

# Package ‘GeoTcgaData’

October 15, 2023

**Type** Package

**Title** Processing Various Types of Data on GEO and TCGA

**Version** 2.0.0

**Description** Gene Expression Omnibus(GEO) and The Cancer Genome Atlas (TCGA) provide us with a wealth of data, such as RNA-seq, DNA Methylation, SNP and Copy number variation data. It's easy to download data from TCGA using the gdc tool, but processing these data into a format suitable for bioinformatics analysis requires more work. This R package was developed to handle these data.

**Depends** R (>= 4.2.0)

**License** Artistic-2.0

**Encoding** UTF-8

**RoxygenNote** 7.2.3

**Suggests** knitr, rmarkdown, DESeq2, S4Vectors, ChAMP, impute, tidy, clusterProfiler, org.Hs.eg.db, edgeR, limma, quantreg, minfi, IlluminaHumanMethylation450kanno.ilmn12.hg19, dearseq, NOISeq, testthat (>= 3.0.0), CATT, TCGAbiolinks, enrichplot, GEOquery, BiocGenerics

**VignetteBuilder** knitr

**Imports** utils, data.table, plyr, cqn, topconfects, stats, SummarizedExperiment, methods

**Language** en-US

**URL** <https://github.com/YuLab-SMU/GeoTcgaData>

**BugReports** <https://github.com/YuLab-SMU/GeoTcgaData/issues>

**biocViews** GeneExpression, DifferentialExpression, RNASeq, CopyNumberVariation, Microarray, Software, DNAMethylation, DifferentialMethylation, SNP, ATACSeq, MethylationArray

**Config/testthat/edition** 3

**git\_url** <https://git.bioconductor.org/packages/GeoTcgaData>

**git\_branch** RELEASE\_3\_17

**git\_last\_commit** ba3333b

**git\_last\_commit\_date** 2023-04-25

**Date/Publication** 2023-10-15

**Author** Erqiang Hu [aut, cre] (<<https://orcid.org/0000-0002-1798-7513>>)

**Maintainer** Erqiang Hu <13766876214@163.com>

## R topics documented:

array_preprocess . . . . .	3
cal_mean_module . . . . .	3
cluster_array . . . . .	4
combine_pvalue . . . . .	5
countToFpkm . . . . .	5
countToTpm . . . . .	6
differential_array . . . . .	7
differential_CNV . . . . .	8
differential_limma . . . . .	9
differential_methy . . . . .	10
differential_RNA . . . . .	12
differential_SNP . . . . .	15
differential_SNP_GEO . . . . .	16
differential_SNP_tcga . . . . .	17
fpkmToTpm . . . . .	18
geneExpress . . . . .	18
gene_ave . . . . .	19
gene_cov . . . . .	19
get_geo_array . . . . .	20
GSE66705_sample2 . . . . .	20
id_conversion_TCGA . . . . .	21
kegg_liver . . . . .	21
Merge_methy_tcga . . . . .	22
module . . . . .	22
prepare_chi . . . . .	23
profile . . . . .	23
repAssign . . . . .	24
repRemove . . . . .	25
SNP_QC . . . . .	25
ventricle . . . . .	26
<b>Index</b>	<b>27</b>

---

array_preprocess	<i>Preprocess of Microarray data</i>
------------------	--------------------------------------

---

**Description**

Preprocess of Microarray data

**Usage**

```
array_preprocess(x, missing_value = "knn", string = " /// ")
```

**Arguments**

x	matrix of Microarray data, each column is a sample, and each row is a gene.
missing_value	Method to impute missing expression data, one of "zero" and "knn".
string	a string, sep of the gene

**Value**

matrix

**Examples**

```
arraylist <- get_geo_array("GSE781")  
arraylist <- lapply(arraylist, array_preprocess)
```

---

cal_mean_module	<i>Find the mean value of the gene in each module</i>
-----------------	---

---

**Description**

Find the mean value of the gene in each module

**Usage**

```
cal_mean_module(geneExpress, module)
```

**Arguments**

geneExpress	a data.frame of gene expression data. Each column is a sample, and each row is a gene.
module	a data.frame of two column. The first column is module name, the second column are genes in this module.

**Value**

a data.frame, means the mean of gene expression value in the same module

**Examples**

```
data(geneExpress)
data(module)
result <- cal_mean_module(geneExpress, module)
```

---

cluster_array	<i>cluster probes of Microarray data</i>
---------------	--

---

**Description**

cluster probes of Microarray data

**Usage**

```
cluster_array(x, clusterCutoff = 0.7)
```

**Arguments**

**x** matrix of Microarray data, the first is the name of the gene, and the others are the expression value.

**clusterCutoff** Pearson correlation threshold to cut off the hierarchical tree.

**Value**

data.frame

**Examples**

```
arraylist <- get_geo_array("GSE781")
arraylist <- lapply(arraylist, array_preprocess)
arraylist_cluster <- lapply(arraylist, cluster_array)
```

---

combine_pvalue	<i>combine pvalues of SNP difference analysis result</i>
----------------	--

---

**Description**

combine pvalues of SNP difference analysis result

**Usage**

```
combine_pvalue(snpResult, snp2gene, combineMethod = min)
```

**Arguments**

snpResult	data.frame of SNP difference analysis result.
snp2gene	data frame of two column: snp and gene.
combineMethod	Method of combining the pvalue of multiple snp in a gene.

**Value**

data.frame

**Examples**

```
snpResult <- data.frame(pvalue = runif(100), estimate = runif(100))
rownames(snpResult) <- paste0("snp", seq_len(100))
snp2gene <- data.frame(snp = rownames(snpResult),
  gene = rep(paste0("gene", seq_len(20)), 5))
result <- combine_pvalue(snpResult, snp2gene)
```

---

countToFpkm	<i>Convert count to FPKM</i>
-------------	------------------------------

---

**Description**

Convert count to FPKM

**Usage**

```
countToFpkm(counts_matrix, keyType = "SYMBOL", gene_cov)
```

**Arguments**

counts_matrix	a matrix, colnames of counts_matrix are sample name, rownames of counts_matrix are gene symbols
keyType	keyType, one of keytypes(org.Hs.eg.db).
gene_cov	data.frame of two column, the first column is gene length, the second column is gene GC content

**Value**

a matrix

**Examples**

```
data(gene_cov)
lung_squ_count2 <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9), ncol = 3)
rownames(lung_squ_count2) <- c("DISC1", "TCOF1", "SPPL3")
colnames(lung_squ_count2) <- c("sample1", "sample2", "sample3")
result <- countToFpm(lung_squ_count2,
  keyType = "SYMBOL",
  gene_cov = gene_cov
)
```

---

countToTpm

*Convert count to Tpm*

---

**Description**

Convert count to Tpm

**Usage**

```
countToTpm(counts_matrix, keyType = "SYMBOL", gene_cov)
```

**Arguments**

counts_matrix	a matrix, colnames of counts_matrix are sample name, rownames of counts_matrix are gene symbols
keyType	keyType, one of keytypes(org.Hs.eg.db).
gene_cov	data.frame of two column, the first column is gene length, the second column is gene GC content

**Value**

a matrix

**Examples**

```
data(gene_cov)
lung_squ_count2 <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9), ncol = 3)
rownames(lung_squ_count2) <- c("DISC1", "TCOF1", "SPPL3")
colnames(lung_squ_count2) <- c("sample1", "sample2", "sample3")
result <- countToTpm(lung_squ_count2,
  keyType = "SYMBOL",
  gene_cov = gene_cov
)
```

---

differential\_array      *Differential analysis of Microarray data*

---

## Description

Differential analysis of Microarray data

## Usage

```
differential_array(df, group, method = "limma", adjust.method = "BH")
```

## Arguments

df	data.frame of the omic data, each column is a sample, and each row is a gene.
group	a vector, group of samples.
method	method to do differential analysis, one of "limma", "ttest", "wilcox".
adjust.method	adjust.method, one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", and "none".

## Value

data.frame

## Examples

```
library(GeoTcgaData)
library(data.table)
# Use real GEO data as example
arrayData <- read.table("GSE54807_series_matrix.txt.gz",
  sep = "\t", header = TRUE,
  fill=TRUE, comment.char = "!", check.names=FALSE)
gpl <- fread("GPL6244-17930.txt", sep = "\t", header = TRUE)
gpl <- gpl[, c("ID", "gene_assignment")]
class(gpl) <- "data.frame"

for (i in seq_len(nrow(gpl))) {
  aa <- strsplit(gpl[i, 2], " // ")[[1]][5]
  gpl[i, 2] <- as.character(strsplit(aa, " /// ")[[1]][1])
}
gpl[,1] <- as.character(gpl[,1])
arrayData[, 1] <- as.character(arrayData[, 1])
rownames(gpl) <- gpl[, 1]
arrayData[, 1] <- gpl[arrayData[, 1], 2]

arrayData <- repRemove(arrayData, " /// ")

# Remove rows that do not correspond to genes
```

```

arrayData <- arrayData[!is.na(arrayData[, 1]), ]
arrayData <- arrayData[!arrayData[, 1] == "", ]
arrayData <- arrayData[!arrayData[, 1] == "---", ]

arrayData <- arrayData[order(arrayData[, 1]), ]
arrayData <- gene_ave(arrayData, 1)

keep <- apply(arrayData, 1, function(x) sum(x < 1) < (length(x)/2))
arrayData <- arrayData[keep, ]

group <- c(rep("group1", 12), rep("group2", 12))
result <- differential_array(df = arrayData, group = group)

# Use random data as example
arrayData <- matrix(runif(200), 25, 8)
rownames(arrayData) <- paste0("gene", 1:25)
colnames(arrayData) <- paste0("sample", 1:8)
group <- c(rep("group1", 4), rep("group2", 4))
result <- differential_array(df = arrayData, group = group)

```

---

differential\_CNV

*Do difference analysis of gene level copy number variation data*


---

## Description

Do difference analysis of gene level copy number variation data

## Usage

```

differential_CNV(
  cnvData,
  sampleGroup,
  method = "Chisquare",
  adjust.method = "BH",
  ...
)

```

## Arguments

cnvData	data.frame of CNV data, each column is a sample, and each row is a CNV.
sampleGroup	vector of sample group
method	method to do diffenential analysis, one of "Chisquare", "fisher", and "CATT"(Cochran-Armitage trend test)
adjust.method	adjust.method, one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", and "none".
...	parameters for "Chisquare", "fisher", and "CATT"(Cochran-Armitage trend test)

**Value**

data.frame with pvalue and estimate

**Examples**

```
# use TCGAbiolinks data as example
library(TCGAbiolinks)
query <- GDCquery(
  project = "TCGA-ACC",
  data.category = "Copy Number Variation",
  data.type = "Gene Level Copy Number",
  access = "open"
)
GDCdownload(query)
cnvData <- GDCprepare(query)
aa <- assays(cnvData)$copy_number
bb <- aa
aa[bb == 2] <- 0
aa[bb < 2] <- -1
aa[bb > 2] <- 1
sampleGroup <- sample(c("A", "B"), ncol(cnvData), replace = TRUE)
diffCnv <- differential_CNV(aa, sampleGroup)

# Use sangerbox CNV data as example
cnvData <- fread("Merge_GeneLevelCopyNumber.txt")
class(cnvData) <- "data.frame"
rownames(cnvData) <- cnvData[, 1]
cnvData <- cnvData[, -c(1, 2, 3)]
sampleGroup <- sample(c("A", "B"), ncol(cnvData), replace = TRUE)
diffCnv <- differential_CNV(cnvData, sampleGroup)

# use random data as example
aa <- matrix(sample(c(0, 1, -1), 200, replace = TRUE), 25, 8)
rownames(aa) <- paste0("gene", 1:25)
colnames(aa) <- paste0("sample", 1:8)
sampleGroup <- sample(c("A", "B"), ncol(aa), replace = TRUE)
diffCnv <- differential_CNV(aa, sampleGroup)
```

---

differential\_limma      *differential\_limma*

---

**Description**

differential\_limma

**Usage**

```
differential_limma(df, group, adjust.method = "BH")
```

**Arguments**

df                    data.frame of the omic data  
group                a vector, group of samples.  
adjust.method      adjust.method.

**Value**

data.frame

**Examples**

```
df <- matrix(runif(200), 25, 8)
df <- as.data.frame(df)
rownames(df) <- paste0("gene", 1:25)
colnames(df) <- paste0("sample", 1:8)
group <- sample(c("group1", "group2"), 8, replace = TRUE)
result <- differential_limma(df = df, group = group)
```

---

differential\_methy      *differential\_methy*

---

**Description**

Get methylation difference gene

**Usage**

```
differential_methy(  
  cpGData,  
  sampleGroup,  
  groupCol,  
  combineMethod = "stouffer",  
  missing_value = "knn",  
  cpG2gene = NULL,  
  normMethod = "PBC",  
  region = "TSS1500",  
  model = "gene",  
  adjust.method = "BH",  
  adjPvalCutoff = 0.05,  
  ucscData = FALSE  
)
```

**Arguments**

cpaData	data.frame of cpG beta value, , or SummarizedExperiment object
sampleGroup	vector of sample group
groupCol	group column
combineMethod	method to combine the cpG pvalues, a function or one of "stouffer", "fisher" and "rhoScores".
missing_value	Method to impute missing expression data, one of "zero" and "knn".
cpG2gene	data.frame to annotate cpG locus to gene
normMethod	Method to do normalization: "PBC" or "BMIQ".
region	region of genes, one of "Body", "TSS1500", "TSS200", "3'UTR", "1stExon", "5'UTR", and "IGR". Only used when cpG2gene is NULL.
model	if "cpG", step1: calculate difference cpGs; step2: calculate difference genes. if "gene", step1: calculate the methylation level of genes; step2: calculate difference genes.
adjust.method	character string specifying the method used to adjust p-values for multiple testing. See <a href="#">p.adjust</a> for possible values.
adjPvalCutoff	adjusted pvalue cutoff
ucscData	Logical, whether the data comes from UCSC Xena.

**Value**

data.frame

**Examples**

```
# use TCGAbiolinks data
library(TCGAbiolinks)
query <- GDCquery(project = "TCGA-ACC",
  data.category = "DNA Methylation",
  data.type = "Methylation Beta Value",
  platform = "Illumina Human Methylation 450")
GDCdownload(query, method = "api", files.per.chunk = 5,
  directory = Your_Path)
merge_result <- Merge_methy_tcgA(Your_Path_to_DNA_Methylation_data)
library(ChAMP) # To avoid reporting errors
differential_gene <- differential_methy(cpaData = merge_result,
  sampleGroup = sample(c("C", "T"),
  ncol(merge_result[[1]]), replace = TRUE))

# use user defined data
library(ChAMP)
cpaData <- matrix(runif(2000), nrow = 200, ncol = 10)
rownames(cpaData) <- paste0("cpG", seq_len(200))
colnames(cpaData) <- paste0("sample", seq_len(10))
sampleGroup <- c(rep("group1", 5), rep("group2", 5))
names(sampleGroup) <- colnames(cpaData)
cpG2gene <- data.frame(cpG = rownames(cpaData),
```

```

    gene = rep(paste0("gene", seq_len(20)), 10))
result <- differential_methy(cpgData, sampleGroup,
    cpg2gene = cpg2gene, normMethod = NULL)
# use SummarizedExperiment object input
library(ChAMP)
cpgData <- matrix(runif(2000), nrow = 200, ncol = 10)
rownames(cpgData) <- paste0("cpg", seq_len(200))
colnames(cpgData) <- paste0("sample", seq_len(10))
sampleGroup <- c(rep("group1", 5), rep("group2", 5))
names(sampleGroup) <- colnames(cpgData)
cpg2gene <- data.frame(cpg = rownames(cpgData),
    gene = rep(paste0("gene", seq_len(20)), 10))
colData <- S4Vectors::DataFrame(
    row.names = colnames(cpgData),
    group = sampleGroup
)
data <- SummarizedExperiment::SummarizedExperiment(
    assays=S4Vectors::SimpleList(counts=cpgData),
    colData = colData)
result <- differential_methy(cpgData = data,
    groupCol = "group", normMethod = NULL,
    cpg2gene = cpg2gene)

```

---

differential\_RNA      *differential\_RNA*

---

## Description

Do difference analysis of RNA-seq data

## Usage

```

differential_RNA(
  counts,
  group,
  groupCol,
  method = "limma",
  geneLength = NULL,
  gccontent = NULL,
  filter = TRUE,
  edgeRNorm = TRUE,
  adjust.method = "BH",
  useTopconfects = TRUE,
  ucscData = FALSE
)

```

**Arguments**

counts	a dataframe or numeric matrix of raw counts data, or SummarizedExperiment object
group	sample groups
groupCol	group column
method	one of "DESeq2", "edgeR", "limma", "dearseq", "NOISeq", "Wilcoxon", and "auto".
geneLength	a vector of gene length.
gccontent	a vector of gene GC content.
filter	if TRUE, use filterByExpr to filter genes.
edgeRNorm	if TRUE, use edgeR to do normalization for dearseq method.
adjust.method	character string specifying the method used to adjust p-values for multiple testing. See <a href="#">p.adjust</a> for possible values.
useTopconfects	if TRUE, use topconfects to provide a more biologically useful ranked gene list.
ucscData	Logical, whether the data comes from UCSC Xena.

**Value**

data.frame

**Examples**

```
library(TCGAbiolinks)

query <- GDCquery(
  project = "TCGA-ACC",
  data.category = "Transcriptome Profiling",
  data.type = "Gene Expression Quantification",
  workflow.type = "STAR - Counts"
)

GDCdownload(query,
  method = "api", files.per.chunk = 3,
  directory = Your_Path
)

dataRNA <- GDCprepare(
  query = query, directory = Your_Path,
  save = TRUE, save.filename = "dataRNA.RData"
)
## get raw count matrix
dataPrep <- TCGAanalyze_Preprocessing(
  object = dataRNA,
  cor.cut = 0.6,
  datatype = "STAR - Counts"
)
```

```

# Use `differential_RNA` to do difference analysis.
# We provide the data of human gene length and GC content in `gene_cov`.
group <- sample(c("grp1", "grp2"), ncol(dataPrep), replace = TRUE)
library(cqn) # To avoid reporting errors: there is no function "rq"
## get gene length and GC content
library(org.Hs.eg.db)
genes_bitr <- bitr(rownames(gene_cov),
  fromType = "ENTREZID", toType = "ENSEMBL",
  OrgDb = org.Hs.eg.db, drop = TRUE
)
genes_bitr <- genes_bitr[!duplicated(genes_bitr[, 2]), ]
gene_cov2 <- gene_cov[genes_bitr$ENTREZID, ]
rownames(gene_cov2) <- genes_bitr$ENSEMBL
genes <- intersect(rownames(dataPrep), rownames(gene_cov2))
dataPrep <- dataPrep[genes, ]
geneLength <- gene_cov2(genes, "length")
gccontent <- gene_cov2(genes, "GC")
names(geneLength) <- names(gccontent) <- genes
## Difference analysis
DEGAll <- differential_RNA(
  counts = dataPrep, group = group,
  geneLength = geneLength, gccontent = gccontent
)
# Use `clusterProfiler` to do enrichment analytics:
diffGenes <- DEGAll$logFC
names(diffGenes) <- rownames(DEGAll)
diffGenes <- sort(diffGenes, decreasing = TRUE)
library(clusterProfiler)
library(enrichplot)
library(org.Hs.eg.db)
gsego <- gseGO(gene = diffGenes, OrgDb = org.Hs.eg.db, keyType = "ENSEMBL")
dotplot(gsego)

# use user-defined data
df <- matrix(rnbinom(400, mu = 4, size = 10), 25, 16)
df <- as.data.frame(df)
rownames(df) <- paste0("gene", 1:25)
colnames(df) <- paste0("sample", 1:16)
group <- sample(c("group1", "group2"), 16, replace = TRUE)
result <- differential_RNA(counts = df, group = group,
  filte = FALSE, method = "Wilcoxon")
# use SummarizedExperiment object input
df <- matrix(rnbinom(400, mu = 4, size = 10), 25, 16)
rownames(df) <- paste0("gene", 1:25)
colnames(df) <- paste0("sample", 1:16)
group <- sample(c("group1", "group2"), 16, replace = TRUE)

nrows <- 200; ncols <- 20
counts <- matrix(
  runif(nrows * ncols, 1, 1e4), nrows,
  dimnames = list(paste0("cg", 1:200), paste0("S", 1:20))
)

```

```
colData <- S4Vectors::DataFrame(
  row.names = paste0("sample", 1:16),
  group = group
)
data <- SummarizedExperiment::SummarizedExperiment(
  assays=S4Vectors::SimpleList(counts=df),
  colData = colData)

result <- differential_RNA(counts = data, groupCol = "group",
  filte = FALSE, method = "Wilcoxon")
```

---

differential\_SNP      *Do difference analysis of SNP data*

---

## Description

Do difference analysis of SNP data

## Usage

```
differential_SNP(snpDf, sampleGroup, combineMethod = min)
```

## Arguments

snpDf                data.frame of SNP data, each column is a sample, and each row is a SNP.  
sampleGroup        vector of sample group.  
combineMethod      Method of combining the pvalue of multiple snp in a gene.

## Value

data.frame

## Examples

```
library(TCGAbiolinks)
query <- GDCquery(
  project = "TCGA-CHOL",
  data.category = "Simple Nucleotide Variation",
  access = "open",
  legacy = FALSE,
  data.type = "Masked Somatic Mutation",
  workflow.type = "Aliquot Ensemble Somatic Variant Merging and Masking"
)
GDCdownload(query)
data_snp <- GDCprepare(query)
samples <- unique(data_snp$Tumor_Sample_Barcode)
sampleGroup <- sample(c("A", "B"), length(samples), replace = TRUE)
names(sampleGroup) <- samples
pvalue <- differential_SNP_tcga(snpData = data_snp,
```

```

    sampleGroup = sampleGroup)

# use demo data
snpDf <- matrix(sample(c("mutation", NA), 100, replace = TRUE), 10, 10)
snpDf <- as.data.frame(snpDf)
sampleGroup <- sample(c("A", "B"), 10, replace = TRUE)
result <- differential_SNP(snpDf, sampleGroup)

```

---

differential\_SNP\_GEO *Do difference analysis of SNP data downloaded from GEO*

---

### Description

Do difference analysis of SNP data downloaded from GEO

### Usage

```
differential_SNP_GEO(snpData, sampleGroup, method = "Chisquare")
```

### Arguments

snpData	data.frame of SNP data downloaded from GEO
sampleGroup	vector of sample group
method	one of "Chisquare", "fisher", and "CATT"(Cochran-Armitage trend test)

### Value

data.frame

### Examples

```

file1 <- read.table("GSE66903_series_matrix.txt.gz",
  fill=TRUE, comment.char="!", header = TRUE)
rownames(file1) <- file1[, 1]
snpData <- file1[, -1]
sampleGroup <- sample(c("A", "B"), ncol(snpData ), replace = TRUE)
names(sampleGroup) <- colnames(snpData)
snpData <- SNP_QC(snpData)
sampleGroup <- sample(c("A", "B"), ncol(snpData ), replace = TRUE)
result1 <- differential_SNP_GEO(snpData = snpData,
  sampleGroup = sampleGroup, method = "Chisquare")

# use demo data
snpDf <- matrix(sample(c("AA", "Aa", "aa"), 100, replace = TRUE), 10, 10)
snpDf <- as.data.frame(snpDf)
sampleGroup <- sample(c("A", "B"), 10, replace = TRUE)
result <- differential_SNP_GEO(snpDf, sampleGroup, method = "fisher")

```

---

differential\_SNP\_tcga *Do difference analysis of SNP data downloaded from TCGAbiolinks*

---

## Description

Do difference analysis of SNP data downloaded from TCGAbiolinks

## Usage

```
differential_SNP_tcga(snpData, sampleGroup, combineMethod = NULL)
```

## Arguments

snpData	data.frame of SNP data downloaded from TCGAbiolinks
sampleGroup	vector of sample group
combineMethod	Method of combining the pvalue of multiple snp in a gene.

## Value

data.frame

## Examples

```
library(TCGAbiolinks)
query <- GDCquery(
  project = "TCGA-CHOL",
  data.category = "Simple Nucleotide Variation",
  access = "open",
  legacy = FALSE,
  data.type = "Masked Somatic Mutation",
  workflow.type = "Aliquot Ensemble Somatic Variant Merging and Masking"
)
GDCdownload(query)
data_snp <- GDCprepare(query)
samples <- unique(data_snp$Tumor_Sample_Barcode)
sampleGroup <- sample(c("A", "B"), length(samples), replace = TRUE)
names(sampleGroup) <- samples
pvalue <- differential_SNP_tcga(snpData = data_snp,
  sampleGroup = sampleGroup)

# use demo data
snpDf <- matrix(sample(c("mutation", NA), 100, replace = TRUE), 10, 10)
snpDf <- as.data.frame(snpDf)
sampleGroup <- sample(c("A", "B"), 10, replace = TRUE)
result <- differential_SNP(snpDf, sampleGroup)
```

fpkmToTpm                      *Convert fpkm to Tpm*

---

**Description**

Convert fpkm to Tpm

**Usage**

```
fpkmToTpm(fpkm_matrix)
```

**Arguments**

fpkm\_matrix      a matrix, colnames of fpkm\_matrix are sample name, rownames of fpkm\_matrix are genes

**Value**

a matrix

**Examples**

```
lung_squ_count2 <- matrix(c(0.11, 0.22, 0.43, 0.14, 0.875,  
                          0.66, 0.77, 0.18, 0.29), ncol = 3)  
rownames(lung_squ_count2) <- c("DISC1", "TCOF1", "SPPL3")  
colnames(lung_squ_count2) <- c("sample1", "sample2", "sample3")  
result <- fpkmToTpm(lung_squ_count2)
```

---

geneExpress                      *a data.frame of gene expression data*

---

**Description**

It is a randomly generated expression data used as an example of functions in this package. the rowname is gene symbols the columns are gene expression values

**Usage**

```
geneExpress
```

**Format**

A data.frame with 10779 rows and 2 column

---

gene_ave	<i>Average the values of same genes in gene expression profile</i>
----------	--

---

**Description**

Average the values of same genes in gene expression profile

**Usage**

```
gene_ave(file_gene_ave, k = 1)
```

**Arguments**

`file_gene_ave` a data.frame of gene expression data, each column is a sample, and each row is a gene.

`k` a number, indicates which is the gene column.

**Value**

a data.frame, the values of same genes in gene expression profile

**Examples**

```
aa <- c("MARCH1", "MARC1", "MARCH1", "MARCH1", "MARCH1")
bb <- c(2.969058399, 4.722410064, 8.165514853, 8.24243893, 8.60815086)
cc <- c(3.969058399, 5.722410064, 7.165514853, 6.24243893, 7.60815086)
file_gene_ave <- data.frame(aa = aa, bb = bb, cc = cc)
colnames(file_gene_ave) <- c("Gene", "GSM1629982", "GSM1629983")

result <- gene_ave(file_gene_ave, 1)
```

---

gene_cov	<i>a data.frame of gene length and GC content</i>
----------	---

---

**Description**

the gene length and GC content data comes from TxDb.Hsapiens.UCSC.hg38.knownGene and BSgenome.Hsapiens.UCSC.hg38

**Usage**

```
gene_cov
```

**Format**

A data.frame with 27341 rows and 2 column

---

`get_geo_array`            *Get Microarray matrix data from GEO*

---

**Description**

Get Microarray matrix data from GEO

**Usage**

```
get_geo_array(gse)
```

**Arguments**

`gse`                    GSE number, such as GSE781.

**Value**

a list of matrix

**Examples**

```
arraylist <- get_geo_array("GSE781")
```

---

GSE66705\_sample2            *a matrix of gene expression data in GEO*

---

**Description**

the first column represents the gene symbol

**Usage**

```
GSE66705_sample2
```

**Format**

A matrix with 999 rows and 3 column

**Details**

the other columns represent the expression of genes

---

id_conversion_TCGA	<i>Convert ENSEMBL gene id to gene Symbol in TCGA</i>
--------------------	---

---

**Description**

Convert ENSEMBL gene id to gene Symbol in TCGA

**Usage**

```
id_conversion_TCGA(profiles, toType = "SYMBOL")
```

**Arguments**

profiles	a data.frame of gene expression data, each column is a sample, and each row is a gene.
toType	one of 'keytypes(org.Hs.eg.db)'

**Value**

a data.frame, gene symbols and their expression value

**Examples**

```
library(org.Hs.eg.db)
data(profile)
result <- id_conversion_TCGA(profile)
```

---

kegg_liver	<i>a matrix of gene expression data in TCGA</i>
------------	---

---

**Description**

It is a randomly generated expression data used as an example of functions in this package. the first column represents the gene symbol

**Usage**

```
kegg_liver
```

**Format**

A matrix with 100 rows and 150 column

**Details**

the other columns represent the expression(count) of genes

---

Merge_methy_tcga	<i>Merge methylation data downloaded from TCGA</i>
------------------	--

---

### Description

When the methylation data is downloaded from TCGA, each sample is saved in a folder, which contains the methylation value file and the descriptive file. This function can directly extract and consolidate all folders.

### Usage

```
Merge_methy_tcga(dirr = NULL)
```

### Arguments

dirr	a string for the directory of methylation data download from tcga using the tools gdc
------	---

### Value

a matrix, a combined methylation expression spectrum matrix

### Examples

```
merge_result <- Merge_methy_tcga(system.file(file.path("extdata", "methy"),
  package = "GeoTcgaData"))
```

---

module	<i>a matrix of module name, gene symbols, and the number of gene symbols</i>
--------	--

---

### Description

It is a randomly generated expression data used as an example of functions in this package.

### Usage

```
module
```

### Format

A matrix with 176 rows and 3 column

---

prepare_chi	<i>Preparer file for chi-square test</i>
-------------	--

---

**Description**

Preparer file for chi-square test

**Usage**

```
prepare_chi(cnv)
```

**Arguments**

cnv                    result of `ann_merge()`

**Value**

a matrix

**Examples**

```
cnv <- matrix(c(
  -1.09150, -1.47120, -0.87050, -0.50880,
  -0.50880, 2.0, 2.0, 2.0, 2.0, 2.0, 2.0, 2.601962, 2.621332, 2.621332,
  2.621332, 2.621332, 2.0, 2.0, 2.0, 2.0, 2.0, 2.0, 2.0, 2.0,
  2.0, 2.0, 2.0, 2.0, 2.0, 2.0, 2.0
), nrow = 5)
cnv <- as.data.frame(cnv)
rownames(cnv) <- c("AJAP1", "FHAD1", "CLCNKB", "CROCCP2", "AL137798.3")
colnames(cnv) <- c(
  "TCGA-DD-A4NS-10A-01D-A30U-01", "TCGA-ED-A82E-01A-11D-A34Y-01",
  "TCGA-WQ-A9G7-01A-11D-A36W-01", "TCGA-DD-AADN-01A-11D-A40Q-01",
  "TCGA-ZS-A9CD-10A-01D-A36Z-01", "TCGA-DD-A1EB-11A-11D-A12Y-01"
)
cnv_chi_file <- prepare_chi(cnv)
```

---

profile	<i>a matrix of gene expression data in TCGA</i>
---------	---

---

**Description**

It is a randomly generated expression data used as an example of functions in this package. the first column represents the gene symbol

**Usage**

```
profile
```

**Format**

A matrix with 10 rows and 10 column

**Details**

the other columns represent the expression(FPKM) of genes

---

repAssign	<i>Handle the case where one id corresponds to multiple genes</i>
-----------	---

---

**Description**

Handle the case where one id corresponds to multiple genes

**Usage**

```
repAssign(input_file, string)
```

**Arguments**

input_file	input file, a data.frame or a matrix, the first column should be genes.
string	a string, sep of the gene

**Value**

a data.frame, when an id corresponds to multiple genes, the expression value is assigned to each gene

**Examples**

```
aa <- c("MARCH1 /// MMA", "MARCH1", "MARCH2 /// MARCH3",  
       "MARCH3 /// MARCH4", "MARCH1")  
bb <- c("2.969058399", "4.722410064", "8.165514853",  
       "8.24243893", "8.60815086")  
cc <- c("3.969058399", "5.722410064", "7.165514853",  
       "6.24243893", "7.60815086")  
input_file <- data.frame(aa = aa, bb = bb, cc = cc)  
  
repAssign_result <- repAssign(input_file, " /// ")
```

---

repRemove	<i>Handle the case where one id corresponds to multiple genes</i>
-----------	---

---

**Description**

Handle the case where one id corresponds to multiple genes

**Usage**

```
repRemove(input_file, string)
```

**Arguments**

input_file	input file, a data.frame or a matrix, the first column should be genes.
string	a string, sep of the gene

**Value**

a data.frame, when an id corresponds to multiple genes, the expression value is deleted

**Examples**

```
aa <- c("MARCH1 /// MMA", "MARC1", "MARCH2 /// MARCH3",  
       "MARCH3 /// MARCH4", "MARCH1")  
bb <- c("2.969058399", "4.722410064", "8.165514853",  
       "8.24243893", "8.60815086")  
cc <- c("3.969058399", "5.722410064", "7.165514853",  
       "6.24243893", "7.60815086")  
input_file <- data.frame(aa = aa, bb = bb, cc = cc)  
repRemove_result <- repRemove(input_file, " /// ")
```

---

SNP_QC	<i>Do quality control of SNP data downloaded from TCGAbiolinks</i>
--------	--

---

**Description**

Do quality control of SNP data downloaded from TCGAbiolinks

**Usage**

```
SNP_QC(  
  snpData,  
  geon = 0.02,  
  mind = 0.02,  
  maf = 0.05,  
  hwe = 1e-06,  
  miss = "NoCall"  
)
```

**Arguments**

snpData	data.frame of SNP data downloaded from TCGAbiolinks
geon	filters out all variants with missing call rates exceeding the provided value (default 0.02) to be removed
mind	filters out all samples with missing call rates exceeding the provided value (default 0.02) to be removed
maf	filters out all variants with minor allele frequency below the provided threshold
hwe	filters out all variants which have Hardy-Weinberg equilibrium exact test p-value below the provided threshold
miss	character of miss value

**Value**

data.frame

**Examples**

```
# use demo data
snpDf <- matrix(sample(c("AA", "Aa", "aa"), 100, replace = TRUE), 10, 10)
snpDf <- as.data.frame(snpDf)
sampleGroup <- sample(c("A", "B"), 10, replace = TRUE)
result <- SNP_QC(snpDf)
```

---

ventricle

*a matrix of gene expression data in GEO*

---

**Description**

It is a randomly generated expression data used as an example of functions in this package. the first column represents the gene symbol

**Usage**

```
ventricle
```

**Format**

A matrix with 32 rows and 20 column

**Details**

the other columns represent the expression of genes

# Index

- \* **datasets**
  - gene\_cov, [19](#)
  - geneExpress, [18](#)
  - GSE66705\_sample2, [20](#)
  - kegg\_liver, [21](#)
  - module, [22](#)
  - profile, [23](#)
  - ventricle, [26](#)
- array\_preprocess, [3](#)
- cal\_mean\_module, [3](#)
- cluster\_array, [4](#)
- combine\_pvalue, [5](#)
- countToFpkm, [5](#)
- countToTpm, [6](#)
- differential\_array, [7](#)
- differential\_CNV, [8](#)
- differential\_limma, [9](#)
- differential\_methy, [10](#)
- differential\_RNA, [12](#)
- differential\_SNP, [15](#)
- differential\_SNP\_GEO, [16](#)
- differential\_SNP\_tcga, [17](#)
- fpkmToTpm, [18](#)
- gene\_ave, [19](#)
- gene\_cov, [19](#)
- geneExpress, [18](#)
- get\_geo\_array, [20](#)
- GSE66705\_sample2, [20](#)
- id\_conversion\_TCGA, [21](#)
- kegg\_liver, [21](#)
- Merge\_methy\_tcga, [22](#)
- module, [22](#)
- p.adjust, [11](#), [13](#)
- prepare\_chi, [23](#)
- profile, [23](#)
- repAssign, [24](#)
- repRemove, [25](#)
- SNP\_QC, [25](#)
- ventricle, [26](#)