034532901
                         16/20536 1.085603e-02 0.064807184 0.034628471
## GD:2000402
                   1/14
## GO:0051709
                         17/20536 1.153088e-02 0.067808461 0.036232146
## GD:0050866
                   2/14 247/20536 1.191973e-02 0.069064319 0.036903189
## GD:0002925
                         19/20536 1.287931e-02 0.072492100 0.038734758
                   1/14
                         19/20536 1.287931e-02 0.072492100 0.038734758
## GO:0060117
                         20/20536 1.355288e-02 0.073814512 0.039441363
## GD:0051767
## GO:0051769
                   1/14
                         20/20536 1.355288e-02 0.073814512 0.039441363
## GD:0050670
                   2/14 277/20536 1.482395e-02 0.073814512 0.039441363
## GD:0033622
                   1/14
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GD:0033630
                   1/14
                         22/20536 1.489874e-02 0.073814512 0.039441363
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GD:0045663
                   1/14
## GD:0071294
                   1/14
                         22/20536 1.489874e-02 0.073814512 0.039441363
                         22/20536 1.489874e-02 0.073814512 0.039441363
## GD:2000114
## GO:0032944
                   2/14 278/20536 1.492557e-02 0.073814512 0.039441363
## GO:0035855
                   1/14
                         23/20536 1.557104e-02 0.073814512 0.039441363
                         23/20536 1.557104e-02 0.073814512 0.039441363
## GD:0071467
                   1/14
## GD:0002706
                   2/14 286/20536 1.574957e-02 0.073814512 0.039441363
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0002693
                   1/14
## GD:0035024
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0050860
                   1/14
                         24/20536 1.624290e-02 0.073814512 0.039441363
                         24/20536 1.624290e-02 0.073814512 0.039441363
## GD:0090023
                   2/14 293/20536 1.648649e-02 0.073814512 0.039441363
## GO:0043270
                   2/14 293/20536 1.648649e-02 0.073814512 0.039441363
## GD:0070663
## GD:0030220
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GD:0032461
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GD:0032878
## GD:0071624
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
                   1/14
                         26/20536 1.758536e-02 0.074501423 0.039808401
## GO:1901741
## GD:0002335
                   1/14
                         27/20536 1.825595e-02 0.076270515 0.040753682
## GD:0036344
                   1/14
                         28/20536 1.892612e-02 0.076270515 0.040753682
## GO:0051000
                   1/14
                         28/20536 1.892612e-02 0.076270515 0.040753682
## GO:1901739
                   1/14
                         28/20536 1.892612e-02 0.076270515 0.040753682
## GO:0045577
                         29/20536 1.959586e-02 0.076270515 0.040753682
                   1/14
## GO:1902624
                   1/14
                         29/20536 1.959586e-02 0.076270515 0.040753682
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0051491
                   1/14
## GD:0060122
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0090022
                   1/14
                         30/20536 2.026517e-02 0.076270515 0.040753682
## GD:0007162
                   2/14 334/20536 2.109402e-02 0.076270515 0.040753682
                   2/14 338/20536 2.156957e-02 0.076270515 0.040753682
## GO:0051235
                         32/20536 2.160253e-02 0.076270515 0.040753682
## GO:0035590
## GO:0043552
                   1/14
                         32/20536 2.160253e-02 0.076270515 0.040753682
## GD:0070588
                   2/14 343/20536 2.217037e-02 0.076270515 0.040753682
## GD:0002922
                   1/14
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GO:0033198
                   1/14
                         33/20536 2.227057e-02 0.076270515 0.040753682
                   1/14
## GO:0048741
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GD:0050855
                   1/14
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GD:0050901
                         33/20536 2.227057e-02 0.076270515 0.040753682
## GO:0070372
                   2/14 344/20536 2.229137e-02 0.076270515 0.040753682
## GD:0001906
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
## GO:0071214
## GO:0104004
                   2/14 348/20536 2.277819e-02 0.076270515 0.040753682
                   2/14 349/20536 2.290060e-02 0.076270515 0.040753682
## GD:0002703
## GO:0050858
                   1/14 34/20536 2.293819e-02 0.076270515 0.040753682
```

```
## GD:0042491
                   1/14
                         35/20536 2.360539e-02 0.076270515 0.040753682
## GD:0060143
                         35/20536 2.360539e-02 0.076270515 0.040753682
                   1/14
## GD:0002699
                   2/14 356/20536 2.376521e-02 0.076270515 0.040753682
## GO:1904062
                   2/14 357/20536 2.388983e-02 0.076270515 0.040753682
## GO:0014904
                         36/20536 2.427217e-02 0.076270515 0.040753682
                   1/14
                         36/20536 2.427217e-02 0.076270515 0.040753682
## GO:0090218
                         36/20536 2.427217e-02 0.076270515 0.040753682
## GD:1902622
## GO:0070371
                   2/14 361/20536 2.439108e-02 0.076270515 0.040753682
## GD:0032770
                   1/14
                         37/20536 2.493852e-02 0.076763869 0.041017296
## GD:0060142
                         37/20536 2.493852e-02 0.076763869 0.041017296
## GD:0007596
                   2/14 369/20536 2.540671e-02 0.077598795 0.041463422
                   2/14 375/20536 2.617984e-02 0.077822257 0.041582825
## GD:0007599
  GO:0050817
                   2/14 375/20536 2.617984e-02 0.077822257 0.041582825
## GD:0002691
                         39/20536 2.626995e-02 0.077822257 0.041582825
## GD:0060338
                         39/20536 2.626995e-02 0.077822257 0.041582825
                   1/14
## GO:0051281
                   1/14
                         40/20536 2.693503e-02 0.079197038 0.042317413
                   2/14 384/20536 2.735767e-02 0.079256775 0.042349332
## GD:0010038
## GD:1903037
                   2/14 384/20536 2.735767e-02 0.079256775 0.042349332
                         41/20536 2.759970e-02 0.079374306 0.042412132
## GD:0070207
                   1/14
## GD:0009268
                         42/20536 2.826394e-02 0.080695584 0.043118132
## GD:0050863
                   2/14 393/20536 2.855702e-02 0.080833583 0.043191869
                         43/20536 2.892775e-02 0.080833583 0.043191869
## GO:0050856
                         43/20536 2.892775e-02 0.080833583 0.043191869
## GO:0060119
                   1/14
                         44/20536 2.959115e-02 0.082105028 0.043871241
## GD:0051489
                   1/14
## GD:0071622
                   1/14
                         45/20536 3.025413e-02 0.083357531 0.044540492
## GD:0010831
                   1/14
                         46/20536 3.091669e-02 0.084591487 0.045199833
## GO:0032459
                   1/14
                         47/20536 3.157882e-02 0.085219559 0.045535431
## GD:0098751
                   1/14
                         47/20536 3.157882e-02 0.085219559 0.045535431
                   1/14
                         48/20536 3.224054e-02 0.085829539 0.045861362
## GD:0033628
## GD:1903727
                   1/14
                         48/20536 3.224054e-02 0.085829539 0.045861362
## GD:0007520
                   1/14
                         49/20536 3.290183e-02 0.086422149 0.046178012
## GO:0016339
                   1/14
                         49/20536 3.290183e-02 0.086422149 0.046178012
## GD:0002639
                   1/14
                         50/20536 3.356271e-02 0.086998077 0.046485748
                         50/20536 3.356271e-02 0.086998077 0.046485748
## GO:0035315
                   1/14
## GD:0061756
                   1/14
                         52/20536 3.488320e-02 0.089829952 0.047998906
                         53/20536 3.554282e-02 0.090934237 0.048588959
## GD:0010043
                   1/14
## GD:0050850
                         54/20536 3.620202e-02 0.091433317 0.048855633
## GD:2000404
                   1/14
                         54/20536 3.620202e-02 0.091433317 0.048855633
## GO:0043547
                   2/14 457/20536 3.768336e-02 0.091527949 0.048906198
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GD:0002686
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0002714
## GO:0002891
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GD:0031295
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0043551
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GD:0046580
                   1/14
                         57/20536 3.817712e-02 0.091527949 0.048906198
## GO:0050732
                         57/20536 3.817712e-02 0.091527949 0.048906198
                   1/14
## GD:0042391
                   2/14 464/20536 3.874277e-02 0.091527949 0.048906198
## GD:0031294
                   1/14
                         58/20536 3.883464e-02 0.091527949 0.048906198
## GD:0002066
                   1/14
                         59/20536 3.949175e-02 0.091527949 0.048906198
## GD:0002823
                   1/14
                         59/20536 3.949175e-02 0.091527949 0.048906198
                         59/20536 3.949175e-02 0.091527949 0.048906198
## GD:0060113
                   1/14
## GD:0060563
                         59/20536 3.949175e-02 0.091527949 0.048906198
## GD:0035036
                   1/14
                         62/20536 4.146058e-02 0.094144112 0.050304094
## GO:0045661
                         62/20536 4.146058e-02 0.094144112 0.050304094
```

```
## GO:0051353
                   1/14
                         62/20536 4.146058e-02 0.094144112 0.050304094
                         63/20536 4.211603e-02 0.094144112 0.050304094
## GD:0032715
                   1/14
## GO:0051058
                         63/20536 4.211603e-02 0.094144112 0.050304094
## GO:0007265
                   2/14 489/20536 4.262051e-02 0.094144112 0.050304094
## GD:0030888
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
## GO:0046847
## GD:0050999
                   1/14
                         64/20536 4.277106e-02 0.094144112 0.050304094
## GO:0070527
                   1/14
                         65/20536 4.342567e-02 0.094388402 0.050434626
## GD:0000768
                   1/14
                         66/20536 4.407986e-02 0.094388402 0.050434626
## GO:0043550
                   1/14
                         66/20536 4.407986e-02 0.094388402 0.050434626
## GD:0046626
                   1/14
                         66/20536 4.407986e-02 0.094388402 0.050434626
                   1/14
## GO:0140253
                         66/20536 4.407986e-02 0.094388402 0.050434626
  GD:0006949
                   1/14
                         68/20536 4.538701e-02 0.096662061 0.051649512
## GD:0070206
                   1/14
                         69/20536 4.603996e-02 0.097155094 0.051912955
## GD:0010830
                         70/20536 4.669249e-02 0.097155094 0.051912955
                   1/14
## GD:0033627
                   1/14
                         70/20536 4.669249e-02 0.097155094 0.051912955
## GO:0002820
                   1/14
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GO:0042490
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GO:0048747
                         71/20536 4.734461e-02 0.097155094 0.051912955
                   1/14
## GO:1904427
                   1/14
                         71/20536 4.734461e-02 0.097155094 0.051912955
## GD:0030449
                   1/14
                         74/20536 4.929849e-02 0.100121681 0.053498093
                         74/20536 4.929849e-02 0.100121681 0.053498093
## GO:1900076
## GO:0002312
                   1/14
                         77/20536 5.124865e-02 0.102497298 0.054767458
                         77/20536 5.124865e-02 0.102497298 0.054767458
## GD:0042130
                   1/14
## GD:2000401
                   1/14
                         77/20536 5.124865e-02 0.102497298 0.054767458
## GD:0032768
                   1/14
                         78/20536 5.189788e-02 0.103271529 0.055181154
                   1/14
                         79/20536 5.254669e-02 0.103516977 0.055312304
## GD:0002637
## GD:0072678
                   1/14
                         79/20536 5.254669e-02 0.103516977 0.055312304
                   1/14
                         80/20536 5.319509e-02 0.103756760 0.055440427
## GO:0031640
## GO:0045454
                   1/14
                         80/20536 5.319509e-02 0.103756760 0.055440427
## GD:0071260
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                         81/20536 5.384308e-02 0.104503317 0.055839336
## GO:0051881
                   1/14
                         82/20536 5.449066e-02 0.104728384 0.055959596
## GO:0061515
                   1/14
                         82/20536 5.449066e-02 0.104728384 0.055959596
## GD:0009988
                   1/14
                         83/20536 5.513782e-02 0.105457777 0.056349333
  GD:0043407
                   1/14
                         84/20536 5.578458e-02 0.106179340 0.056734887
                         88/20536 5.836749e-02 0.110561489 0.059076404
## GD:0071277
                   1/14
## GD:0034109
                         89/20536 5.901219e-02 0.110718106 0.059160088
## GO:0051155
                   1/14
                         89/20536 5.901219e-02 0.110718106 0.059160088
                         92/20536 6.094383e-02 0.113800335 0.060807018
## GO:1903725
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                   1/14
                         93/20536 6.158690e-02 0.114458668 0.061158786
## GD:0032720
## GD:0006956
                   1/14
                         94/20536 6.222955e-02 0.115110063 0.061506846
                   1/14
                         95/20536 6.287180e-02 0.115754618 0.061851252
## GD:1903556
## GD:0045445
                   1/14
                         97/20536 6.415506e-02 0.117567884 0.062820136
## GD:0014068
                   1/14
                         99/20536 6.543670e-02 0.118266326 0.063193335
## GD:0032945
                   1/14
                         99/20536 6.543670e-02 0.118266326 0.063193335
                         99/20536 6.543670e-02 0.118266326 0.063193335
## GD:0050672
                   1/14
## GD:0030219
                   1/14 103/20536 6.799508e-02 0.122329046 0.065364171
## GD:0002690
                   1/14 104/20536 6.863366e-02 0.122916640 0.065678141
## GD:0060079
                   1/14 105/20536 6.927183e-02 0.122965984 0.065704506
## GD:0002707
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
## GD:0032091
## GD:0070664
                   1/14 106/20536 6.990959e-02 0.122965984 0.065704506
## GD:0042472
                   1/14 108/20536 7.118391e-02 0.124099382 0.066310116
## GO:0120034
                   1/14 108/20536 7.118391e-02 0.124099382 0.066310116
```

```
## GD:1990868
                   1/14 111/20536 7.309234e-02 0.126308696 0.067490620
                   1/14 111/20536 7.309234e-02 0.126308696 0.067490620
## GD:1990869
                   1/14 112/20536 7.372768e-02 0.126850238 0.067779983
## GO:0050848
## GD:0033138
                   1/14 113/20536 7.436261e-02 0.127386378 0.068066459
## GO:0099565
                   1/14 114/20536 7.499713e-02 0.127917186 0.068350086
                   1/14 115/20536 7.563125e-02 0.128442733 0.068630902
## GO:0035335
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
## GD:0002065
## GD:0002704
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
## GD:0030593
                   1/14 119/20536 7.816371e-02 0.131048940 0.070023479
## GD:0014902
                   1/14 122/20536 8.005882e-02 0.133093563 0.071115984
## GO:0051341
                   1/14 122/20536 8.005882e-02 0.133093563 0.071115984
## GO:0031343
                   1/14 124/20536 8.132022e-02 0.134622541 0.071932964
## GD:0051149
                   1/14 127/20536 8.320930e-02 0.137063268 0.073237119
## GO:0042471
                   1/14 128/20536 8.383819e-02 0.137063268 0.073237119
                   1/14 128/20536 8.383819e-02 0.137063268 0.073237119
## GO:1903828
## GD:0002377
                   1/14 129/20536 8.446668e-02 0.137520138 0.073481239
                   1/14 134/20536 8.760314e-02 0.142039664 0.075896160
## GO:1990266
## GD:0002688
                   1/14 135/20536 8.822924e-02 0.142468521 0.076125312
                   1/14 136/20536 8.885493e-02 0.142893236 0.076352250
## GO:0051153
## GD:0072676
                   1/14 137/20536 8.948023e-02 0.143313859 0.076577002
## GO:0071621
                   1/14 138/20536 9.010512e-02 0.143730440 0.076799594
                   1/14 139/20536 9.072962e-02 0.144143029 0.077020053
## GD:0046683
                   1/14 143/20536 9.322364e-02 0.146727713 0.078401129
## GD:0014066
                   1/14 143/20536 9.322364e-02 0.146727713 0.078401129
## GD:0030010
## GD:0060337
                   1/14 144/20536 9.384615e-02 0.146727713 0.078401129
## GD:0071357
                   1/14 144/20536 9.384615e-02 0.146727713 0.078401129
                   1/14 148/20536 9.633223e-02 0.149428734 0.079844368
## GO:0034340
## GD:1904064
                   1/14 148/20536 9.633223e-02 0.149428734 0.079844368
                   1/14 149/20536 9.695276e-02 0.149801517 0.080043557
## GO:0033135
## GD:0008286
                   1/14 151/20536 9.819263e-02 0.151124595 0.080750518
## GD:0060078
                   1/14 152/20536 9.881197e-02 0.151385676 0.080890022
## GD:0007605
                   1/14 153/20536 9.943092e-02 0.151385676 0.080890022
## GD:0002824
                   1/14 154/20536 1.000495e-01 0.151385676 0.080890022
## GO:0014074
                   1/14 154/20536 1.000495e-01 0.151385676 0.080890022
## GO:0045834
                   1/14 155/20536 1.006676e-01 0.151385676 0.080890022
                   1/14 155/20536 1.006676e-01 0.151385676 0.080890022
## GD:0051592
## GD:0071901
                   1/14 157/20536 1.019028e-01 0.151964651 0.081199386
## GD:0097530
                   1/14 157/20536 1.019028e-01 0.151964651 0.081199386
                   1/14 158/20536 1.025197e-01 0.151964651 0.081199386
## GD:0035023
                   1/14 159/20536 1.031363e-01 0.151964651 0.081199386
## GO:0002821
## GO:0050921
                   1/14 159/20536 1.031363e-01 0.151964651 0.081199386
                   1/14 160/20536 1.037525e-01 0.151964651 0.081199386
## GD:0002687
## GD:0034767
                   1/14 160/20536 1.037525e-01 0.151964651 0.081199386
                   1/14 163/20536 1.055987e-01 0.154095918 0.082338188
## GD:0007338
## GD:0002702
                   1/14 165/20536 1.068276e-01 0.154742877 0.082683878
                   1/14 165/20536 1.068276e-01 0.154742877 0.082683878
## GD:0008037
## GD:0014065
                   1/14 168/20536 1.086679e-01 0.156832057 0.083800191
## GD:0007519
                   1/14 171/20536 1.105047e-01 0.158900923 0.084905650
## GO:0050954
                   1/14 173/20536 1.117273e-01 0.160074731 0.085532851
## GD:1902600
                   1/14 176/20536 1.135582e-01 0.162108498 0.086619555
                   1/14 178/20536 1.147769e-01 0.163256706 0.087233078
## GD:0030168
## GO:0051100
                   1/14 179/20536 1.153857e-01 0.163532226 0.087380297
## GD:0060538
                   1/14 181/20536 1.166020e-01 0.164663806 0.087984935
## GO:0120032
                   1/14 186/20536 1.196361e-01 0.168246423 0.089899237
```

```
## GO:0051897
                   1/14 187/20536 1.202418e-01 0.168246423 0.089899237
                   1/14 188/20536 1.208470e-01 0.168246423 0.089899237
## GD:0032675
## GD:0060491
                   1/14 188/20536 1.208470e-01 0.168246423 0.089899237
## GD:0055002
                   1/14 189/20536 1.214519e-01 0.168493173 0.090031084
## GO:0002244
                   1/14 190/20536 1.220564e-01 0.168632356 0.090105454
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
## GD:0043409
## GD:0045619
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
## GO:0051099
                   1/14 192/20536 1.232643e-01 0.168632356 0.090105454
## GD:0042267
                   1/14 195/20536 1.250731e-01 0.170514907 0.091111358
## GD:0032635
                   1/14 197/20536 1.262771e-01 0.171562674 0.091671213
## GD:0009566
                   1/14 198/20536 1.268785e-01 0.171787395 0.091791288
                   1/14 199/20536 1.274795e-01 0.172010058 0.091910263
## GD:0002228
## GD:0051147
                   1/14 201/20536 1.286804e-01 0.172298463 0.092064367
## GD:2000045
                   1/14 201/20536 1.286804e-01 0.172298463 0.092064367
## GO:0002285
                   1/14 202/20536 1.292803e-01 0.172298463 0.092064367
## GO:0048015
                   1/14 203/20536 1.298798e-01 0.172298463 0.092064367
## GD:0055001
                   1/14 203/20536 1.298798e-01 0.172298463 0.092064367
## GD:0002698
                   1/14 204/20536 1.304789e-01 0.172512391 0.092178675
## GD:0048017
                   1/14 206/20536 1.316760e-01 0.172934459 0.092404199
## GD:0048839
                   1/14 206/20536 1.316760e-01 0.172934459 0.092404199
## GD:0007219
                   1/14 207/20536 1.322739e-01 0.173142638 0.092515436
                   1/14 209/20536 1.334687e-01 0.173553383 0.092734910
## GO:0001959
                   1/14 209/20536 1.334687e-01 0.173553383 0.092734910
## GO:0034764
## GD:0032680
                   1/14 210/20536 1.340655e-01 0.173755986 0.092843167
## GD:0032640
                   1/14 213/20536 1.358537e-01 0.174922719 0.093466588
## GO:1903555
                   1/14 213/20536 1.358537e-01 0.174922719 0.093466588
## GD:0002708
                   1/14 214/20536 1.364490e-01 0.175116924 0.093570357
## GD:0009612
                   1/14 215/20536 1.370439e-01 0.175309381 0.093673193
                   1/14 216/20536 1.376384e-01 0.175500107 0.093775104
## GO:0042129
## GD:0002700
                   1/14 217/20536 1.382326e-01 0.175689119 0.093876099
## GD:0071706
                   1/14 218/20536 1.388263e-01 0.175876433 0.093976187
## GO:1902806
                   1/14 219/20536 1.394197e-01 0.176062068 0.094075377
## GO:0031341
                   1/14 221/20536 1.406053e-01 0.176992029 0.094572284
## GO:0007163
                   1/14 222/20536 1.411976e-01 0.177171500 0.094668181
## GD:0060759
                   1/14 223/20536 1.417895e-01 0.177349357 0.094763215
                   1/14 225/20536 1.429721e-01 0.178262636 0.095251208
## GD:0007266
## GD:0002064
                   1/14 231/20536 1.465108e-01 0.181525957 0.096994901
## GD:0043393
                   1/14 231/20536 1.465108e-01 0.181525957 0.096994901
                   1/14 234/20536 1.482751e-01 0.182563683 0.097549390
## GD:0032869
                   1/14 234/20536 1.482751e-01 0.182563683 0.097549390
## GD:0060348
## GD:0002685
                   1/14 237/20536 1.500360e-01 0.183731070 0.098173161
                   1/14 238/20536 1.506222e-01 0.183731070 0.098173161
## GD:0019722
## GD:0050777
                   1/14 238/20536 1.506222e-01 0.183731070 0.098173161
                   1/14 240/20536 1.517935e-01 0.184588352 0.098631233
## GO:0043583
## GD:0007584
                   1/14 241/20536 1.523786e-01 0.184729692 0.098706755
                   1/14 244/20536 1.541316e-01 0.186281702 0.099536042
## GD:0042098
## GD:0097529
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## GD:0050870
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## GO:0051896
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## GD:0033673
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## GO:0098742
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## GD:0090596
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## GD:1903039
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## GD:0032868
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## GO:0043491
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## GO:0050852
## GD:0000082
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## GO:0050867
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## GO:0043434
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## GO:0001558
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## GO:0019722	ENSG00000083454
## GD:0050777	ENSG00000111679
## GD:0043583	ENSG00000111913
## GD:0007584	ENSG00000083454
## GD:0042098	ENSG00000111679
## GO:0097529	ENSG00000111913
## GO:0002705	ENSG00000104921
## GD:0050920	ENSG00000111913
## GD:0006469	ENSG00000111679
## GD:0070374	ENSG00000161929
## GO:0030595	ENSG00000111913
## GD:0050870	ENSG00000111679
## GD:0051896	ENSG00000177455
## GD:0001909	ENSG00000111679
## GD:0046578	ENSG00000111913
## GD:0050730	ENSG00000111679
## GD:0033673	ENSG00000111679
## GD:0098742	ENSG00000188404
## GD:0002440	ENSG00000170476
## GD:0031334	ENSG00000100721
## GD:0090596	ENSG00000111913
## GD:1903039	ENSG00000111679
## GD:0032868	ENSG00000170476
## GD:0043491	ENSG00000177455
## GD:0050852	ENSG00000111679
## GD:0000082	ENSG00000111679
## GD:0048562	ENSG00000111913
## GD:0051348	ENSG00000111679
## GD:0018105	ENSG00000100721
## GD:0044843	ENSG00000111679
## GD:1902105	ENSG00000111679
## GO:0051146	ENSG00000111913
## GD:0022409	ENSG00000111679
## GO:0051251	ENSG00000111679
## GD:0018209	ENSG0000100721
## GD:0071375	ENSG0000170476
## GD:0060326	ENSG00000111913
## GD:0071496	ENSG00000111913
## GD:0030336	ENSG00000111913
## GD:0001818 ## GD:0071356	ENSG00000111679
	ENSG00000100721 ENSG00000111679
## GD:0071902 ## GD:0051056	ENSG00000100721 ENSG00000111913
## GD:2000146	ENSG00000111913 ENSG00000111913
## G0:2000146 ## G0:0043405	ENSG00000111913 ENSG00000111679
## GD:0043405 ## GD:0002696	ENSG00000111679 ENSG00000111679
## GD:0002696 ## GD:0034612	ENSG00000111679 ENSG00000100721
## GD:0034612 ## GD:0018108	ENSG00000110721 ENSG00000111679
## GD:0018108 ## GD:0018212	ENSG00000111679 ENSG00000111679
## GU.UU10212	EN2G00000111013

##	GD:0031346	
##	GD:0050867	
##	GD:0051098	
##	GD:0042692	
	GD:0042032	
	GO:0040013	
	GO:0051271	
	GO:1901653	
	GO:0009913	
	GO:0019216	
	GO:0060537	
	GO:0007517	
##	GO:0001933	
##	GO:0045088	
##	GO:0043434	
##	GO:0048568	
##	GO:0001558	
##	GO:0019932	
##	GO:0043254	
##	GD:0030099	
##	GO:0045785	
##	GD:0006644	
##	GD:0042326	
##		Count
##	GO:0050853	3
##	GO:0042113	4
	GO:0010522	3
	GD:0002920	3
	GD:0050864	3
	GD:0030304	3
	GD:0002923	2
	GD:0002923	
		3
	GO:0019724	3
	GD:0060402	3
##	GD:0060401	3
##	GD:0010524	2
##	GO:0051924	3
##	GO:0002712	2
##	GD:0002889	2
##	GO:0050854	2
##	GD:0006959	3
##	GO:0045123	2
##	GO:0002455	2
##	GO:0007204	3
##	GO:0046651	3
##	GO:0051279	2
##	GO:0032943	3
##	GO:0050851	3
##	GO:0002460	3
##	GD:0070661	3
##	GO:0051480	3
##	GD:0030098	3
##	GD:0042100	2
		_

## GO:0051260

3

111

ENSG00000111913 ENSG00000111679 ENSG00000111913 ENSG00000111913 ENSG00000111913 ENSG00000111913 ENSG00000111913 ENSG00000170476 ENSG00000111913 ENSG00000177455 ENSG00000111913 ENSG00000111913 ENSG00000111679 ENSG00000111679 ENSG00000170476 ENSG00000111913 ENSG00000068831 ENSG00000083454 ENSG0000100721 ENSG00000111679 ENSG00000111679 ENSG00000177455 ENSG00000111679

```
## GO:0007159
                   3
## GO:0010959
                   3
## GO:0002449
                   3
## GO:0051209
                   2
## GO:0051283
                   2
## GO:0051928
                   2
## GO:0051282
                   2
## GO:0006816
                   3
## GD:0050868
                   2
## GO:0051208
                   2
## GD:0006874
                   3
                   2
## GO:0097553
## GO:1903038
                   2
                   2
## GO:1903169
## GO:0001768
                   1
## GO:0002713
                   1
## GD:0002890
                   1
## GO:0010918
                   1
## GO:0051250
                   2
## GO:0001767
                   1
## GO:0071248
                   2
## GO:0002921
                   1
## GD:0060088
                   1
## GO:1904424
                   1
## GO:0002822
                   2
## GD:0022408
                   2
## GO:0002093
                   1
## GO:0051712
                   1
## GO:0072672
                   1
## GD:0002695
                   2
                   2
## GO:0051651
## GD:0045838
                   1
## GO:0051770
                   1
## GO:0071241
                   2
                   2
## GD:0002819
## GD:2000402
                   1
## GO:0051709
## GO:0050866
                   2
## GD:0002925
                   1
## GO:0060117
                   1
## GO:0051767
                   1
## GO:0051769
                   1
## GD:0050670
                   2
## GD:0033622
                   1
## GD:0033630
                   1
## GO:0045663
                   1
## GD:0071294
                   1
## GO:2000114
                   1
## GO:0032944
                   2
## GO:0035855
                   1
## GD:0071467
                   1
## GD:0002706
                   2
## GD:0002693
                   1
## GO:0035024
                   1
```

```
## GD:0050860
                   1
## GD:0090023
                   1
## GO:0043270
                   2
## GD:0070663
                   2
## GD:0030220
                   1
## GO:0032461
                   1
## GD:0032878
                   1
## GO:0071624
                   1
## GO:1901741
                   1
## GD:0002335
                   1
## GO:0036344
                   1
## GO:0051000
                   1
## GO:1901739
                   1
## GO:0045577
                   1
## GO:1902624
                   1
## GO:0051491
                   1
## GO:0060122
                   1
## GD:0090022
                   1
## GD:0007162
                   2
                   2
## GO:0051235
## GO:0035590
                   1
## GO:0043552
                   1
## GO:0070588
                   2
## GD:0002922
                   1
## GO:0033198
                   1
## GO:0048741
                   1
## GO:0050855
                   1
## GD:0050901
                   1
                   2
## GO:0070372
## GD:0001906
                   2
                   2
## GO:0071214
## GD:0104004
                   2
                   2
## GO:0002703
## GO:0050858
                   1
## GD:0042491
                   1
## GO:0060143
                   1
## GD:0002699
## GO:1904062
                   2
## GD:0014904
                   1
## GO:0090218
                   1
## GO:1902622
                   1
## GO:0070371
                   2
## GD:0032770
                   1
## GD:0060142
                   1
## GD:0007596
                   2
                   2
## GO:0007599
## GD:0050817
                   2
## GD:0002691
                   1
## GO:0060338
                   1
## GO:0051281
                   1
## GO:0010038
                   2
## GO:1903037
                   2
## GD:0070207
                   1
## GD:0009268
                   1
```

```
## GD:0050863
                   2
## GO:0050856
                   1
## GO:0060119
## GO:0051489
                   1
## GO:0071622
                   1
## GO:0010831
                   1
## GD:0032459
                   1
## GD:0098751
                   1
## GD:0033628
                   1
## GO:1903727
                   1
## GO:0007520
                   1
## GO:0016339
                   1
## GD:0002639
                   1
## GO:0035315
                   1
## GO:0061756
                   1
## GO:0010043
                   1
## GO:0050850
                   1
## GD:2000404
                   1
## GD:0043547
                   2
## GD:0002686
                   1
## GO:0002714
                   1
## GO:0002891
                   1
## GO:0031295
                   1
## GD:0043551
                   1
## GO:0046580
                   1
## GO:0050732
                   1
## GO:0042391
                   2
## GO:0031294
                   1
## GD:0002066
                   1
## GD:0002823
                   1
## GO:0060113
                   1
## GD:0060563
                   1
## GO:0035036
                   1
## GD:0045661
                   1
## GO:0051353
                   1
## GO:0032715
                   1
## GO:0051058
                   1
## GO:0007265
                   2
## GD:0030888
                   1
## GD:0046847
                   1
## GD:0050999
                   1
## GO:0070527
                   1
## GD:0000768
                   1
## GO:0043550
                   1
## GD:0046626
                   1
## GO:0140253
                   1
## GD:0006949
                   1
## GO:0070206
                   1
## GD:0010830
                   1
## GD:0033627
                   1
## GO:0002820
                   1
## GO:0042490
                   1
## GO:0048747
                   1
## GO:1904427
                   1
```

```
## GD:0030449
                   1
## GD:1900076
                   1
## GO:0002312
## GO:0042130
                   1
## GO:2000401
                   1
## GD:0032768
                   1
## GD:0002637
                   1
## GO:0072678
                   1
## GO:0031640
                   1
## GO:0045454
                   1
## GO:0071260
                   1
## GO:0051881
                   1
## GO:0061515
                   1
## GO:0009988
                   1
## GO:0043407
                   1
## GO:0071277
                   1
## GO:0034109
                   1
## GO:0051155
                   1
## GO:1903725
                   1
## GO:0032720
                   1
## GD:0006956
                   1
## GO:1903556
                   1
## GO:0045445
                   1
## GD:0014068
                   1
## GO:0032945
                   1
## GD:0050672
                   1
## GO:0030219
                   1
## GD:0002690
                   1
## GO:0060079
                   1
## GD:0002707
                   1
## GD:0032091
                   1
## GD:0070664
                   1
## GO:0042472
                   1
## GO:0120034
                   1
## GO:1990868
                   1
## GO:1990869
                   1
## GO:0050848
                   1
## GO:0033138
                   1
## GD:0099565
                   1
## GO:0035335
                   1
## GD:0002065
                   1
## GO:0002704
                   1
## GD:0030593
                   1
## GD:0014902
                   1
## GO:0051341
                   1
## GO:0031343
                   1
## GO:0051149
                   1
## GO:0042471
                   1
## GO:1903828
                   1
## GD:0002377
                   1
## GO:1990266
                   1
## GD:0002688
                   1
## GO:0051153
                   1
## GD:0072676
                   1
```

```
## GO:0071621
                   1
## GO:0046683
                   1
## GO:0014066
## GO:0030010
                   1
## GD:0060337
                   1
## GO:0071357
                   1
## GD:0034340
                   1
## GO:1904064
                   1
## GO:0033135
                   1
## GD:0008286
                   1
## GD:0060078
                   1
## GD:0007605
                   1
## GD:0002824
                   1
## GO:0014074
                   1
## GO:0045834
                   1
## GO:0051592
                   1
## GD:0071901
                   1
## GD:0097530
                   1
## GO:0035023
                   1
## GO:0002821
                   1
## GD:0050921
                   1
## GD:0002687
                   1
## GO:0034767
                   1
## GD:0007338
                   1
## GD:0002702
                   1
## GD:0008037
                   1
## GO:0014065
                   1
## GD:0007519
                   1
## GO:0050954
                   1
## GO:1902600
                   1
## GO:0030168
                   1
## GO:0051100
                   1
## GO:0060538
                   1
## GD:0120032
                   1
## GD:0051897
                   1
## GO:0032675
                   1
## GO:0060491
                   1
## GO:0055002
                   1
## GD:0002244
                   1
## GO:0043409
                   1
## GO:0045619
                   1
## GO:0051099
                   1
## GD:0042267
                   1
## GO:0032635
                   1
## GD:0009566
                   1
## GD:0002228
                   1
## GO:0051147
                   1
## GO:2000045
                   1
## GO:0002285
                   1
## GO:0048015
                   1
## GD:0055001
                   1
## GD:0002698
                   1
## GD:0048017
                   1
## GD:0048839
                   1
```

```
## GD:0007219
                   1
## GO:0001959
                   1
## GO:0034764
## GD:0032680
                   1
## GD:0032640
                   1
## GO:1903555
                   1
## GD:0002708
                   1
## GD:0009612
                   1
## GO:0042129
                   1
## GD:0002700
                   1
## GO:0071706
                   1
## GO:1902806
                   1
## GO:0031341
                   1
## GO:0007163
                   1
## GD:0060759
                   1
## GD:0007266
                   1
## GD:0002064
                   1
## GD:0043393
                   1
## GD:0032869
                   1
## GD:0060348
                   1
## GO:0002685
                   1
## GO:0019722
                   1
## GO:0050777
                   1
## GD:0043583
                   1
## GO:0007584
                   1
## GD:0042098
                   1
## GO:0097529
                   1
## GD:0002705
                   1
## GO:0050920
                   1
## GD:0006469
                   1
## GO:0070374
                   1
## GD:0030595
                   1
## GO:0050870
                   1
## GO:0051896
                   1
## GD:0001909
                   1
## GO:0046578
                   1
## GO:0050730
## GD:0033673
                   1
## GD:0098742
                   1
## GD:0002440
                   1
## GO:0031334
                   1
## GO:0090596
                   1
## GD:1903039
                   1
## GD:0032868
                   1
## GD:0043491
                   1
## GO:0050852
                   1
## GD:0000082
                   1
## GO:0048562
                   1
## GO:0051348
                   1
## GO:0018105
                   1
## GO:0044843
                   1
## GO:1902105
                   1
## GO:0051146
                   1
## GO:0022409
                   1
```

```
## GO:0051251
                   1
## GD:0018209
                   1
## GO:0071375
                   1
## GD:0060326
                   1
  GO:0071496
                   1
## GD:0030336
                   1
## GD:0001818
                   1
## GO:0071356
                   1
  GD:0006470
                   1
## GO:0071902
                   1
## GO:0051056
                   1
## GO:2000146
                   1
## GD:0043405
                   1
## GD:0002696
                   1
## GD:0034612
                   1
## GO:0018108
## GO:0018212
                   1
## GD:0031346
                   1
## GD:0050867
                   1
## GO:0051098
## GD:0042692
                   1
## GO:0040013
                   1
## GO:0014706
                   1
## GO:0051271
                   1
## GO:1901653
                   1
## GD:0009913
                   1
## GO:0019216
                   1
## GD:0060537
                   1
## GO:0007517
                   1
## GD:0001933
                   1
## GD:0045088
## GD:0043434
                   1
## GD:0048568
                   1
## GO:0001558
                   1
## GD:0019932
## GD:0043254
                   1
## GD:0030099
                   1
## GO:0045785
                   1
## GD:0006644
                   1
## GO:0042326
```

Como podemos observar, la mayoría de los genes seleccionados como diferencialmente expresados en todas las comparaciones están relacionados directamente con la activación de funciones relacionadas con el sistema immuno como la vía del receptor de células B, su activación, diferenciación o regulación de la inmunidad humoral, lo que tiene sentido dadas las muestras utilizadas para el estudio.

Si a nivel más específico analizamos la comparación NIT vs ELI, observamos que los cambios entre muestras sin infiltraciones y aquellas con infiltraciones extensas son bastante grandes a nivel de "fold-changes" de expresión, representada mediante los datos de contaje. El nivel de veces que la expresión varia de un grupo a otro de muestras para los genes con un p-valor más significativo es de entre 4 a 8 veces menos expresión. Aplicando la significancia biológica de estas diferencias, observamos que estos cambios además se asocian con la regulación celular del calcio y, una vez más, la activación, diferenciación y señalización de células B.

```
## Coefficient: groupNIT
## genes logFC logCPM LR PValue FDR
```

```
## 48230 ENSG00000167483 -7.239925 3.774220 88.17577 5.988910e-21 1.161130e-16
## 3379 ENSG00000143297 -8.019151 4.609100 81.79179 1.512053e-19 1.465785e-15
## 49407 ENSG00000104894 -4.347653 5.494380 80.31945 3.185183e-19 1.880011e-15
## 49477 ENSG00000269404 -6.540817 2.628305 79.93021 3.878710e-19 1.880011e-15
## 25262 ENSG00000245164 -5.030760 3.572782 78.70927 7.195723e-19 2.790214e-15
## 45681 ENSG00000007312 -4.444605 3.977842 76.93160 1.769827e-18 5.718899e-15
            symbol
                      entrez
## 48230
            NIBAN3
                      199786
## 3379
             FCRL5
                       83416
## 49407
              CD37
                         951
## 49477
              SPIB
                        6689
## 25262 LINCO0861 100130231
## 45681
             CD79B
                         974
##
                      ID
## GD:0010524 GD:0010524
## GD:0050853 GD:0050853
## GO:0010522 GO:0010522
## G0:0051928 G0:0051928
## G0:0030183 G0:0030183
## GD:0060402 GD:0060402
## GD:0060401 GD:0060401
## G0:0042113 G0:0042113
## G0:0051924 G0:0051924
## GD:0043270 GD:0043270
## GD:0007204 GD:0007204
## GD:0050851 GD:0050851
## GO:0051480 GO:0051480
## GD:0030098 GD:0030098
## GD:0010959 GD:0010959
## GD:0006816 GD:0006816
## GD:0002335 GD:0002335
## G0:0006874 G0:0006874
## GD:0035590 GD:0035590
## GO:0043552 GO:0043552
## GD:0033198 GD:0033198
## GD:0050855 GD:0050855
## GD:0050901 GD:0050901
## GD:0090218 GD:0090218
## G0:0051281 G0:0051281
## GO:1903727 GO:1903727
## GD:0016339 GD:0016339
## GD:0061756 GD:0061756
## GD:0050850 GD:0050850
## GO:0043551 GO:0043551
## GD:0043550 GD:0043550
## GO:1904427 GO:1904427
## GD:0030449 GD:0030449
## GD:0050854 GD:0050854
## GD:0002312 GD:0002312
## G0:0045123 G0:0045123
## G0:0051279 G0:0051279
## GO:1903725 GO:1903725
## GD:0006956 GD:0006956
```

```
## GD:0042100 GD:0042100
## GD:0060079 GD:0060079
## GD:0002920 GD:0002920
## GD:0050848 GD:0050848
## GD:0099565 GD:0099565
## GD:0050864 GD:0050864
## GD:0051209 GD:0051209
## GD:0051283 GD:0051283
## GD:0051282 GD:0051282
## GD:0046683 GD:0046683
## GD:0051208 GD:0051208
## GO:1904064 GO:1904064
## GD:0097553 GD:0097553
## GD:0060078 GD:0060078
## GD:0014074 GD:0014074
## GO:0045834 GO:0045834
## GD:0016064 GD:0016064
## GD:0034767 GD:0034767
## GO:1903169 GO:1903169
## G0:0019724 G0:0019724
## GO:0051897 GO:0051897
## GD:0002285 GD:0002285
## GD:0034764 GD:0034764
## G0:0051651 G0:0051651
## GO:0019722 GO:0019722
## GD:0007584 GD:0007584
## GO:0051896 GO:0051896
## GD:0098742 GD:0098742
## GO:0043491 GO:0043491
## GD:0006959 GD:0006959
## GD:0051235 GD:0051235
## GD:0046651 GD:0046651
## GO:0070588 GO:0070588
## GD:0032943 GD:0032943
## GD:1904062 GD:1904062
## GD:0002460 GD:0002460
## GD:0007596 GD:0007596
## GD:0070661 GD:0070661
## GD:0007599 GD:0007599
## GD:0050817 GD:0050817
## GD:0051260 GD:0051260
## GD:0007159 GD:0007159
## GD:0019216 GD:0019216
## GD:0002449 GD:0002449
## GD:0043547 GD:0043547
## GD:0042391 GD:0042391
## GD:0019932 GD:0019932
## GD:0006644 GD:0006644
## GO:0010524
## GD:0050853
## GD:0010522
```

## GD:0051928

## GO:0030183

positive regulation of ca

B

regulation of ca

positive reg

cai	# GD:0060402	##
	# GD:0060401	##
	# GO:0042113	##
reg	# GO:0051924	
posi	# GO:0043270	
positive regulation of cyto	# GD:0007204	
antigen rec	# GD:0050851	
regulation of cyto	# GO:0051480	
regulation of eye	# GD:0030098	
r	# GD:0030030	
1	# GD:0006816	
	# GD:0002335	
	# GD:0006874	
purinergic nucle	# GO:0035590	
positive regulation of phosph	# GO:0043552	
	# GD:0033198	
regulation of B	# GO:0050855	
•••	# GO:0050901	
positive reg	# GO:0090218	
positive regulation of release of sequences	# GO:0051281	
positive regulation of	# GO:1903727	
calcium-dependent cell-cell adhesion via plasma	# GO:0016339	
leukocyte adhes	# GO:0061756	
positive regulati	# GO:0050850	
regulation of phosph	# GO:0043551	
reg	# GO:0043550	
positive regulation of cal-	# GO:1904427	
reg	# GO:0030449	
regulation of antigen rec	# GO:0050854	
B cell activa	# GD:0002312	
	# GO:0045123	
regulation of release of sequ	# GO:0051279	
regulation of	# GO:1903725	##
	# GD:0006956	##
	# GO:0042100	##
e:	# GO:0060079	
regul	# GD:0002920	##
regulation	# GO:0050848	##
chemical syn	# GO:0099565	##
	# GO:0050864	##
release of seque	# GO:0051209	##
negative regulation	# GO:0051283	##
regulation	# GO:0051282	##
_	# GO:0046683	##
	# GO:0051208	##
positive regulation of	# GO:1904064	##
calcium ion t	# GO:0097553	##
regulation of	# GD:0060078	##
respon	# GO:0014074	
positive regul	# GO:0045834	
immunog	# GD:0016064	
positive regulation	# GD:0034767	
regulation of cal	# GO:1903169	
10641401011 01 041	# GO:0019724	
	. 30.0010/24	H 11°

```
## GD:0051897
                                                                                        positive regulati
## GD:0002285
                                                                                        lymphocyte activa
## GO:0034764
                                                                                           positive regul
## GO:0051651
## GO:0019722
## GO:0007584
## GD:0051896
                                                                                                 regulati
## GO:0098742
                                                                                cell-cell adhesion via pl
## GD:0043491
## GO:0006959
## GO:0051235
## GD:0046651
## GD:0070588
                                                                                                      cal
## GD:0032943
## GO:1904062
                                                                                             regulation of
## G0:0002460 adaptive immune response based on somatic recombination of immune receptors built from im
## GD:0007596
## GD:0070661
## GD:0007599
## GD:0050817
## GO:0051260
## GO:0007159
## GO:0019216
                                                                                                    regul
## GD:0002449
## GO:0043547
                                                                                                   positi
## GD:0042391
## GO:0019932
                                                                                                       sec
  GD:0006644
              GeneRatio
                          BgRatio
                                        pvalue
                                                   p.adjust
## GO:0010524
                    2/6
                         54/20536 0.0001011151 0.006784535 0.002298451
## GD:0050853
                         67/20536 0.0001559663 0.006784535 0.002298451
## GO:0010522
                    2/6 104/20536 0.0003760038 0.010904109 0.003694072
## GO:0051928
                    2/6 134/20536 0.0006231347 0.011166944 0.003783115
                    2/6 136/20536 0.0006417784 0.011166944 0.003783115
## GO:0030183
## GD:0060402
                    2/6 169/20536 0.0009881922 0.014328787 0.004854277
                    2/6 191/20536 0.0012594678 0.015653385 0.005303022
## GD:0060401
## GO:0042113
                    2/6 249/20536 0.0021269893 0.023131008 0.007836276
## GO:0051924
                    2/6 288/20536 0.0028325467 0.025491110 0.008635827
## GO:0043270
                    2/6 293/20536 0.0029300127 0.025491110 0.008635827
## GD:0007204
                    2/6 337/20536 0.0038555893 0.029267310 0.009915120
                    2/6 345/20536 0.0040368704 0.029267310 0.009915120
## GO:0050851
## GO:0051480
                    2/6 377/20536 0.0048015169 0.030772418 0.010425018
## GD:0030098
                    2/6 383/20536 0.0049518833 0.030772418 0.010425018
## GO:0010959
                    2/6 434/20536 0.0063180887 0.036328624 0.012307338
## GD:0006816
                    2/6 483/20536 0.0077770168 0.036328624 0.012307338
## GO:0002335
                         27/20536 0.0078636564 0.036328624 0.012307338
## GD:0006874
                    2/6 490/20536 0.0079969637 0.036328624 0.012307338
                         32/20536 0.0093142186 0.036328624 0.012307338
## GD:0035590
## GD:0043552
                    1/6
                         32/20536 0.0093142186 0.036328624 0.012307338
## GD:0033198
                    1/6
                         33/20536 0.0096041189 0.036328624 0.012307338
                         33/20536 0.0096041189 0.036328624 0.012307338
## GO:0050855
                    1/6
## GO:0050901
                    1/6
                         33/20536 0.0096041189 0.036328624 0.012307338
## GD:0090218
                    1/6
                         36/20536 0.0104733955 0.037966059 0.012862065
## GO:0051281
                         40/20536 0.0116314419 0.040477418 0.013712858
```

```
## GO:1903727
                    1/6
                         48/20536 0.0139441467 0.045861623 0.015536908
                         49/20536 0.0142329174 0.045861623 0.015536908
## GD:0016339
                    1/6
## GD:0061756
                         52/20536 0.0150988069 0.046914150 0.015893481
  GO:0050850
                         54/20536 0.0156757143 0.047027143 0.015931760
                    1/6
  GO:0043551
                    1/6
                         57/20536 0.0165405474 0.047967587 0.016250362
                    1/6
                         66/20536 0.0191312485 0.053690923 0.018189302
## GO:0043550
## GD:1904427
                         71/20536 0.0205680677 0.054833841 0.018576498
## GO:0030449
                    1/6
                         74/20536 0.0214293170 0.054833841 0.018576498
  GO:0050854
                    1/6
                         74/20536 0.0214293170 0.054833841 0.018576498
## GD:0002312
                    1/6
                         77/20536 0.0222899351 0.055406410 0.018770472
## GO:0045123
                    1/6
                         81/20536 0.0234364448 0.056638075 0.019187733
## GO:0051279
                    1/6
                         84/20536 0.0242955915 0.057127472 0.019353530
  GO:1903725
                         92/20536 0.0265835708 0.060576241 0.020521896
                    1/6
## GD:0006956
                         94/20536 0.0271548665 0.060576241 0.020521896
                         99/20536 0.0285818833 0.062165596 0.021060335
## GD:0042100
## GD:0060079
                    1/6 105/20536 0.0302920006 0.063927355 0.021657180
  GD:0002920
                    1/6 107/20536 0.0308614819 0.063927355 0.021657180
  GO:0050848
                    1/6 112/20536 0.0322839659 0.064958297 0.022006441
## GD:0099565
                    1/6 114/20536 0.0328524721 0.064958297 0.022006441
## GO:0050864
                    1/6 120/20536 0.0345563211 0.066808888 0.022633380
  GO:0051209
                    1/6 132/20536 0.0379565156 0.069198712 0.023443000
                    1/6 134/20536 0.0385222433 0.069198712 0.023443000
## GO:0051283
## GO:0051282
                    1/6 136/20536 0.0390876937 0.069198712 0.023443000
                    1/6 139/20536 0.0399353497 0.069198712 0.023443000
## GD:0046683
## GD:0051208
                    1/6 139/20536 0.0399353497 0.069198712 0.023443000
  GD:1904064
                    1/6 148/20536 0.0424745798 0.069198712 0.023443000
## GO:0097553
                    1/6 150/20536 0.0430380925 0.069198712 0.023443000
  GD:0060078
                    1/6 152/20536 0.0436013287 0.069198712 0.023443000
                    1/6 154/20536 0.0441642887 0.069198712 0.023443000
## GO:0014074
## GD:0045834
                    1/6 155/20536 0.0444456651 0.069198712 0.023443000
## GD:0016064
                    1/6 159/20536 0.0455704807 0.069198712 0.023443000
  GD:0034767
                    1/6 160/20536 0.0458515121 0.069198712 0.023443000
  GO:1903169
                    1/6 161/20536 0.0461324745 0.069198712 0.023443000
## GO:0019724
                    1/6 169/20536 0.0483776932 0.071336598 0.024167269
  GO:0051897
                    1/6 187/20536 0.0534133372 0.077449339 0.026238131
                    1/6 202/20536 0.0575927262 0.082140446 0.027827374
## GD:0002285
## GD:0034764
                    1/6 209/20536 0.0595378386 0.083545032 0.028303217
## GO:0051651
                    1/6 226/20536 0.0642477588 0.088723096 0.030057431
                    1/6 238/20536 0.0675605600 0.091533679 0.031009595
## GO:0019722
                    1/6 241/20536 0.0683872313 0.091533679 0.031009595
## GD:0007584
  GD:0051896
                    1/6 264/20536 0.0747047784 0.098474481 0.033360986
                    1/6 284/20536 0.0801692393 0.104100355 0.035266908
## GD:0098742
## GD:0043491
                    1/6 292/20536 0.0823474803 0.105356335 0.035692406
                    1/6 327/20536 0.0918268131 0.114889497 0.038922031
## GD:0006959
## GO:0051235
                    1/6 338/20536 0.0947891230 0.114889497 0.038922031
                    1/6 342/20536 0.0958643282 0.114889497 0.038922031
## GO:0046651
## GO:0070588
                    1/6 343/20536 0.0961329631 0.114889497 0.038922031
## GD:0032943
                    1/6 344/20536 0.0964015316 0.114889497 0.038922031
## GD:1904062
                    1/6 357/20536 0.0998868741 0.115296180 0.039059807
## GD:0002460
                    1/6 367/20536 0.1025602770 0.115296180 0.039059807
                    1/6 369/20536 0.1030941627 0.115296180 0.039059807
## GD:0007596
## GO:0070661
                    1/6 370/20536 0.1033610063 0.115296180 0.039059807
## GD:0007599
                    1/6 375/20536 0.1046942322 0.115296180 0.039059807
## GO:0050817
                    1/6 375/20536 0.1046942322 0.115296180 0.039059807
```

```
## GD:0051260
                    1/6 415/20536 0.1153006901 0.124691337 0.042242679
## GD:0007159
                    1/6 418/20536 0.1160919346 0.124691337 0.042242679
  GD:0019216
                    1/6 429/20536 0.1189881210 0.126243494 0.042768516
## GD:0002449
                    1/6 455/20536 0.1258022307 0.130836160 0.044324410
  GO:0043547
                    1/6 457/20536 0.1263245686 0.130836160 0.044324410
                    1/6 464/20536 0.1281507035 0.131166014 0.044436157
##
  GO:0042391
                    1/6 478/20536 0.1317934321 0.133325914 0.045167884
  GO:0019932
                    1/6 489/20536 0.1346466704 0.134646670 0.045615327
## GD:0006644
                                        geneID Count
##
  GO:0010524 ENSG00000177455/ENSG00000083454
                                                    2
   GD:0050853 ENSG00000007312/ENSG00000177455
                                                    2
                                                    2
  GO:0010522 ENSG00000177455/ENSG00000083454
  GO:0051928 ENSG00000177455/ENSG00000083454
                                                    2
   GO:0030183 ENSG00000007312/ENSG00000177455
                                                    2
  GO:0060402 ENSG00000177455/ENSG00000083454
                                                    2
   GO:0060401 ENSG00000177455/ENSG00000083454
                                                    2
                                                    2
  GO:0042113 ENSG00000007312/ENSG00000177455
   GO:0051924 ENSG00000177455/ENSG00000083454
                                                    2
  GO:0043270 ENSG00000177455/ENSG00000083454
                                                    2
  GO:0007204 ENSG00000177455/ENSG00000083454
                                                    2
  GO:0050851 ENSG00000007312/ENSG00000177455
                                                    2
  GO:0051480 ENSG00000177455/ENSG00000083454
  GO:0030098 ENSG00000007312/ENSG00000177455
                                                    2
   GO:0010959 ENSG00000177455/ENSG00000083454
                                                    2
  GO:0006816 ENSG00000177455/ENSG00000083454
                                                    2
  GD:0002335
                               ENSG00000177455
                                                    1
  GO:0006874 ENSG00000177455/ENSG00000083454
                                                    2
  GD:0035590
                               ENSG00000083454
                                                    1
  GO:0043552
                               ENSG00000177455
                                                    1
  GO:0033198
                               ENSG00000083454
                                                    1
## GD:0050855
                               ENSG00000177455
                                                    1
  GO:0050901
                               ENSG00000188404
                                                    1
  GD:0090218
                               ENSG00000177455
                                                    1
## GO:0051281
                               ENSG00000177455
                                                    1
  GO:1903727
                               ENSG00000177455
                                                    1
##
  GD:0016339
                               ENSG00000188404
                                                    1
## GD:0061756
                               ENSG00000188404
## GO:0050850
                               ENSG00000083454
                                                    1
## GO:0043551
                               ENSG00000177455
                                                    1
## GO:0043550
                               ENSG00000177455
                                                    1
## GO:1904427
                               ENSG00000177455
                                                    1
## GO:0030449
                               ENSG00000177455
                                                    1
## GD:0050854
                               ENSG00000177455
                                                    1
## GO:0002312
                               ENSG00000177455
                                                    1
## GO:0045123
                               ENSG00000188404
                                                    1
## GO:0051279
                               ENSG00000177455
                                                    1
  GO:1903725
                               ENSG00000177455
                                                    1
## GD:0006956
                               ENSG00000177455
                                                    1
## GD:0042100
                               ENSG00000177455
                                                    1
## GD:0060079
                               ENSG00000083454
                                                    1
##
  GD:0002920
                               ENSG00000177455
                                                    1
## GO:0050848
                               ENSG00000083454
                                                    1
## GD:0099565
                               ENSG00000083454
                                                    1
## GO:0050864
                               ENSG00000177455
```

```
## GD:0051209
                                ENSG00000177455
                                                     1
  GO:0051283
                                                     1
                                ENSG00000177455
## GO:0051282
                                ENSG00000177455
                                                     1
## GD:0046683
                                ENSG00000083454
                                                     1
  GO:0051208
                                ENSG00000177455
                                                     1
##
  GD:1904064
                                ENSG00000177455
                                                     1
## GD:0097553
                                ENSG00000177455
                                                     1
## GD:0060078
                                ENSG00000083454
                                                     1
  GD:0014074
                                ENSG00000083454
                                                     1
## GO:0045834
                                ENSG00000177455
                                                     1
## GD:0016064
                                ENSG00000177455
                                                     1
## GD:0034767
                                ENSG00000177455
                                                     1
  GD:1903169
                                ENSG00000177455
                                                     1
## GD:0019724
                                ENSG00000177455
                                                     1
## GO:0051897
                                ENSG00000177455
                                                     1
  GO:0002285
                                ENSG00000177455
                                                     1
  GO:0034764
##
                                ENSG00000177455
                                                     1
  GO:0051651
                                ENSG00000177455
                                                     1
## GD:0019722
                                ENSG00000083454
                                                     1
## GD:0007584
                                ENSG00000083454
                                                     1
##
  GO:0051896
                                ENSG00000177455
                                                     1
## GO:0098742
                                ENSG00000188404
                                                     1
## GO:0043491
                                ENSG00000177455
                                                     1
  GD:0006959
                                ENSG00000177455
                                                     1
## GO:0051235
                                ENSG00000177455
                                                     1
  GD:0046651
                                ENSG00000177455
                                                     1
## GO:0070588
                                ENSG00000177455
                                                     1
  GD:0032943
                                ENSG00000177455
                                                     1
## GO:1904062
                                ENSG00000177455
                                                     1
## GD:0002460
                                ENSG00000177455
                                                     1
## GD:0007596
                                ENSG00000083454
                                                     1
##
  GD:0070661
                                ENSG00000177455
                                                     1
## GD:0007599
                                ENSG00000083454
                                                     1
## GD:0050817
                                ENSG00000083454
                                                     1
  GD:0051260
                                ENSG00000007312
                                                     1
  GD:0007159
##
                                ENSG00000188404
                                                     1
## GD:0019216
                                ENSG00000177455
                                                     1
## GD:0002449
                                ENSG00000177455
                                                     1
## GO:0043547
                                ENSG00000072818
                                                     1
## GO:0042391
                                ENSG00000083454
                                                     1
## GO:0019932
                                ENSG00000083454
                                                     1
## GD:0006644
                                ENSG00000177455
```

En cuanto a la siguiente comparación, de muestras con pequeñas y extensas infiltraciones observamos que la magnitud de la diferencia no es tan superior como en la anterior comparación así como el nivel de significatividad estadística de estas. De forma similar, el análisis de significancia biológica nos muestra cambios también a nivel de sistema immune, esta vez más centrados en la regulación de la respuesta humanoral, así como las células B, T y adhesión leucocitaria.

```
## Coefficient: groupSFI
## genes logFC logCPM LR PValue FDR
## 45499 ENSG00000265206 -3.948208 1.598581 49.19632 2.315850e-12 2.749481e-08
## 17962 ENSG00000111913 -2.308750 4.453070 48.35250 3.560898e-12 2.749481e-08
## 38705 ENSG00000100721 -6.993576 2.651936 47.60813 5.205218e-12 2.749481e-08
## 31641 ENSG00000068831 -2.656732 5.768233 47.43959 5.672543e-12 2.749481e-08
```

```
## 45681 ENSG00000007312 -3.254789 3.977842 45.57067 1.472298e-11 5.708982e-08
## 47726 ENSG00000104921 -5.149591 2.678307 42.84492 5.925564e-11 1.620990e-07
          symbol entrez
## 45499
           <NA>
                   <NA>
## 17962
         RIPOR2
                   9750
## 38705
           TCL1A
                   8115
## 31641 RASGRP2
                  10235
## 45681
           CD79B
                    974
## 47726
           FCER2
                   2208
##
                      ID
## GD:0002923 GD:0002923
## GD:0050853 GD:0050853
## GD:0002712 GD:0002712
## GD:0002889 GD:0002889
## GD:0051260 GD:0051260
## GD:0002455 GD:0002455
## GD:0002920 GD:0002920
## GD:0030183 GD:0030183
## GD:0050868 GD:0050868
## GD:1903038 GD:1903038
## GD:0016064 GD:0016064
## G0:0019724 G0:0019724
## GD:0051250 GD:0051250
## GD:0071248 GD:0071248
## GD:0002822 GD:0002822
## GD:0022408 GD:0022408
## GD:0002695 GD:0002695
## GD:0071241 GD:0071241
## GD:0002819 GD:0002819
## GD:0050866 GD:0050866
## GD:0001768 GD:0001768
## GD:0002713 GD:0002713
## GD:0002890 GD:0002890
## GD:0010918 GD:0010918
## GD:0042113 GD:0042113
## GD:0001767 GD:0001767
## GD:0002921 GD:0002921
## GD:0060088 GD:0060088
## GO:1904424 GO:1904424
## GD:0002706 GD:0002706
## GD:0002093 GD:0002093
## GO:0051712 GO:0051712
## GD:0072672 GD:0072672
## GD:0045838 GD:0045838
## GD:0051770 GD:0051770
## GD:2000402 GD:2000402
## GD:0051709 GD:0051709
## GD:0006959 GD:0006959
## GD:0007162 GD:0007162
## GD:0070372 GD:0070372
## GD:0050851 GD:0050851
## GD:0002925 GD:0002925
## G0:0060117 G0:0060117
```

```
## GD:0001906 GD:0001906
## GD:0071214 GD:0071214
## GO:0104004 GO:0104004
## GD:0002703 GD:0002703
## G0:0051767 G0:0051767
## G0:0051769 G0:0051769
## GD:0070371 GD:0070371
## GD:0002460 GD:0002460
## GD:0033630 GD:0033630
## GD:0045663 GD:0045663
## GD:0071294 GD:0071294
## GD:2000114 GD:2000114
## GD:0035855 GD:0035855
## GD:0071467 GD:0071467
## GD:0030098 GD:0030098
## GD:0010038 GD:0010038
## GD:1903037 GD:1903037
## GD:0002693 GD:0002693
## GD:0035024 GD:0035024
## GD:0050860 GD:0050860
## GD:0090023 GD:0090023
## GD:0050863 GD:0050863
## GD:0030220 GD:0030220
## GD:0032461 GD:0032461
## GD:0032878 GD:0032878
## GD:0071624 GD:0071624
## GO:1901741 GO:1901741
## GD:0007159 GD:0007159
## G0:0036344 G0:0036344
## GD:0051000 GD:0051000
## GO:1901739 GO:1901739
## G0:0045577 G0:0045577
## G0:1902624 G0:1902624
## GD:0051491 GD:0051491
## GD:0060122 GD:0060122
## GD:0090022 GD:0090022
## GD:0002449 GD:0002449
## GD:0002922 GD:0002922
## G0:0048741 G0:0048741
## GD:0050858 GD:0050858
## G0:0042491 G0:0042491
## GD:0060143 GD:0060143
## GD:0014904 GD:0014904
## GO:1902622 GO:1902622
## GD:0032770 GD:0032770
## GD:0060142 GD:0060142
## GD:0007265 GD:0007265
## GD:0002691 GD:0002691
## GD:0060338 GD:0060338
## GD:0070207 GD:0070207
## GD:0009268 GD:0009268
## GD:0050856 GD:0050856
## GD:0060119 GD:0060119
## GO:0051489 GO:0051489
```

```
## GD:0071622 GD:0071622
## G0:0010831 G0:0010831
## GO:0032459 GO:0032459
## GD:0098751 GD:0098751
## GD:0033628 GD:0033628
## GD:0007520 GD:0007520
## GD:0035315 GD:0035315
## GD:0010043 GD:0010043
## GD:2000404 GD:2000404
## GD:0002686 GD:0002686
## GD:0002714 GD:0002714
## G0:0002891 G0:0002891
## GD:0031295 GD:0031295
## GD:0046580 GD:0046580
## GD:0050732 GD:0050732
## GO:0031294 GO:0031294
## GD:0002066 GD:0002066
## GD:0002823 GD:0002823
## GD:0060113 GD:0060113
## GD:0060563 GD:0060563
## GD:0035036 GD:0035036
## G0:0045661 G0:0045661
## GO:0051353 GO:0051353
## GD:0032715 GD:0032715
## GD:0051058 GD:0051058
## GD:0046847 GD:0046847
## GO:0050999 GO:0050999
## GD:0070527 GD:0070527
## GD:0000768 GD:0000768
## GO:0140253 GO:0140253
## GD:0006949 GD:0006949
## GD:0070206 GD:0070206
## GD:0010830 GD:0010830
## GD:0033627 GD:0033627
## GD:0002820 GD:0002820
## GD:0042490 GD:0042490
## G0:0048747 G0:0048747
## GO:0050854 GO:0050854
## GD:0042130 GD:0042130
## G0:2000401 G0:2000401
## GD:0032768 GD:0032768
## GD:0072678 GD:0072678
## GD:0031640 GD:0031640
## GO:0045454 GO:0045454
## GD:0045123 GD:0045123
## GD:0071260 GD:0071260
## GD:0051881 GD:0051881
## GD:0061515 GD:0061515
## GD:0009988 GD:0009988
## G0:0043407 G0:0043407
## GD:0051279 GD:0051279
## G0:0071277 G0:0071277
## GD:0034109 GD:0034109
## GO:0051155 GO:0051155
```

```
## GD:0032720 GD:0032720
## GO:1903556 GO:1903556
## GO:0045445 GO:0045445
## GD:0014068 GD:0014068
## G0:0032945 G0:0032945
## GD:0050672 GD:0050672
## GD:0030219 GD:0030219
## GD:0002690 GD:0002690
## GD:0010522 GD:0010522
## GD:0002707 GD:0002707
## GD:0032091 GD:0032091
## GD:0070664 GD:0070664
## GD:0042472 GD:0042472
## GD:0120034 GD:0120034
## GD:1990868 GD:1990868
## GO:1990869 GO:1990869
## GD:0033138 GD:0033138
## GD:0035335 GD:0035335
## GD:0002065 GD:0002065
## GD:0002704 GD:0002704
## GD:0030593 GD:0030593
## GD:0050864 GD:0050864
## GD:0014902 GD:0014902
## G0:0051341 G0:0051341
## GD:0031343 GD:0031343
## G0:0051149 G0:0051149
## G0:0042471 G0:0042471
## GD:1903828 GD:1903828
## G0:0051209 G0:0051209
## GD:0051283 GD:0051283
## GD:1990266 GD:1990266
## GD:0002688 GD:0002688
## GO:0051153 GO:0051153
## GD:0051282 GD:0051282
## GD:0072676 GD:0072676
## GD:0071621 GD:0071621
## GD:0051208 GD:0051208
## GD:0014066 GD:0014066
## GD:0030010 GD:0030010
## GD:0060337 GD:0060337
## GO:0071357 GO:0071357
## GD:0034340 GD:0034340
## GD:0033135 GD:0033135
## GO:0097553 GO:0097553
## GD:0007605 GD:0007605
## G0:0002824 G0:0002824
## GD:0051592 GD:0051592
## GD:0071901 GD:0071901
## GD:0097530 GD:0097530
## GD:0035023 GD:0035023
## GD:0002821 GD:0002821
## G0:0050921 G0:0050921
## GD:0002687 GD:0002687
## GD:1903169 GD:1903169
```

```
## GD:0007338 GD:0007338
## GD:0008037 GD:0008037
## GD:0014065 GD:0014065
## GD:0060402 GD:0060402
## GD:0007519 GD:0007519
## G0:0050954 G0:0050954
## GD:1902600 GD:1902600
## GD:0030168 GD:0030168
## GD:0051100 GD:0051100
## GD:0060538 GD:0060538
## GD:0120032 GD:0120032
## GD:0032675 GD:0032675
## GD:0060491 GD:0060491
## GD:0055002 GD:0055002
## GD:0002244 GD:0002244
## G0:0060401 G0:0060401
## GD:0043409 GD:0043409
## GD:0045619 GD:0045619
## G0:0051099 G0:0051099
## GD:0042267 GD:0042267
## GD:0032635 GD:0032635
## GD:0009566 GD:0009566
## GD:0002228 GD:0002228
## G0:0051147 G0:0051147
## GD:2000045 GD:2000045
## GD:0048015 GD:0048015
## G0:0055001 G0:0055001
## GD:0002698 GD:0002698
## G0:0048017 G0:0048017
## GD:0048839 GD:0048839
## GD:0007219 GD:0007219
## GD:0001959 GD:0001959
## GD:0032680 GD:0032680
## GD:0032640 GD:0032640
## GO:1903555 GO:1903555
## GD:0002708 GD:0002708
## GD:0009612 GD:0009612
## G0:0042129 G0:0042129
## GD:0071706 GD:0071706
## GD:1902806 GD:1902806
## G0:0031341 G0:0031341
## GD:0007163 GD:0007163
## GD:0060759 GD:0060759
## GD:0007266 GD:0007266
## GD:0051651 GD:0051651
## GD:0002064 GD:0002064
## GD:0043393 GD:0043393
## GD:0060348 GD:0060348
## GD:0002685 GD:0002685
## GO:0050777 GO:0050777
## GD:0043583 GD:0043583
## GD:0042098 GD:0042098
## GD:0097529 GD:0097529
## GD:0002705 GD:0002705
```

```
## GD:0050920 GD:0050920
## GD:0006469 GD:0006469
## GD:0070374 GD:0070374
## GD:0030595 GD:0030595
## GD:0050870 GD:0050870
## GD:0001909 GD:0001909
## GD:0046578 GD:0046578
## GD:0050670 GD:0050670
## GD:0032944 GD:0032944
## GO:0050730 GO:0050730
## GD:0033673 GD:0033673
## GD:0031334 GD:0031334
## GD:0090596 GD:0090596
## GD:1903039 GD:1903039
## GD:0051924 GD:0051924
## GD:0070663 GD:0070663
## GD:0050852 GD:0050852
## GD:0000082 GD:0000082
## GD:0048562 GD:0048562
## GO:0051348 GO:0051348
## GO:0018105 GO:0018105
## GD:0044843 GD:0044843
## GO:1902105 GO:1902105
## GD:0051146 GD:0051146
## GD:0022409 GD:0022409
## G0:0051251 G0:0051251
## G0:0007204 G0:0007204
## GD:0018209 GD:0018209
## G0:0051235 G0:0051235
## GD:0046651 GD:0046651
## GD:0070588 GD:0070588
## GD:0032943 GD:0032943
## GD:0060326 GD:0060326
## GD:0002699 GD:0002699
## GD:1904062 GD:1904062
## GD:0071496 GD:0071496
## GD:0030336 GD:0030336
## GD:0001818 GD:0001818
## GD:0071356 GD:0071356
## GD:0006470 GD:0006470
## GD:0007596 GD:0007596
## GD:0070661 GD:0070661
## GD:0071902 GD:0071902
## GO:0007599 GO:0007599
## GD:0050817 GD:0050817
## GO:0051480 GO:0051480
## GD:0051056 GD:0051056
## GD:2000146 GD:2000146
## GD:0043405 GD:0043405
## GD:0002696 GD:0002696
## GD:0034612 GD:0034612
## GO:0018108 GO:0018108
## GD:0018212 GD:0018212
## GD:0031346 GD:0031346
```

```
## GD:0050867 GD:0050867
## GD:0051098 GD:0051098
## GD:0042692 GD:0042692
## G0:0040013 G0:0040013
## GD:0014706 GD:0014706
## G0:0051271 G0:0051271
## GD:0009913 GD:0009913
## GO:0010959 GO:0010959
## GD:0060537 GD:0060537
## G0:0007517 G0:0007517
## GD:0001933 GD:0001933
## GO:0043547 GO:0043547
## GD:0045088 GD:0045088
## G0:0042391 G0:0042391
## GD:0048568 GD:0048568
## GO:0001558 GO:0001558
## GD:0043254 GD:0043254
## GD:0006816 GD:0006816
## GD:0030099 GD:0030099
## GO:0045785 GO:0045785
## GD:0006874 GD:0006874
## GD:0042326 GD:0042326
##
## GD:0002923
                                                                                    regulation of humoral
## GD:0050853
## GO:0002712
## GD:0002889
## GD:0051260
## GO:0002455
                                                                                                  humoral
## GD:0002920
## GD:0030183
## GO:0050868
## GD:1903038
## GD:0016064
## GO:0019724
## GO:0051250
## GO:0071248
## GO:0002822
                       regulation of adaptive immune response based on somatic recombination of immune
## GD:0022408
## GD:0002695
## GO:0071241
## GD:0002819
## GD:0050866
## GO:0001768
## GD:0002713
## GD:0002890
                                                                                                   negativ
## GO:0010918
## GO:0042113
## GO:0001767
## GD:0002921
## GD:0060088
## GO:1904424
## GD:0002706
## GD:0002093
```

##	GD:0051712							pos
	GD:0072672							P s
	GD:0045838							
	GD:0051770						por	sitive re
	GD:2000402						1	
	GD:0051709							
	GD:0006959							
	GD:0007162							
	GD:0070372							
	GD:0050851							
	GD:0002925				positi	ve regulation	ı of	humoral
	GO:0060117				1	O		
	GD:0001906							
	GO:0071214							
	GO:0104004							
	GD:0002703							
##	GD:0051767							
	GO:0051769							r
	GD:0070371							
##	GD:0002460	adaptive immu	ne response	e based on	somatic	recombination	ı of	immune :
##	GD:0033630	-	-					pos
##	GD:0045663							-
##	GO:0071294							
##	GO:2000114							
##	GO:0035855							
##	GD:0071467							
##	GD:0030098							
##	GD:0010038							
##	GD:1903037							
##	GD:0002693							
##	GO:0035024							
##	GD:0050860							ne
##	GD:0090023							
##	GD:0050863							
##	GO:0030220							
##	GO:0032461							
##	GD:0032878							regui
##	GO:0071624							
	GO:1901741							
	GO:0007159							
	GD:0036344							
	GD:0051000							
	GO:1901739							
	GO:0045577							
	GO:1902624							
	G0:0051491							
	GO:0060122							
	GD:0090022							
	GO:0002449							
	G0:0002922							
	GD: 0048741							
шш	AND							- 4- 2

negative re

positive regu

## GD:0050858

## GO:0042491 ## GO:0060143

```
## GD:0014904
## GO:1902622
## GO:0032770
## GO:0060142
                                                                                                      regu
## GO:0007265
## GD:0002691
## GD:0060338
                                                                                                       reg
## GD:0070207
## GD:0009268
## GO:0050856
## GD:0060119
## GO:0051489
## GD:0071622
## GD:0010831
## GD:0032459
## GD:0098751
## GO:0033628
## GD:0007520
## GD:0035315
## GO:0010043
## GD:2000404
## GD:0002686
## GO:0002714
## GD:0002891
                                                                                                   positiv
## GD:0031295
## GD:0046580
## GD:0050732
                                                                                                         n
## GD:0031294
## GD:0002066
## G0:0002823 negative regulation of adaptive immune response based on somatic recombination of immune
## GD:0060113
## GO:0060563
## GD:0035036
## GO:0045661
## GO:0051353
## GO:0032715
## GO:0051058
                                                                                                 negative :
## GD:0046847
## GO:0050999
## GD:0070527
## GD:0000768
## GD:0140253
## GD:0006949
## GD:0070206
## GD:0010830
## GD:0033627
## GD:0002820
## GD:0042490
## GD:0048747
## GD:0050854
                                                                                                        re
## GD:0042130
## GD:2000401
## GO:0032768
## GD:0072678
```

```
## GD:0031640
## GO:0045454
## GO:0045123
## GO:0071260
## GO:0051881
## GO:0061515
## GD:0009988
## GD:0043407
## GO:0051279
## GD:0071277
## GD:0034109
## GO:0051155
## GD:0032720
## GO:1903556
## GO:0045445
## GO:0014068
## GO:0032945
## GD:0050672
## GD:0030219
## GD:0002690
## GD:0010522
## GD:0002707
## GO:0032091
## GD:0070664
## GO:0042472
## GD:0120034
## GD:1990868
## GD:1990869
## GO:0033138
## GD:0035335
## GD:0002065
## GO:0002704
## GO:0030593
## GO:0050864
## GD:0014902
## GO:0051341
## GO:0031343
## GO:0051149
## GD:0042471
## GO:1903828
## GD:0051209
## GD:0051283
## GO:1990266
## GD:0002688
## GO:0051153
## GO:0051282
## GD:0072676
## GD:0071621
## GO:0051208
## GD:0014066
## GD:0030010
```

regula

posi

positiv

negative regulation of

positive regulat

## G0:0060337 ## G0:0071357 ## G0:0034340

```
## GO:0033135
## GO:0097553
## GD:0007605
## G0:0002824 positive regulation of adaptive immune response based on somatic recombination of immune
## GO:0051592
## GD:0071901
                                                                                                  negative
## GD:0097530
## GD:0035023
## GD:0002821
## GD:0050921
## GD:0002687
## GD:1903169
## GD:0007338
## GD:0008037
## GD:0014065
## GD:0060402
## GO:0007519
## GO:0050954
## GD:1902600
## GO:0030168
## GO:0051100
## GD:0060538
## GO:0120032
                                                                                                   regulat
## GD:0032675
## GD:0060491
## GO:0055002
## GD:0002244
## GD:0060401
## GD:0043409
## GD:0045619
## GD:0051099
## GD:0042267
## GD:0032635
## GD:0009566
## GD:0002228
## GO:0051147
## GO:2000045
## GO:0048015
## GD:0055001
## GD:0002698
## GD:0048017
## GD:0048839
## GD:0007219
## GD:0001959
## GD:0032680
## GD:0032640
## GO:1903555
                                                                                              regulation of
## GD:0002708
## GD:0009612
## GD:0042129
## GO:0071706
## GD:1902806
## GD:0031341
## GD:0007163
```

```
## GD:0060759
## GD:0007266
## GO:0051651
## GO:0002064
## GO:0043393
## GD:0060348
## GD:0002685
## GD:0050777
## GO:0043583
## GO:0042098
## GD:0097529
## GD:0002705
## GD:0050920
## GD:0006469
## GD:0070374
## GO:0030595
## GO:0050870
## GD:0001909
## GO:0046578
## GO:0050670
## GD:0032944
## GD:0050730
## GD:0033673
## GD:0031334
## GO:0090596
## GD:1903039
## GO:0051924
## GD:0070663
## GO:0050852
## GD:0000082
## GO:0048562
## GO:0051348
## GD:0018105
## GO:0044843
## GO:1902105
## GO:0051146
## GO:0022409
## GO:0051251
## GO:0007204
## GO:0018209
## GO:0051235
## GD:0046651
## GO:0070588
## GD:0032943
## GD:0060326
## GD:0002699
## GD:1904062
## GO:0071496
## GD:0030336
## GO:0001818
## GO:0071356
## GD:0006470
## GO:0007596
```

## GO:0070661

pos

```
## GD:0071902
## GD:0007599
## GO:0050817
## GD:0051480
## GO:0051056
## GD:2000146
## GD:0043405
## GD:0002696
## GD:0034612
## GO:0018108
## GO:0018212
## GO:0031346
## GD:0050867
## GD:0051098
## GO:0042692
## GD:0040013
## GD:0014706
## GO:0051271
## GD:0009913
## GD:0010959
## GD:0060537
## GO:0007517
## GD:0001933
## GO:0043547
## GO:0045088
## GD:0042391
## GD:0048568
## GD:0001558
## GO:0043254
## GD:0006816
## GD:0030099
## GO:0045785
## GD:0006874
  GO:0042326
              GeneRatio
                          BgRatio
                                        pvalue
                                                  p.adjust
                                                                qvalue
## GD:0002923
                         25/20536 3.965998e-05 0.01328609 0.006512586
                    2/8
## GD:0050853
                         67/20536 2.899109e-04 0.02424197 0.011882948
## GO:0002712
                         72/20536 3.348214e-04 0.02424197 0.011882948
## GD:0002889
                         72/20536 3.348214e-04 0.02424197 0.011882948
                    3/8 415/20536 4.254425e-04 0.02424197 0.011882948
## GO:0051260
## GO:0002455
                         82/20536 4.341846e-04 0.02424197 0.011882948
## GD:0002920
                    2/8 107/20536 7.378153e-04 0.03530973 0.017308148
## GD:0030183
                    2/8 136/20536 1.187609e-03 0.04615756 0.022625542
## GO:0050868
                    2/8 139/20536 1.240054e-03 0.04615756 0.022625542
## GD:1903038
                    2/8 156/20536 1.557981e-03 0.04826631 0.023659212
## GO:0016064
                    2/8 159/20536 1.617729e-03 0.04826631 0.023659212
## GO:0019724
                    2/8 169/20536 1.824735e-03 0.04826631 0.023659212
## GD:0051250
                    2/8 191/20536 2.322338e-03 0.04826631 0.023659212
## GO:0071248
                    2/8 201/20536 2.567535e-03 0.04826631 0.023659212
## GO:0002822
                    2/8 210/20536 2.798290e-03 0.04826631 0.023659212
                    2/8 218/20536 3.011374e-03 0.04826631 0.023659212
## GD:0022408
## GD:0002695
                    2/8 223/20536 3.148344e-03 0.04826631 0.023659212
## GD:0071241
                    2/8 229/20536 3.316543e-03 0.04826631 0.023659212
## GD:0002819
                    2/8 233/20536 3.430994e-03 0.04826631 0.023659212
```

positive

```
## GD:0050866
                    2/8 247/20536 3.846097e-03 0.04826631 0.023659212
                         10/20536 3.889627e-03 0.04826631 0.023659212
## GD:0001768
                    1/8
## GD:0002713
                         10/20536 3.889627e-03 0.04826631 0.023659212
                         10/20536 3.889627e-03 0.04826631 0.023659212
## GD:0002890
                    1/8
  GD:0010918
                         10/20536 3.889627e-03 0.04826631 0.023659212
## GO:0042113
                    2/8 249/20536 3.907234e-03 0.04826631 0.023659212
## GD:0001767
                         11/20536 4.277861e-03 0.04826631 0.023659212
## GD:0002921
                    1/8
                         12/20536 4.665962e-03 0.04826631 0.023659212
## GD:0060088
                    1/8
                         12/20536 4.665962e-03 0.04826631 0.023659212
## GO:1904424
                    1/8
                         12/20536 4.665962e-03 0.04826631 0.023659212
## GD:0002706
                    2/8 286/20536 5.120224e-03 0.04826631 0.023659212
## GD:0002093
                         14/20536 5.441767e-03 0.04826631 0.023659212
  GO:0051712
                         14/20536 5.441767e-03 0.04826631 0.023659212
                    1/8
## GD:0072672
                         14/20536 5.441767e-03 0.04826631 0.023659212
## GO:0045838
                         15/20536 5.829471e-03 0.04826631 0.023659212
                    1/8
## GO:0051770
                         15/20536 5.829471e-03 0.04826631 0.023659212
## GO:2000402
                    1/8
                         16/20536 6.217043e-03 0.04826631 0.023659212
  GO:0051709
                         17/20536 6.604483e-03 0.04826631 0.023659212
## GD:0006959
                    2/8 327/20536 6.642967e-03 0.04826631 0.023659212
## GD:0007162
                    2/8 334/20536 6.921383e-03 0.04826631 0.023659212
## GD:0070372
                    2/8 344/20536 7.328335e-03 0.04826631 0.023659212
                    2/8 345/20536 7.369624e-03 0.04826631 0.023659212
## GO:0050851
                    1/8
## GD:0002925
                         19/20536 7.378966e-03 0.04826631 0.023659212
## GD:0060117
                         19/20536 7.378966e-03 0.04826631 0.023659212
## GD:0001906
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
## GD:0071214
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
                    2/8 348/20536 7.494138e-03 0.04826631 0.023659212
## GO:0104004
## GD:0002703
                    2/8 349/20536 7.535857e-03 0.04826631 0.023659212
                         20/20536 7.766009e-03 0.04826631 0.023659212
## GO:0051767
## GO:0051769
                         20/20536 7.766009e-03 0.04826631 0.023659212
## GD:0070371
                    2/8 361/20536 8.044854e-03 0.04826631 0.023659212
  GD:0002460
                    2/8 367/20536 8.305119e-03 0.04826631 0.023659212
## GD:0033630
                         22/20536 8.539700e-03 0.04826631 0.023659212
## GD:0045663
                    1/8
                         22/20536 8.539700e-03 0.04826631 0.023659212
  GD:0071294
                         22/20536 8.539700e-03 0.04826631 0.023659212
                    1/8
                         22/20536 8.539700e-03 0.04826631 0.023659212
## GD:2000114
## GD:0035855
                         23/20536 8.926347e-03 0.04826631 0.023659212
## GO:0071467
                         23/20536 8.926347e-03 0.04826631 0.023659212
                    2/8 383/20536 9.017812e-03 0.04826631 0.023659212
## GD:0030098
                    2/8 384/20536 9.063252e-03 0.04826631 0.023659212
## GO:0010038
## GO:1903037
                    2/8 384/20536 9.063252e-03 0.04826631 0.023659212
## GD:0002693
                         24/20536 9.312863e-03 0.04826631 0.023659212
## GD:0035024
                    1/8
                         24/20536 9.312863e-03 0.04826631 0.023659212
## GD:0050860
                         24/20536 9.312863e-03 0.04826631 0.023659212
                    1/8
## GD:0090023
                         24/20536 9.312863e-03 0.04826631 0.023659212
                    2/8 393/20536 9.476932e-03 0.04826631 0.023659212
## GO:0050863
## GD:0030220
                    1/8
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GD:0032461
                    1/8
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GD:0032878
                    1/8
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GD:0071624
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GO:1901741
                         26/20536 1.008550e-02 0.04826631 0.023659212
## GO:0007159
                    2/8 418/20536 1.067029e-02 0.04915267 0.024093690
## GD:0036344
                         28/20536 1.085761e-02 0.04915267 0.024093690
                    1/8
## GO:0051000
                         28/20536 1.085761e-02 0.04915267 0.024093690
```

```
## GD:1901739
                    1/8
                         28/20536 1.085761e-02 0.04915267 0.024093690
## GD:0045577
                         29/20536 1.124346e-02 0.04931364 0.024172592
                    1/8
## GO:1902624
                         29/20536 1.124346e-02 0.04931364 0.024172592
                    1/8
## GO:0051491
                         30/20536 1.162919e-02 0.04931364 0.024172592
  GO:0060122
                    1/8
                         30/20536 1.162919e-02 0.04931364 0.024172592
                         30/20536 1.162919e-02 0.04931364 0.024172592
## GD:0090022
                    1/8
## GD:0002449
                    2/8 455/20536 1.255408e-02 0.05223373 0.025603965
## GD:0002922
                    1/8
                         33/20536 1.278557e-02 0.05223373 0.025603965
  GD:0048741
                    1/8
                         33/20536 1.278557e-02 0.05223373 0.025603965
## GO:0050858
                    1/8
                         34/20536 1.317077e-02 0.05315912 0.026057574
## GO:0042491
                    1/8
                         35/20536 1.355583e-02 0.05342593 0.026188361
## GO:0060143
                    1/8
                         35/20536 1.355583e-02 0.05342593 0.026188361
  GD:0014904
                    1/8
                         36/20536 1.394077e-02 0.05362364 0.026285273
## GD:1902622
                    1/8
                         36/20536 1.394077e-02 0.05362364 0.026285273
## GD:0032770
                         37/20536 1.432557e-02 0.05362364 0.026285273
                    1/8
## GD:0060142
                         37/20536 1.432557e-02 0.05362364 0.026285273
  GO:0007265
                    2/8 489/20536 1.440635e-02 0.05362364 0.026285273
  GO:0002691
                         39/20536 1.509479e-02 0.05496471 0.026942638
                         39/20536 1.509479e-02 0.05496471 0.026942638
  GD:0060338
                    1/8
## GO:0070207
                         41/20536 1.586347e-02 0.05714262 0.028010208
##
  GO:0009268
                    1/8
                         42/20536 1.624762e-02 0.05790375 0.028383301
## GO:0050856
                         43/20536 1.663164e-02 0.05803748 0.028448852
## GD:0060119
                         43/20536 1.663164e-02 0.05803748 0.028448852
                    1/8
                         44/20536 1.701552e-02 0.05876494 0.028805440
  GD:0051489
                    1/8
## GO:0071622
                    1/8
                         45/20536 1.739927e-02 0.05947711 0.029154531
  GD:0010831
                    1/8
                         46/20536 1.778290e-02 0.06017445 0.029496352
## GO:0032459
                    1/8
                         47/20536 1.816639e-02 0.06025485 0.029535764
  GD:0098751
                    1/8
                         47/20536 1.816639e-02 0.06025485 0.029535764
                         48/20536 1.854975e-02 0.06092319 0.029863372
## GD:0033628
                    1/8
## GD:0007520
                         49/20536 1.893298e-02 0.06157813 0.030184410
                    1/8
## GD:0035315
                    1/8
                         50/20536 1.931608e-02 0.06222005 0.030499067
  GO:0010043
                    1/8
                         53/20536 2.046459e-02 0.06516201 0.031941158
  GD:2000404
                         54/20536 2.084716e-02 0.06516201 0.031941158
                         57/20536 2.199410e-02 0.06516201 0.031941158
## GD:0002686
                    1/8
  GO:0002714
                         57/20536 2.199410e-02 0.06516201 0.031941158
                         57/20536 2.199410e-02 0.06516201 0.031941158
  GD:0002891
                    1/8
## GD:0031295
                         57/20536 2.199410e-02 0.06516201 0.031941158
## GD:0046580
                         57/20536 2.199410e-02 0.06516201 0.031941158
                    1/8
## GO:0050732
                         57/20536 2.199410e-02 0.06516201 0.031941158
                    1/8
                         58/20536 2.237615e-02 0.06516201 0.031941158
## GO:0031294
                    1/8
                         59/20536 2.275808e-02 0.06516201 0.031941158
  GD:0002066
## GO:0002823
                    1/8
                         59/20536 2.275808e-02 0.06516201 0.031941158
## GD:0060113
                    1/8
                         59/20536 2.275808e-02 0.06516201 0.031941158
## GD:0060563
                         59/20536 2.275808e-02 0.06516201 0.031941158
                    1/8
## GD:0035036
                    1/8
                         62/20536 2.390306e-02 0.06663724 0.032664289
## GD:0045661
                         62/20536 2.390306e-02 0.06663724 0.032664289
                    1/8
  GO:0051353
                    1/8
                         62/20536 2.390306e-02 0.06663724 0.032664289
## GD:0032715
                    1/8
                         63/20536 2.428446e-02 0.06663724 0.032664289
## GO:0051058
                    1/8
                         63/20536 2.428446e-02 0.06663724 0.032664289
## GD:0046847
                    1/8
                         64/20536 2.466573e-02 0.06663724 0.032664289
                         64/20536 2.466573e-02 0.06663724 0.032664289
##
  GD:0050999
                    1/8
## GO:0070527
                         65/20536 2.504686e-02 0.06707352 0.032878145
## GD:0000768
                         66/20536 2.542787e-02 0.06707352 0.032878145
                    1/8
## GO:0140253
                         66/20536 2.542787e-02 0.06707352 0.032878145
```

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## GD:0006949
                         68/20536 2.618950e-02 0.06832740 0.033492773
## GD:0070206
                         69/20536 2.657012e-02 0.06832740 0.033492773
                    1/8
## GO:0010830
                         70/20536 2.695060e-02 0.06832740 0.033492773
## GD:0033627
                         70/20536 2.695060e-02 0.06832740 0.033492773
                    1/8
## GD:0002820
                         71/20536 2.733096e-02 0.06832740 0.033492773
## GD:0042490
                    1/8
                         71/20536 2.733096e-02 0.06832740 0.033492773
                         71/20536 2.733096e-02 0.06832740 0.033492773
## GD:0048747
## GO:0050854
                    1/8
                         74/20536 2.847125e-02 0.07065089 0.034631700
## GD:0042130
                    1/8
                         77/20536 2.961038e-02 0.07240493 0.035491499
## GD:2000401
                    1/8
                         77/20536 2.961038e-02 0.07240493 0.035491499
## GD:0032768
                    1/8
                         78/20536 2.998982e-02 0.07279045 0.035680473
                         79/20536 3.036914e-02 0.07279045 0.035680473
## GD:0072678
                    1/8
  GO:0031640
                    1/8
                         80/20536 3.074833e-02 0.07279045 0.035680473
## GD:0045454
                         80/20536 3.074833e-02 0.07279045 0.035680473
## GO:0045123
                         81/20536 3.112739e-02 0.07279045 0.035680473
                    1/8
## GD:0071260
                         81/20536 3.112739e-02 0.07279045 0.035680473
## GO:0051881
                         82/20536 3.150632e-02 0.07279045 0.035680473
                    1/8
  GO:0061515
                         82/20536 3.150632e-02 0.07279045 0.035680473
## GD:0009988
                         83/20536 3.188511e-02 0.07302951 0.035797654
                    1/8
## GD:0043407
                         84/20536 3.226378e-02 0.07302951 0.035797654
## GO:0051279
                    1/8
                         84/20536 3.226378e-02 0.07302951 0.035797654
                         88/20536 3.377716e-02 0.07577475 0.037143318
## GO:0071277
                         89/20536 3.415519e-02 0.07577475 0.037143318
## GO:0034109
                    1/8
## GD:0051155
                    1/8
                         89/20536 3.415519e-02 0.07577475 0.037143318
## GD:0032720
                    1/8
                         93/20536 3.566598e-02 0.07860594 0.038531111
## GO:1903556
                    1/8
                         95/20536 3.642060e-02 0.07974445 0.039089186
## GO:0045445
                         97/20536 3.717470e-02 0.08086704 0.039639463
                    1/8
## GD:0014068
                    1/8
                         99/20536 3.792829e-02 0.08092979 0.039670218
                         99/20536 3.792829e-02 0.08092979 0.039670218
## GO:0032945
## GD:0050672
                         99/20536 3.792829e-02 0.08092979 0.039670218
## GD:0030219
                    1/8 103/20536 3.943391e-02 0.08335218 0.040857630
## GD:0002690
                    1/8 104/20536 3.981000e-02 0.08335218 0.040857630
## GD:0010522
                    1/8 104/20536 3.981000e-02 0.08335218 0.040857630
## GD:0002707
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
  GO:0032091
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
                    1/8 106/20536 4.056178e-02 0.08336317 0.040863014
## GD:0070664
## GD:0042472
                    1/8 108/20536 4.131305e-02 0.08387801 0.041115377
## GO:0120034
                    1/8 108/20536 4.131305e-02 0.08387801 0.041115377
                    1/8 111/20536 4.243898e-02 0.08513209 0.041730106
## GO:1990868
                    1/8 111/20536 4.243898e-02 0.08513209 0.041730106
## GO:1990869
## GO:0033138
                    1/8 113/20536 4.318896e-02 0.08612085 0.042214776
                    1/8 115/20536 4.393843e-02 0.08709689 0.042693211
## GD:0035335
## GD:0002065
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
## GD:0002704
## GD:0030593
                    1/8 119/20536 4.543582e-02 0.08849419 0.043378140
                    1/8 120/20536 4.580985e-02 0.08870693 0.043482424
## GO:0050864
## GD:0014902
                    1/8 122/20536 4.655752e-02 0.08912439 0.043687055
## GO:0051341
                    1/8 122/20536 4.655752e-02 0.08912439 0.043687055
## GO:0031343
                    1/8 124/20536 4.730468e-02 0.09004015 0.044135941
## GO:0051149
                    1/8 127/20536 4.842445e-02 0.09132484 0.044765673
                    1/8 128/20536 4.879745e-02 0.09132484 0.044765673
## GO:0042471
## GO:1903828
                    1/8 128/20536 4.879745e-02 0.09132484 0.044765673
## GD:0051209
                    1/8 132/20536 5.028818e-02 0.09359190 0.045876939
## GO:0051283
                    1/8 134/20536 5.103278e-02 0.09375811 0.045958415
```

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## GD:1990266
                    1/8 134/20536 5.103278e-02 0.09375811 0.045958415
## GD:0002688
                    1/8 135/20536 5.140489e-02 0.09375811 0.045958415
## GO:0051153
                    1/8 136/20536 5.177687e-02 0.09375811 0.045958415
## GO:0051282
                    1/8 136/20536 5.177687e-02 0.09375811 0.045958415
## GD:0072676
                    1/8 137/20536 5.214872e-02 0.09392377 0.046039618
                    1/8 138/20536 5.252045e-02 0.09408743 0.046119839
## GO:0071621
                    1/8 139/20536 5.289204e-02 0.09424912 0.046199096
## GD:0051208
## GO:0014066
                    1/8 143/20536 5.437716e-02 0.09552406 0.046824046
## GD:0030010
                    1/8 143/20536 5.437716e-02 0.09552406 0.046824046
## GD:0060337
                    1/8 144/20536 5.474812e-02 0.09552406 0.046824046
## GO:0071357
                    1/8 144/20536 5.474812e-02 0.09552406 0.046824046
                    1/8 148/20536 5.623068e-02 0.09760248 0.047842849
## GO:0034340
## GD:0033135
                    1/8 149/20536 5.660100e-02 0.09773885 0.047909695
## GD:0097553
                    1/8 150/20536 5.697120e-02 0.09787360 0.047975748
## GD:0007605
                    1/8 153/20536 5.808103e-02 0.09927114 0.048660797
## GD:0002824
                    1/8 154/20536 5.845072e-02 0.09939589 0.048721943
## GO:0051592
                    1/8 155/20536 5.882028e-02 0.09950532 0.048775584
## GO:0071901
                    1/8 157/20536 5.955902e-02 0.09950532 0.048775584
                    1/8 157/20536 5.955902e-02 0.09950532 0.048775584
## GD:0097530
## GD:0035023
                    1/8 158/20536 5.992820e-02 0.09950532 0.048775584
## GO:0002821
                    1/8 159/20536 6.029725e-02 0.09950532 0.048775584
## GO:0050921
                    1/8 159/20536 6.029725e-02 0.09950532 0.048775584
                    1/8 160/20536 6.066618e-02 0.09962338 0.048833457
## GD:0002687
                    1/8 161/20536 6.103498e-02 0.09974009 0.048890664
## GD:1903169
## GD:0007338
                    1/8 163/20536 6.177220e-02 0.10045479 0.049240997
## GD:0008037
                    1/8 165/20536 6.250891e-02 0.10116177 0.049587543
## GD:0014065
                    1/8 168/20536 6.361303e-02 0.10245368 0.050220816
## GD:0060402
                    1/8 169/20536 6.398082e-02 0.10255299 0.050269495
                    1/8 171/20536 6.471602e-02 0.10323746 0.050605006
## GO:0007519
## GO:0050954
                    1/8 173/20536 6.545071e-02 0.10391463 0.050936944
## GD:1902600
                    1/8 176/20536 6.655180e-02 0.10516440 0.051549555
## GO:0030168
                    1/8 178/20536 6.728523e-02 0.10582418 0.051872968
## GO:0051100
                    1/8 179/20536 6.765175e-02 0.10590344 0.051911820
## GO:0060538
                    1/8 181/20536 6.838442e-02 0.10655247 0.052229963
## GO:0120032
                    1/8 186/20536 7.021390e-02 0.10828444 0.053078942
                    1/8 188/20536 7.094481e-02 0.10828444 0.053078942
## GD:0032675
## GD:0060491
                    1/8 188/20536 7.094481e-02 0.10828444 0.053078942
## GO:0055002
                    1/8 189/20536 7.131008e-02 0.10828444 0.053078942
## GO:0002244
                    1/8 190/20536 7.167522e-02 0.10828444 0.053078942
                    1/8 191/20536 7.204023e-02 0.10828444 0.053078942
## GO:0060401
## GD:0043409
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GO:0045619
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GD:0051099
                    1/8 192/20536 7.240512e-02 0.10828444 0.053078942
## GD:0042267
                    1/8 195/20536 7.349904e-02 0.10943190 0.053641402
## GD:0032635
                    1/8 197/20536 7.422769e-02 0.11002777 0.053933484
## GO:0009566
                    1/8 198/20536 7.459182e-02 0.11008044 0.053959306
## GD:0002228
                    1/8 199/20536 7.495583e-02 0.11013248 0.053984812
## GO:0051147
                    1/8 201/20536 7.568348e-02 0.11023464 0.054034889
## GD:2000045
                    1/8 201/20536 7.568348e-02 0.11023464 0.054034889
## GO:0048015
                    1/8 203/20536 7.641063e-02 0.11033431 0.054083748
                    1/8 203/20536 7.641063e-02 0.11033431 0.054083748
## GO:0055001
## GD:0002698
                    1/8 204/20536 7.677401e-02 0.11038324 0.054107730
## GD:0048017
                    1/8 206/20536 7.750041e-02 0.11047931 0.054154821
## GD:0048839
                    1/8 206/20536 7.750041e-02 0.11047931 0.054154821
```

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## GD:0007219
                    1/8 207/20536 7.786342e-02 0.11052646 0.054177937
## GD:0001959
                    1/8 209/20536 7.858906e-02 0.11108581 0.054452117
## GD:0032680
                    1/8 210/20536 7.895170e-02 0.11112949 0.054473530
## GD:0032640
                    1/8 213/20536 8.003886e-02 0.11172090 0.054763428
## GO:1903555
                    1/8 213/20536 8.003886e-02 0.11172090 0.054763428
                    1/8 214/20536 8.040099e-02 0.11176072 0.054782943
## GD:0002708
## GD:0009612
                    1/8 215/20536 8.076300e-02 0.11180003 0.054802212
## GO:0042129
                    1/8 216/20536 8.112489e-02 0.11183884 0.054821238
## GD:0071706
                    1/8 218/20536 8.184829e-02 0.11237368 0.055083404
## GD:1902806
                    1/8 219/20536 8.220980e-02 0.11240932 0.055100877
## GO:0031341
                    1/8 221/20536 8.293245e-02 0.11293647 0.055359276
## GD:0007163
                    1/8 222/20536 8.329359e-02 0.11296904 0.055375242
  GD:0060759
                    1/8 223/20536 8.365461e-02 0.11300118 0.055390996
## GD:0007266
                    1/8 225/20536 8.437626e-02 0.11351827 0.055644460
## GO:0051651
                    1/8 226/20536 8.473690e-02 0.11354745 0.055658767
## GD:0002064
                    1/8 231/20536 8.653825e-02 0.11504093 0.056390839
## GO:0043393
                    1/8 231/20536 8.653825e-02 0.11504093 0.056390839
## GD:0060348
                    1/8 234/20536 8.761757e-02 0.11601535 0.056868484
## GD:0002685
                    1/8 237/20536 8.869577e-02 0.11698064 0.057341647
## GD:0050777
                    1/8 238/20536 8.905492e-02 0.11699372 0.057348059
## GD:0043583
                    1/8 240/20536 8.977285e-02 0.11747619 0.057584559
                    1/8 244/20536 9.120723e-02 0.11888881 0.058276995
## GD:0042098
                    1/8 248/20536 9.263964e-02 0.12028445 0.058961113
## GO:0097529
                    1/8 250/20536 9.335510e-02 0.12028445 0.058961113
## GD:0002705
## GD:0050920
                    1/8 250/20536 9.335510e-02 0.12028445 0.058961113
## GD:0006469
                    1/8 259/20536 9.656856e-02 0.12347507 0.060525094
## GD:0070374
                    1/8 259/20536 9.656856e-02 0.12347507 0.060525094
## GD:0030595
                    1/8 263/20536 9.799357e-02 0.12434790 0.060952938
                    1/8 263/20536 9.799357e-02 0.12434790 0.060952938
## GO:0050870
## GD:0001909
                    1/8 271/20536 1.008377e-01 0.12699482 0.062250408
                    1/8 271/20536 1.008377e-01 0.12699482 0.062250408
## GD:0046578
## GO:0050670
                    1/8 277/20536 1.029656e-01 0.12911067 0.063287557
## GD:0032944
                    1/8 278/20536 1.033198e-01 0.12911067 0.063287557
## GO:0050730
                    1/8 279/20536 1.036739e-01 0.12911067 0.063287557
  GD:0033673
                    1/8 283/20536 1.050891e-01 0.13038837 0.063913861
                    1/8 286/20536 1.061492e-01 0.13064435 0.064039335
## GD:0031334
## GD:0090596
                    1/8 287/20536 1.065024e-01 0.13064435 0.064039335
## GO:1903039
                    1/8 287/20536 1.065024e-01 0.13064435 0.064039335
## GO:0051924
                    1/8 288/20536 1.068554e-01 0.13064435 0.064039335
                    1/8 293/20536 1.086186e-01 0.13226533 0.064833910
## GD:0070663
## GO:0050852
                    1/8 294/20536 1.089708e-01 0.13226533 0.064833910
## GD:0000082
                    1/8 298/20536 1.103787e-01 0.13349050 0.065434464
## GD:0048562
                    1/8 306/20536 1.131886e-01 0.13639636 0.066858859
## GO:0051348
                    1/8 313/20536 1.156409e-01 0.13877465 0.068024654
## GO:0018105
                    1/8 314/20536 1.159908e-01 0.13877465 0.068024654
## GO:0044843
                    1/8 317/20536 1.170396e-01 0.13945137 0.068356368
## GO:1902105
                    1/8 318/20536 1.173889e-01 0.13945137 0.068356368
## GD:0051146
                    1/8 320/20536 1.180873e-01 0.13978529 0.068520046
## GD:0022409
                    1/8 334/20536 1.229622e-01 0.14464409 0.070901736
## GO:0051251
                    1/8 335/20536 1.233095e-01 0.14464409 0.070901736
                    1/8 337/20536 1.240038e-01 0.14464409 0.070901736
## GD:0007204
## GO:0018209
                    1/8 337/20536 1.240038e-01 0.14464409 0.070901736
## GD:0051235
                    1/8 338/20536 1.243507e-01 0.14464409 0.070901736
## GO:0046651
                    1/8 342/20536 1.257373e-01 0.14554644 0.071344052
```

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## GD:0070588
                    1/8 343/20536 1.260837e-01 0.14554644 0.071344052
## GD:0032943
                    1/8 344/20536 1.264299e-01 0.14554644 0.071344052
## GD:0060326
                    1/8 353/20536 1.295405e-01 0.14861670 0.072849033
## GD:0002699
                    1/8 356/20536 1.305752e-01 0.14917745 0.073123905
  GO:1904062
                    1/8 357/20536 1.309199e-01 0.14917745 0.073123905
                    1/8 362/20536 1.326415e-01 0.15026993 0.073659417
## GO:0071496
## GD:0030336
                    1/8 363/20536 1.329854e-01 0.15026993 0.073659417
## GO:0001818
                    1/8 364/20536 1.333292e-01 0.15026993 0.073659417
  GD:0071356
                    1/8 365/20536 1.336730e-01 0.15026993 0.073659417
## GD:0006470
                    1/8 369/20536 1.350466e-01 0.15056445 0.073803783
## GD:0007596
                    1/8 369/20536 1.350466e-01 0.15056445 0.073803783
## GO:0070661
                    1/8 370/20536 1.353897e-01 0.15056445 0.073803783
  GD:0071902
                    1/8 371/20536 1.357327e-01 0.15056445 0.073803783
## GD:0007599
                    1/8 375/20536 1.371035e-01 0.15108448 0.074058691
## GO:0050817
                    1/8 375/20536 1.371035e-01 0.15108448 0.074058691
## GD:0051480
                    1/8 377/20536 1.377882e-01 0.15110183 0.074067196
  GO:0051056
                    1/8 378/20536 1.381304e-01 0.15110183 0.074067196
  GD:2000146
                    1/8 379/20536 1.384724e-01 0.15110183 0.074067196
                    1/8 381/20536 1.391562e-01 0.15135491 0.074191252
## GD:0043405
## GD:0002696
                    1/8 387/20536 1.412045e-01 0.15308580 0.075039700
## GO:0034612
                    1/8 394/20536 1.435889e-01 0.15516862 0.076060659
                    1/8 399/20536 1.452884e-01 0.15650041 0.076713475
## GO:0018108
## GO:0018212
                    1/8 402/20536 1.463068e-01 0.15709219 0.077003557
                    1/8 407/20536 1.480016e-01 0.15811863 0.077506699
  GD:0031346
## GD:0050867
                    1/8 409/20536 1.486787e-01 0.15811863 0.077506699
## GD:0051098
                    1/8 409/20536 1.486787e-01 0.15811863 0.077506699
## GD:0042692
                    1/8 414/20536 1.503694e-01 0.15926474 0.078068497
  GD:0040013
                    1/8 415/20536 1.507072e-01 0.15926474 0.078068497
                    1/8 417/20536 1.513825e-01 0.15932968 0.078100328
## GO:0014706
## GO:0051271
                    1/8 418/20536 1.517199e-01 0.15932968 0.078100328
## GD:0009913
                    1/8 424/20536 1.537421e-01 0.16094873 0.078893957
  GO:0010959
                    1/8 434/20536 1.571030e-01 0.16395483 0.080367488
## GD:0060537
                    1/8 436/20536 1.577738e-01 0.16414351 0.080459977
## GO:0007517
                    1/8 438/20536 1.584441e-01 0.16433054 0.080551656
  GD:0001933
                    1/8 456/20536 1.644559e-01 0.16985922 0.083261707
                    1/8 457/20536 1.647888e-01 0.16985922 0.083261707
## GD:0043547
## GD:0045088
                    1/8 459/20536 1.654542e-01 0.17002197 0.083341486
## GO:0042391
                    1/8 464/20536 1.671158e-01 0.17120421 0.083920995
## GO:0048568
                    1/8 466/20536 1.677796e-01 0.17136021 0.083997465
                    1/8 470/20536 1.691058e-01 0.17218976 0.084404094
## GO:0001558
  GD:0043254
                    1/8 479/20536 1.720830e-01 0.17469031 0.085629813
## GO:0006816
                    1/8 483/20536 1.734032e-01 0.17549871 0.086026075
  GD:0030099
                    1/8 487/20536 1.747216e-01 0.17610223 0.086321910
## GO:0045785
                    1/8 488/20536 1.750509e-01 0.17610223 0.086321910
  GD:0006874
                    1/8 490/20536 1.757091e-01 0.17623521 0.086387096
## GO:0042326
                    1/8 497/20536 1.780094e-01 0.17800945 0.087256790
                                                        geneID Count
## GD:0002923
                              ENSG00000104921/ENSG00000111679
                                                                   2
## GD:0050853
                              ENSG00000007312/ENSG00000111679
                                                                   2
## GD:0002712
                              ENSG00000104921/ENSG00000111679
                                                                   2
                                                                   2
  GD:0002889
                              ENSG00000104921/ENSG00000111679
## GD:0051260 ENSG00000111913/ENSG00000100721/ENSG00000007312
                                                                   3
                              ENSG00000104921/ENSG00000111679
## GD:0002455
                                                                   2
## GD:0002920
                              ENSG00000104921/ENSG00000111679
```

##	GO:0030183	ENSG00000007312/ENSG00000111679	2
##	GD:0050868	ENSG00000111913/ENSG00000111679	2
##	GO:1903038	ENSG00000111913/ENSG00000111679	2
	GD:0016064	ENSG00000104921/ENSG00000111679	2
##	GO:0019724	ENSG00000104921/ENSG00000111679	2
##	GO:0051250	ENSG00000111913/ENSG00000111679	2
##	GO:0071248	ENSG00000068831/ENSG00000122986	2
##	GD:0002822	ENSG00000104921/ENSG00000111679	2
##	GD:0022408	ENSG00000111913/ENSG00000111679	2
##	GD:0002695	ENSG00000111913/ENSG00000111679	2
##	GO:0071241	ENSG00000068831/ENSG00000122986	2
##	GD:0002819	ENSG00000104921/ENSG00000111679	2
##	GD:0050866	ENSG00000111913/ENSG00000111679	2
##	GO:0001768	ENSG00000111913	1
##	GO:0002713	ENSG00000111679	1
##	GO:0002890	ENSG00000111679	1
##	GO:0010918	ENSG00000100721	1
##	GO:0042113	ENSG00000007312/ENSG00000111679	2
##	GO:0001767	ENSG00000111913	1
##	GO:0002921	ENSG00000111679	1
##	GD:0060088	ENSG00000111913	1
##	GO:1904424	ENSG00000111913	1
##	GD:0002706	ENSG00000104921/ENSG00000111679	2
##	GD:0002093	ENSG00000111913	1
##	GO:0051712	ENSG00000104921	1
##	GD:0072672	ENSG00000111913	1
##	GO:0045838	ENSG00000100721	1
##	GO:0051770	ENSG00000104921	1
##	GD:2000402	ENSG00000111913	1
##	GO:0051709	ENSG00000104921	1
##	GD:0006959	ENSG00000104921/ENSG00000111679	2
##	GD:0007162	ENSG00000111913/ENSG00000111679	2
##	GD:0070372	ENSG00000161929/ENSG00000111679	2
##	GO:0050851	ENSG00000007312/ENSG00000111679	2
##	GD:0002925	ENSG00000104921	1
##	GO:0060117	ENSG00000111913	1
##	GD:0001906	ENSG00000104921/ENSG00000111679	2
##	GO:0071214	ENSG00000111913/ENSG00000122986	2
	GD:0104004	ENSG00000111913/ENSG00000122986	2
##	GD:0002703	ENSG00000104921/ENSG00000111679	2
##	GD:0051767	ENSG0000104921	1
##	GD:0051769	ENSG0000104921	1
##	GD:0070371	ENSG00000161929/ENSG00000111679	2
##	GD:0002460	ENSG00000104921/ENSG00000111679	2
##	GD:0033630	ENSG00000111679	1
##	GD:0045663	ENSG00000111913	1
##	GD:0071294	ENSG00000122986	1
	GD:2000114	ENSG00000111913	1
	GD:0035855	ENSG0000111679	1
	GD:0071467	ENSG00000122986	1
	GD:0030098	ENSG00000007312/ENSG00000111679	2
	GD:0010038	ENSG00000068831/ENSG00000122986	2
	GD:1903037	ENSG00000111913/ENSG00000111679	2
	GD:0002693	ENSG0000111913	1
		2110400000111010	-

##	GO:0035024	ENSG00000111913	1
	GD:0050860	ENSG00000111679	1
##	GD:0090023	ENSG00000111913	1
##	GD:0050863	ENSG00000111913/ENSG00000111679	2
	GD:0030220	ENSG00000111679	1
	GO:0032461	ENSG00000100721	1
	GO:0032878	ENSG00000111913	1
##	GO:0071624	ENSG00000111913	1
	GO:1901741	ENSG00000111913	1
	GO:0007159	ENSG00000111913/ENSG00000111679	2
	GO:0036344	ENSG00000111679	1
	GO:0051000	ENSG00000104921	1
##	GO:1901739	ENSG00000111913	1
	GO:0045577	ENSG00000111679	1
	GO:1902624	ENSG00000111913	1
	GO:0051491	ENSG00000111913	1
	GD:0060122	ENSG00000111913	1
	GD:0090022	ENSG00000111913	1
	GO:0002449	ENSG00000104921/ENSG00000111679	2
	GO:0002922	ENSG0000104921	1
##	GO:0048741	ENSG00000111913	1
##	GO:0050858	ENSG00000111679	1
##	GO:0042491	ENSG00000111913	1
##	GD:0060143	ENSG00000111913	1
	GO:0014904	ENSG00000111913	1
##	GO:1902622	ENSG00000111913	1
##	GO:0032770	ENSG00000104921	1
##	GO:0060142	ENSG00000111913	1
	GO:0007265	ENSG00000111913/ENSG00000068831	2
	GO:0002691	ENSG00000111913	1
	GD:0060338	ENSG00000111679	1
	GO:0070207	ENSG0000100721	1
	GD:0009268	ENSG00000122986	1
	GO:0050856	ENSG00000111679	1
	GO:0060119	ENSG00000111913	1
	GO:0051489	ENSG00000111913	1
	GO:0071622	ENSG00000111913	1
	GO:0010831	ENSG00000111913	1
	GO:0032459	ENSG00000100721	1
	GO:0098751	ENSG00000111679	1
	GD:0033628	ENSG00000111679	1
	GO:0007520	ENSG00000111913	1
	GO:0035315	ENSG00000111913	1
	GO:0010043	ENSG00000122986	1
	GD:2000404	ENSG00000111913	1
	GD:0002686	ENSG00000111913	1
	GO:0002714	ENSG00000104921	1
	GD:0002891	ENSG00000104921	1
	GO:0031295	ENSG00000111679	1
	GO:0046580	ENSG00000111913	1
	GO:0050732	ENSG00000111679	1
	GO:0031294	ENSG00000111679	1
	GD:0002066	ENSG00000111913	1
##	GD:0002823	ENSG00000111679	1

##	GD:0060113	ENSG00000111913	1
##	GD:0060563	ENSG00000111913	1
##	# GD:0035036 ENSG0000012298		1
##	# GD:0045661 ENSG000001119		1
##	ENSG000001049		1
##	GO:0032715	ENSG00000111679	1
##	GO:0051058	ENSG00000111913	1
##	GO:0046847	ENSG00000111913	1
##	GO:0050999	ENSG00000104921	1
##	GO:0070527	ENSG00000111679	1
	GD:0000768	ENSG00000111913	1
##	GO:0140253	ENSG00000111913	1
##	GO:0006949	ENSG00000111913	1
##	GO:0070206	ENSG00000100721	1
##	GD:0010830	ENSG00000111913	1
##	GD:0033627	ENSG00000111679	1
##	GD:0002820	ENSG00000111679	1
##	GO:0042490	ENSG00000111913	1
##	GO:0048747	ENSG00000111913	1
##	GO:0050854	ENSG00000111679	1
##	GO:0042130	ENSG00000111679	1
##	GO:2000401	ENSG00000111913	1
##	GD:0032768	ENSG00000104921	1
##	GD:0072678	ENSG00000111913	1
##	GO:0031640	ENSG00000104921	1
##	GO:0045454	ENSG00000122986	1
##	GO:0045123	ENSG00000111913	1
##	GO:0071260	ENSG00000111913	1
##	GO:0051881	ENSG00000100721	1
##	GO:0061515	ENSG00000111679	1
##	GD:0009988	ENSG00000122986	1
	GO:0043407	ENSG00000111679	1
	GO:0051279	ENSG00000111679	1
	GO:0071277	ENSG00000068831	1
##	GO:0034109	ENSG00000111679	1
##	GO:0051155	ENSG00000111913	1
	GO:0032720	ENSG00000111679	1
	GO:1903556	ENSG00000111679	1
	GO:0045445	ENSG00000111913	1
	GO:0014068	ENSG00000111679	1
	GO:0032945	ENSG00000111679	1
##	GO:0050672	ENSG00000111679	1
	GO:0030219	ENSG00000111679	1
##	GD:0002690	ENSG00000111913	1
##	GO:0010522	ENSG00000111679	1
	GO:0002707	ENSG00000111679	1
##	GO:0032091	ENSG00000111913	1
	GO:0070664	ENSG00000111679	1
	GO:0042472	ENSG00000111913	1
##	GO:0120034	ENSG00000111913	1
	GO:1990868	ENSG00000111913	1
	GO:1990869	ENSG00000111913	1
	GO:0033138	ENSG00000100721	1
##	GO:0035335	ENSG00000111679	1

##	GO:0002065	ENSG00000111913	1
	GO:0002704	ENSG00000111679	1
##	# GD:0030593 ENSG000001119		1
	# GD:0050864 ENSG000001116		1
	ENSG000001119		1
	GO:0051341	ENSG00000104921	1
	GO:0031343	ENSG00000104921	1
	GO:0051149	ENSG00000111913	1
	GO:0042471	ENSG00000111913	1
	GO:1903828	ENSG00000111913	1
	GO:0051209	ENSG00000111679	1
	GO:0051283	ENSG00000111679	1
	GO:1990266	ENSG00000111913	1
	GD:0002688	ENSG00000111913	1
	GO:0051153	ENSG00000111913	1
	GO:0051282	ENSG00000111679	1
	GO:0072676	ENSG00000111913	1
	GO:0071621	ENSG00000111913	1
	GO:0051208	ENSG00000111679	1
	GO:0014066	ENSG00000111679	1
	GO:0030010	ENSG00000111913	1
	GD:0060337	ENSG00000111679	1
	GO:0071357	ENSG00000111679	1
##	GO:0034340	ENSG00000111679	1
##	GO:0033135	ENSG00000100721	1
##	GO:0097553	ENSG00000111679	1
	GO:0007605	ENSG00000111913	1
##	GO:0002824	ENSG00000104921	1
	GO:0051592	ENSG00000068831	1
##	GO:0071901	ENSG00000111679	1
	GO:0097530	ENSG00000111913	1
	GO:0035023	ENSG00000111913	1
	GD:0002821	ENSG00000104921	1
##	GO:0050921	ENSG00000111913	1
	GD:0002687	ENSG00000111913	1
	GO:1903169	ENSG00000111679	1
	GO:0007338	ENSG00000122986	1
	GD:0008037	ENSG00000122986	1
	GO:0014065	ENSG00000111679	1
	GD:0060402	ENSG00000111679	1
	GO:0007519	ENSG00000111913	1
	GO:0050954	ENSG00000111913	1
	GO:1902600	ENSG00000122986	1
	GD:0030168	ENSG00000111679	1
##	GO:0051100	ENSG00000111913	1
##	GD:0060538	ENSG00000111913	1
	GO:0120032	ENSG00000111913	1
##	GD:0032675	ENSG00000111679	1
##	GD:0060491	ENSG00000111913	1
	GD: 0055002	ENSG00000111913	1
	GD:0002244	ENSG00000111679	1
	GD:0060401	ENSG00000111679	1
	GD: 0043409	ENSG00000111679	1
##	GD:0045619	ENSG00000111679	1

##	GO:0051099	ENSG00000111913	1
##	GO:0042267	ENSG00000111679	1
##	‡ GD:0032635 ENSG000001116		1
##	# GO:0009566 ENSG000001229		1
##	ENSG000001116		1
##	GO:0051147	ENSG00000111913	1
##	GO:2000045	ENSG00000111679	1
##	GO:0048015	ENSG00000111679	1
##	GO:0055001	ENSG00000111913	1
##	GO:0002698	ENSG00000111679	1
##	GO:0048017	ENSG00000111679	1
##	GO:0048839	ENSG00000111913	1
##	GO:0007219	ENSG00000104921	1
##	GD:0001959	ENSG00000111679	1
##	GD:0032680	ENSG00000111679	1
##	GD:0032640	ENSG00000111679	1
##	GO:1903555	ENSG00000111679	1
##	GO:0002708	ENSG00000104921	1
##	GD:0009612	ENSG00000111913	1
##	GD:0042129	ENSG00000111679	1
##	GD:0071706	ENSG00000111679	1
##	GD:1902806	ENSG00000111679	1
##	GO:0031341	ENSG00000104921	1
##	GO:0007163	ENSG00000111913	1
##	GD:0060759	ENSG00000111679	1
##	GD:0007266	ENSG00000111913	1
##	GO:0051651	ENSG00000111679	1
##	GD:0002064	ENSG00000111913	1
##	GD:0043393	ENSG00000111913	1
##	GD:0060348	ENSG00000111679	1
##	GD:0002685	ENSG00000111913	1
##	GO:0050777	ENSG00000111679	1
##	GD:0043583	ENSG00000111913	1
##	GO:0042098	ENSG00000111679	1
##	GD:0097529	ENSG00000111913	1
##	GO:0002705	ENSG00000104921	1
##	GO:0050920	ENSG00000111913	1
##	GD:0006469	ENSG00000111679	1
##	GO:0070374	ENSG00000161929	1
##	GO:0030595	ENSG00000111913	1
##	GO:0050870	ENSG00000111679	1
##	GO:0001909	ENSG00000111679	1
##	GO:0046578	ENSG00000111913	1
##	GO:0050670	ENSG00000111679	1
##	GO:0032944	ENSG00000111679	1
##	GO:0050730	ENSG00000111679	1
##	GD:0033673	ENSG00000111679	1
##	GD:0031334	ENSG00000100721	1
##	GD:0090596	ENSG00000111913	1
##	GD:1903039	ENSG00000111679	1
##	GO:0051924	ENSG00000111679	1
##	GD:0070663	ENSG00000111679	1
##	GD:0050852	ENSG00000111679	1
##	GD:0000082	ENSG00000111679	1

	GO:0048562	ENSG00000111913	1
##	GO:0051348	ENSG00000111679	1
##	GD:0018105 ENSG0000010072		1
##	GO:0044843 ENSG0000011167		1
##	GO:1902105 ENSG00000111679		1
##	GO:0051146 ENSG00000111913		1
##	GD:0022409 ENSG00000111679		1
##	GO:0051251	ENSG00000111679	1
##	GD:0007204 ENSG0000011167		1
##	GO:0018209	ENSG00000100721	1
##	GO:0051235	ENSG00000111679	1
##	GO:0046651	ENSG00000111679	1
##	GO:0070588	ENSG00000111679	1
##	GD:0032943	ENSG00000111679	1
##	GD:0060326	ENSG00000111913	1
##	GD:0002699	ENSG00000104921	1
##	GD:1904062	ENSG00000111679	1
	GD:0071496	ENSG00000111913	1
	GD:0030336	ENSG00000111913	1
	GD:0001818	ENSG00000111679	1
	GD:0071356	ENSG00000100721	1
	GD:0006470	ENSG00000111679	1
	GD:0007596	ENSG00000111679	1
	GD:0070661	ENSG00000111679	1
	GD:0071902	ENSG00000111073	1
	GD:0007599	ENSG00000100721 ENSG00000111679	1
	GD:0050817	ENSG00000111679	1
	GD:0051480	ENSG00000111679	1
	GD:0051480	ENSG00000111079 ENSG00000111913	1
	GD:2000146	ENSG00000111913	1
		ENSG00000111913	
	GD:0043405		1
	GD: 0002696	ENSG00000111679 ENSG00000100721	1
	GD:0034612		1
	GD:0018108	ENSG00000111679	1
	GO:0018212	ENSG00000111679	1
	GO:0031346	ENSG00000111913	1
	GD:0050867	ENSG00000111679	1
	GD:0051098	ENSG00000111913	1
	GD:0042692	ENSG00000111913	1
	GD:0040013	ENSG00000111913	1
	G0:0014706	ENSG00000111913	1
	GO:0051271	ENSG00000111913	1
	GD:0009913	ENSG00000111913	1
##	GO:0010959	ENSG00000111679	1
##	GD:0060537	ENSG00000111913	1
##	GO:0007517	ENSG00000111913	1
##	GD:0001933	ENSG00000111679	1
##	GO:0043547	ENSG00000068831	1
##	GD:0045088	ENSG00000111679	1
##	GO:0042391	ENSG00000100721	1
##	GD:0048568	ENSG00000111913	1
##	GO:0001558	ENSG00000068831	1
##	GD:0043254	ENSG00000100721	1
##	GD:0006816	ENSG00000111679	1

```
## GD:0030099
                                                 ENSG00000111679
                                                                      1
## GO:0045785
                                                 ENSG00000111679
                                                                      1
## GD:0006874
                                                 ENSG00000111679
                                                                      1
## GO:0042326
                                                 ENSG00000111679
                                                                      1
```

## Coefficient:

Por último, la comparación entre muestras sin infiltraciones así como con infiltraciones pequeñas focales muestra cambios de magnitud más parecidas al primero, es decir, en general a nivel de expresión génica difieren más los tejidos sin infiltraciones con los infiltrados, independientemente del tamaño de estas, que los tejidos con infiltraciones entre ellos. En este caso los cambios también están asociados con procesos del sistema immune así como regulación de la proliferación y activación de células B y producción de immunoglobulinas.

```
groupNIT
##
                   genes
                              logFC
                                      logCPM
                                                   LR
                                                             PValue
                                                                             FDR.
##
  48230 ENSG00000167483 -7.239925 3.774220 88.17577 5.988910e-21 1.161130e-16
         ENSG00000143297 -8.019151 4.609100 81.79179 1.512053e-19 1.465785e-15
## 49407 ENSG00000104894 -4.347653 5.494380 80.31945 3.185183e-19 1.880011e-15
## 49477 ENSG00000269404 -6.540817 2.628305 79.93021 3.878710e-19 1.880011e-15
  25262 ENSG00000245164 -5.030760 3.572782 78.70927 7.195723e-19 2.790214e-15
   45681 ENSG00000007312 -4.444605 3.977842 76.93160 1.769827e-18 5.718899e-15
##
            symbol
                      entrez
## 48230
            NIBAN3
                      199786
## 3379
             FCRL5
                       83416
## 49407
              CD37
                         951
## 49477
                         6689
              SPIB
## 25262 LINCO0861 100130231
## 45681
             CD79B
                         974
##
                      ID
## GD:0033622 GD:0033622
  GD:0002639 GD:0002639
  GD:0030888 GD:0030888
## G0:0046626 G0:0046626
  GD:1900076 GD:1900076
  GD:0002637 GD:0002637
  GD:0042100 GD:0042100
## G0:0050864 G0:0050864
## GD:0002377 GD:0002377
## GD:0008286 GD:0008286
## GD:0002702 GD:0002702
## GD:0002700 GD:0002700
## GD:0032869 GD:0032869
## G0:0042113 G0:0042113
## GD:0050670 GD:0050670
## GD:0032944 GD:0032944
## G0:0002440 G0:0002440
## GD:0032868 GD:0032868
## GD:0070663 GD:0070663
## G0:0046651 G0:0046651
  GO:0032943 GO:0032943
## G0:0071375 G0:0071375
## GD:0002699 GD:0002699
## GD:0070661 GD:0070661
## GO:1901653 GO:1901653
  GD:0043434 GD:0043434
##
```

Description

```
## GD:0033622
                                                                      integrin activation
## GD:0002639
                                        positive regulation of immunoglobulin production
## GD:0030888
                                                       regulation of B cell proliferation
                                        regulation of insulin receptor signaling pathway
## GD:0046626
                                     regulation of cellular response to insulin stimulus
  GD:1900076
  GD:0002637
                                                  regulation of immunoglobulin production
## GD:0042100
                                                                     B cell proliferation
## GD:0050864
                                                          regulation of B cell activation
  GD:0002377
                                                                 immunoglobulin production
                                                       insulin receptor signaling pathway
## GD:0008286
  GO:0002702 positive regulation of production of molecular mediator of immune response
                       regulation of production of molecular mediator of immune response
## GD:0002700
  GD:0032869
                                                    cellular response to insulin stimulus
## GO:0042113
                                                                        B cell activation
## GO:0050670
                                                   regulation of lymphocyte proliferation
## GD:0032944
                                             regulation of mononuclear cell proliferation
  GD:0002440
                                     production of molecular mediator of immune response
  GD:0032868
                                                                      response to insulin
  GD:0070663
                                                    regulation of leukocyte proliferation
## GD:0046651
                                                                 lymphocyte proliferation
  GD:0032943
                                                           mononuclear cell proliferation
## GO:0071375
                                            cellular response to peptide hormone stimulus
## GD:0002699
                                           positive regulation of immune effector process
  GD:0070661
                                                                  leukocyte proliferation
                                                             cellular response to peptide
  GO:1901653
                                                              response to peptide hormone
   GO:0043434
              GeneRatio
                          BgRatio
                                       pvalue
                                                                           geneID
                                                 p.adjust qvalue
  GD:0033622
                         22/20536 0.001071289 0.01666991
                                                              NA ENSG00000170476
  GD:0002639
                    1/1
                         50/20536 0.002434749 0.01666991
                                                              NA ENSG00000170476
## GD:0030888
                    1/1
                         64/20536 0.003116478 0.01666991
                                                              NA ENSG00000170476
## GD:0046626
                    1/1
                         66/20536 0.003213868 0.01666991
                                                              NA ENSG00000170476
  GD:1900076
                         74/20536 0.003603428 0.01666991
                                                              NA ENSG00000170476
  GD:0002637
                         79/20536 0.003846903 0.01666991
                                                              NA ENSG00000170476
  GO:0042100
                         99/20536 0.004820802 0.01790584
                                                              NA ENSG00000170476
  GD:0050864
                    1/1 120/20536 0.005843397 0.01814699
                                                              NA ENSG00000170476
  GD:0002377
                    1/1 129/20536 0.006281652 0.01814699
                                                              NA ENSG00000170476
## GD:0008286
                    1/1 151/20536 0.007352941 0.01899104
                                                              NA ENSG00000170476
## GD:0002702
                    1/1 165/20536 0.008034671 0.01899104
                                                              NA ENSG00000170476
## GD:0002700
                    1/1 217/20536 0.010566810 0.01951857
                                                              NA ENSG00000170476
                    1/1 234/20536 0.011394624 0.01951857
  GD:0032869
                                                              NA ENSG00000170476
  GO:0042113
                    1/1 249/20536 0.012125049 0.01951857
                                                              NA ENSG00000170476
                                                              NA ENSG00000170476
## GD:0050670
                    1/1 277/20536 0.013488508 0.01951857
                    1/1 278/20536 0.013537203 0.01951857
                                                              NA ENSG00000170476
  GO:0032944
                    1/1 286/20536 0.013926763 0.01951857
                                                              NA ENSG00000170476
## GD:0002440
## GD:0032868
                    1/1 291/20536 0.014170238 0.01951857
                                                              NA ENSG00000170476
## GD:0070663
                    1/1 293/20536 0.014267628 0.01951857
                                                              NA ENSG00000170476
  GO:0046651
                    1/1 342/20536 0.016653681 0.01951857
                                                              NA ENSG00000170476
                    1/1 344/20536 0.016751071 0.01951857
                                                              NA ENSG00000170476
## GD:0032943
  GO:0071375
                    1/1 349/20536 0.016994546 0.01951857
                                                              NA ENSG00000170476
                    1/1 356/20536 0.017335411 0.01951857
## GD:0002699
                                                              NA ENSG00000170476
  GD:0070661
                    1/1 370/20536 0.018017141 0.01951857
                                                              NA ENSG00000170476
  GO:1901653
                    1/1 419/20536 0.020403194 0.02121932
                                                              NA ENSG00000170476
  GD:0043434
                    1/1 466/20536 0.022691858 0.02269186
                                                              NA ENSG00000170476
##
              Count
```

##	GO:0033622	1
##	GO:0002639	1
##	GO:0030888	1
##	GO:0046626	1
##	GO:1900076	1
##	GO:0002637	1
##	GO:0042100	1
##	GO:0050864	1
##	GO:0002377	1
##	GO:0008286	1
##	GO:0002702	1
##	GO:0002700	1
##	GO:0032869	1
##	GO:0042113	1
##	GD:0050670	1
##	GO:0032944	1
##	GO:0002440	1
##	GO:0032868	1
##	GD:0070663	1
##	GO:0046651	1
##	GO:0032943	1
##	GO:0071375	1
##	GD:0002699	1
##	GO:0070661	1
##	GO:1901653	1
##	GO:0043434	1

## Discusión

Como discusión me gustaría añadir simplemente que el estudio me ha parecido muy completo pese a que yo no he sabido sacarle todo el provecho posible. Me he encontrado dificultades a la hora de seleccionar todo el conjunto de genes diferencialmente expresados de cada comparación, así como un análisis más extenso de estos, conocimiento que espero poder seguir adquiriendo aún acabada la asignatura. A nivel de aspectos generales de la práctica, creo que los datos del estudio son suficientemente claros y bien representados como para llevar a cabo el análisis sin mayor problemática.

## **Apéndice**

Enlace a repositorio: https://github.com/andrealopmar/ADO-PEC2.git

```
#Selección de datos
targets_RNAseq<-targets[targets$molecular_data_type=="RNA Seq (NGS)",]</pre>
table(targets RNAseq$Group)
targets ELI<-targets RNAseq[targets RNAseq$Group=="ELI",]</pre>
targets_NIT<-targets_RNAseq[targets_RNAseq$Group=="NIT",]</pre>
targets_SFI<-targets_RNAseq[targets_RNAseq$Group=="SFI",]</pre>
set.seed(123)
select sampleNIT<-sample(119,10)
select_sampleSFI<-sample(24,10)</pre>
targets_NIT_sel<-targets_NIT[select_sampleNIT,]</pre>
targets_SFI_sel<-targets_SFI[select_sampleSFI,]</pre>
targets_RNAseqS<-rbind(targets_ELI, targets_NIT_sel, targets_SFI_sel)</pre>
table(targets_RNAseqS$Group)
#Asociar targets y counts
library(dplyr)
counts_sel<-dplyr::select(counts,contains(targets_RNAseqS$Sample_Name))</pre>
counts data<-cbind(counts$ens,counts sel)</pre>
names(counts_data)[1] <-paste("ens")</pre>
counts_data$ens<-substr(counts_data$ens,1,15)</pre>
#Change names
targets_ELI$Sample_Name
colnames(counts_data)[2:9]
colnames(counts_data)[2:9]<-paste("ELI",1:8)</pre>
colnames(counts_data)[2:9]
names_NIT_sel<-targets_NIT_sel$Sample_Name
names_NIT_sel
colnames(counts_data)[10:19]
colnames(counts_data)[10:19] <- paste("NIT",1:10)</pre>
colnames(counts_data)[10:19]
names_SFI_sel<-targets_SFI_sel$Sample_Name
names SFI sel
colnames(counts_data)[20:29]
colnames(counts_data)[20:29]<-paste("SFI", 1:10)</pre>
colnames(counts_data)[20:29]
colnames(counts_sel)[1:8]<-paste("ELI",1:8)</pre>
colnames(counts_sel)[9:18]<-paste("NIT",1:10)</pre>
colnames(counts_sel)[19:28]<-paste("SFI", 1:10)</pre>
#Definir dataset
group<-substr(colnames(counts_sel),1,3)</pre>
dgList <- DGEList(counts=counts_sel, genes=counts_data$ens, group = group)</pre>
plotMDS(dgList)
```

```
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
                                                                                                         \16
#Boxplot
library(reshape)
library(ggplot2)
pseudoCount<-log2(counts_sel + 1)</pre>
counts_logS<- melt(pseudoCount, variable_name = "Samples")</pre>
## Using as id variables
df.countslog<-data.frame(counts_logS, Condition = substr(counts_logS$Samples, 1, 3))</pre>
ggplot(df.countslog, aes(x = Samples, y = value, fill = Condition)) + geom_boxplot() + xlab("") +
ylab(expression(log[2](count + 1)))
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
#Filtraje
countsPerMillion <- cpm(dgList)</pre>
countCheck <- countsPerMillion > 1
dim(dgList)
keep <- which(rowSums(countCheck) >= 2)
dgList <- dgList[keep,]</pre>
dim(cpm(dgList))
#Normalización
dgList <- calcNormFactors(dgList, method="TMM")</pre>
plotMDS(dgList)
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
#Plot density
library(edgeR)
library(limma)
keep<- rowSums(counts_sel) > 0
counts_filt<-pseudoCount[keep, ]</pre>
counts_norm<-cpm(counts_filt, normalized.lib.sized= TRUE)</pre>
par(mfrow=c(2,1))
plotDensities(counts_filt, group = substr(colnames(counts_norm),1,3), main = "Distribución de datos fil
plotDensities(counts_norm, group = substr(colnames(counts_norm),1,3), main= "Distribución de datos norm
```

```
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
#Density norm
df.norm<- melt(counts_norm, variable_name = "X2")</pre>
df.norm<-data.frame(df.norm, Condition = substr(df.norm$X2, 1, 3))</pre>
par(mfrow=c(2,1))
ggplot(df.countslog, aes(x = value, colour = Samples, fill = Samples, main= "Distribución de datos crud
geom_density(alpha = 0.2, size = 1.25) + facet_wrap(~ Condition) +
theme(legend.position = "top") + xlab(expression(log[2](count + 1)))
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
ggplot(df.norm, aes(x = value, colour = X2, fill = X2, main= "Distribución de datos normalizados")) +
geom_density(alpha = 0.2, size = 1.25) + facet_wrap(~ Condition) +
theme(legend.position = "top") + xlab("pseudocounts")
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
#Dif expresados
designMat <- model.matrix(~group)</pre>
dgList <- estimateGLMCommonDisp(dgList, design=designMat)</pre>
dgList <- estimateGLMTrendedDisp(dgList, design=designMat)</pre>
dgList <- estimateGLMTagwiseDisp(dgList, design=designMat)</pre>
plotBCV(dgList, main= "Dispersión de las muestras normalizadas")
fit<-glmFit(dgList,designMat)</pre>
#Comparación NIT vs ELI
lrt2vs1 <- glmLRT(fit, coef=2)</pre>
edgeR_result2vs1 <- topTags(lrt2vs1)</pre>
edgeR_result2vs1
deGenes2vs1 <- decideTestsDGE(lrt2vs1, p=0.001)</pre>
deGenes2vs1 <- rownames(lrt2vs1)[as.logical(deGenes2vs1)]</pre>
plotSmear(lrt2vs1, de.tags=deGenes2vs1)
abline(h=c(-1, 1), col=2)
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
```

```
#Comparación SFI vs ELI
lrt3vs1 <- glmLRT(fit, coef=3)</pre>
edgeR_result3vs1 <- topTags(lrt3vs1)</pre>
edgeR result3vs1
deGenes3vs1 <- decideTestsDGE(lrt3vs1, p=0.001)</pre>
deGenes3vs1 <- rownames(lrt3vs1)[as.logical(deGenes3vs1)]</pre>
plotSmear(lrt3vs1, de.tags=deGenes3vs1)
abline(h=c(-1, 1), col=2)
#Comparación SFI vs NIT
lrt3vs2 <- glmLRT(fit,contrast=c(0,-1,1))</pre>
edgeR_result3vs2 <- topTags(lrt3vs2)</pre>
edgeR_result3vs2
deGenes3vs2 <- decideTestsDGE(lrt3vs2, p=0.001)</pre>
deGenes3vs2 <- rownames(lrt3vs2)[as.logical(deGenes3vs2)]</pre>
plotSmear(lrt3vs2, de.tags=deGenes3vs2)
abline(h=c(-1, 1), col=2)
Lopez_Andrea_ADO_PEC2_versio\protect \begingroup \immediate \write \@unused \def \MessageBreak
#Anot NIT vs ELI
edgeR_result2vs1$table$symbol <- mapIds(org.Hs.eg.db,</pre>
                      keys=edgeR_result2vs1$table$genes,
                      column="SYMBOL",
                      keytype="ENSEMBL",
                      multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
edgeR result2vs1$table$entrez <- mapIds(org.Hs.eg.db,
                      keys=edgeR_result2vs1$table$genes,
                      column="ENTREZID",
                      keytype="ENSEMBL",
                      multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
resOrdered2vs1 <- edgeR_result2vs1[order(edgeR_result2vs1$table$PValue),]
head(resOrdered2vs1)
#Anot SFI vs ELI
edgeR_result3vs1$table$symbol <- mapIds(org.Hs.eg.db,</pre>
                      keys=edgeR_result3vs1$table$genes,
                      column="SYMBOL",
                      keytype="ENSEMBL",
                      multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
edgeR_result3vs1$table$entrez <- mapIds(org.Hs.eg.db,</pre>
                      keys=edgeR result3vs1$table$genes,
                      column="ENTREZID",
```

. /16

```
keytype="ENSEMBL",
                     multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
resOrdered3vs1 <- edgeR_result3vs1[order(edgeR_result3vs1$table$PValue),]
head(resOrdered3vs1)
#Anot SFI vs NIT
edgeR_result3vs2$table$symbol <- mapIds(org.Hs.eg.db,</pre>
                     keys=edgeR_result3vs2$table$genes,
                     column="SYMBOL",
                     keytype="ENSEMBL",
                     multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
edgeR_result3vs2$table$entrez <- mapIds(org.Hs.eg.db,</pre>
                     keys=edgeR result3vs2$table$genes,
                     column="ENTREZID",
                     keytype="ENSEMBL",
                     multiVals="first")
## 'select()' returned 1:1 mapping between keys and columns
resOrdered3vs2 <- edgeR_result2vs1[order(edgeR_result3vs2$table$PValue),]
head(resOrdered3vs2)
#Gene enrich tot
library("clusterProfiler")
listOfTables <- list(NITvsELI = edgeR_result2vs1$table, SFIvsELI = edgeR_result3vs1$table, SFIvsNIT = e
all_res<-rbind(edgeR_result2vs1$table, edgeR_result3vs1$table, edgeR_result3vs2$table)
eg.all <- enrichGO(gene
                              = all_res$genes,
                OrgDb
                             = org.Hs.eg.db,
                             = 'ENSEMBL',
                keyType
                ont
                              = "BP",
                pAdjustMethod = "fdr",
                pvalueCutoff = 0.01,
                qvalueCutoff = 0.05)
eg.all@result
#Gene enrich NIT vs ELI
res.2vs1<-as.data.frame(edgeR_result2vs1$table)</pre>
eg.2vs1 <- enrichGO(gene
                                = res.2vs1$genes,
                OrgDb
                             = org.Hs.eg.db,
                keyType
                             = 'ENSEMBL',
                              = "BP",
                ont
                pAdjustMethod = "fdr",
                pvalueCutoff = 0.01,
                qvalueCutoff = 0.05)
eg.2vs1@result
#Gene enrich SFI vs ELI
res.3vs1<-as.data.frame(edgeR_result3vs1$table)</pre>
eg.3vs1 <- enrichGO(gene
                                 = res.3vs1$genes,
                OrgDb
                              = org.Hs.eg.db,
```

```
keyType = 'ENSEMBL',
                ont = "BP",
                pAdjustMethod = "fdr",
                pvalueCutoff = 0.01,
                qvalueCutoff = 0.05)
eg.3vs1@result
#Gene enrich SFI vs NIT
res.3vs2<-as.data.frame(edgeR_result3vs2$table)</pre>
eg.3vs2 <- enrichGO(gene = res.3vs2$genes,
OrgDb = org.Hs.eg.db,
                keyType
ont
                            = 'ENSEMBL',
                            = "BP",
                pAdjustMethod = "fdr",
                pvalueCutoff = 0.01,
                qvalueCutoff = 0.05)
eg.3vs2@result
```

"