Package 'PathoStat'

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Type Package

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Description The purpose of this package is to perform Statistical Microbiome Analysis on metagenomics results from sequencing data samples. In particular, it supports analyses on the PathoScope generated report files. PathoStat provides various functionalities including Relative Abundance charts, Diversity estimates and plots, tests of Differential Abundance, Time Series visualization, and Core OTU analysis.

URL https://github.com/mani2012/PathoStat

BugReports https://github.com/mani2012/PathoStat/issues

License GPL (>= 2)

Depends R (>= 3.5)

Imports limma, corpcor,matrixStats, reshape2, scales, ggplot2, rentrez, DT, tidyr, plyr, dplyr, phyloseq, shiny, stats, methods, XML, graphics, utils, BiocStyle, edgeR, DESeq2, ComplexHeatmap, plotly, webshot, vegan, shinyjs, glmnet, gmodels, ROCR, RColorBrewer, knitr, devtools, ape

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biocViews Microbiome, Metagenomics, GraphAndNetwork, Microarray, PatternLogic, PrincipalComponent, Sequencing, Software, Visualization, RNASeq, ImmunoOncology

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R topics documented:

`Bootstrap_LOOCV_LR_AUC` *Do bootstrap and LOOCV*

Description

Do bootstrap and LOOCV

Usage

```
Bootstrap_LOOCV_LR_AUC(df, targetVec, nboot = 50)
```

Arguments

`df`	Row is sample, column is feature. Required
`targetVec`	y vector. Required
`nboot`	number of BOOTSTRAP

Value

bootstrap loocv result dataframe

Examples

```
data('iris')
Bootstrap_LOOCV_LR_AUC(iris[,1:4],
c(rep(1,100), rep(0,50)), nboot = 3)
```

`Chisq_Test_Pam` *Given PAM and disease/control annotation, do Chi-square test for each row of PAM*

Description

Given PAM and disease/control annotation, do Chi-square test for each row of PAM

Usage

```
Chisq_Test_Pam(pam, label.vec.num, pvalue.cutoff = 0.05)
```

Arguments

pam	Input data object that contains the data to be tested. Required
label.vec.num	The target binary condition. Required
pvalue.cutoff	choose p-value cut-off

Value

df.output object

Examples

```
tmp <- matrix(rbinom(12,1,0.5), nrow = 3)
rownames(tmp) <- c("a", "b", "c")
Chisq_Test_Pam(tmp, c(1,1,0,0))
```

---

findRAfromCount *Return the Relative Abundance (RA) data for the given count OTU table*

Description

Return the Relative Abundance (RA) data for the given count OTU table

Usage

```
findRAfromCount(count_otu)
```

Arguments

count_otu	Count OTU table

Value

ra_otu Relative Abundance (RA) OTU table

Examples

```
data_dir <- system.file("data", package = "PathoStat")
infileName <- "pstat_data.rda"
pstat_test <- loadPstat(data_dir, infileName)
ra_otu <- findRAfromCount(phyloseq::otu_table(pstat_test))
```

findTaxonMat *Find the Taxonomy Information Matrix*

Description

Find the Taxonomy Information Matrix

Usage

```
findTaxonMat(names, taxonLevels)
```

Arguments

names	Row names of the taxonomy matrix
taxonLevels	Taxon Levels of all tids

Value

taxmat Taxonomy Information Matrix

Examples

```
example_data_dir <- system.file("example/data", package = "PathoStat")
pathoreport_file_suffix <- "-sam-report.tsv"
datlist <- readPathoscopeData(example_data_dir, pathoreport_file_suffix,
input.files.name.vec = as.character(1:6))
dat <- datlist$data
ids <- rownames(dat)
tids <- unlist(lapply(ids, FUN = grepTid))
# taxonLevels <- findTaxonomy(tids[1:5])
# taxmat <- findTaxonMat(ids[1:5], taxonLevels)
```

findTaxonomy *Find the taxonomy for unlimited tids*

Description

Find the taxonomy for unlimited tids

Usage

```
findTaxonomy(tids)
```

Arguments

tids	Given taxonomy ids

Value

taxondata Data with the taxonomy information

Examples

```
example_data_dir <- system.file("example/data", package = "PathoStat")
pathoreport_file_suffix <- "-sam-report.tsv"
datlist <- readPathoscopeData(example_data_dir, pathoreport_file_suffix,
input.files.name.vec = as.character(1:6))
dat <- datlist$data
ids <- rownames(dat)
tids <- unlist(lapply(ids, FUN = grepTid))
# taxonLevels <- findTaxonomy(tids[1:5])
```

`findTaxonomy300` *Find the taxonomy for maximum 300 tids*

Description

Find the taxonomy for maximum 300 tids

Usage

```
findTaxonomy300(tids)
```

Arguments

`tids`	Given taxonomy ids

Value

taxondata Data with the taxonomy information

Examples

```
example_data_dir <- system.file("example/data", package = "PathoStat")
pathoreport_file_suffix <- "-sam-report.tsv"
datlist <- readPathoscopeData(example_data_dir,
pathoreport_file_suffix, input.files.name.vec = as.character(1:6))
dat <- datlist$data
ids <- rownames(dat)
tids <- unlist(lapply(ids, FUN = grepTid))
# taxonLevels <- findTaxonomy300(tids[1:5])
```

Fisher_Test_Pam — *Given PAM and disease/control annotation, do Chi-square test for each row of PAM*

Description

Given PAM and disease/control annotation, do Chi-square test for each row of PAM

Usage

```
Fisher_Test_Pam(pam, label.vec.num, pvalue.cutoff = 0.05)
```

Arguments

pam	Input data object that contains the data to be tested. Required
label.vec.num	The target binary condition. Required
pvalue.cutoff	choose p-value cut-off

Value

df.output object

Examples

```
tmp <- matrix(rbinom(12,1,0.5), nrow = 3)
rownames(tmp) <- c("a", "b", "c")
Fisher_Test_Pam(tmp, c(1,1,0,0))
```

formatTaxTable — *Format taxonomy table for rendering*

Description

Format taxonomy table for rendering

Usage

```
formatTaxTable(ttable)
```

Arguments

ttable	Taxonomy table

Value

Formatted table suitable for rendering with. DT::renderDataTable

getShinyInput *Getter function to get the shinyInput option*

Description

Getter function to get the shinyInput option

Usage

```
getShinyInput()
```

Value

shinyInput option

Examples

```
getShinyInput()
```

getShinyInputCombat *Getter function to get the shinyInputCombat option*

Description

Getter function to get the shinyInputCombat option

Usage

```
getShinyInputCombat()
```

Value

shinyInputCombat option

Examples

```
getShinyInputCombat()
```

`getShinyInputOrig` *Getter function to get the shinyInputOrig option*

Description

Getter function to get the shinyInputOrig option

Usage

```
getShinyInputOrig()
```

Value

shinyInputOrig option

Examples

```
getShinyInputOrig()
```

`getSignatureFromMultipleGlmnet` *Use Lasso to do feature selection*

Description

Use Lasso to do feature selection

Usage

```
getSignatureFromMultipleGlmnet(df.input, target.vec, nfolds = 10,
  logisticRegression = TRUE, nRun = 100, alpha = 1)
```

Arguments

`df.input`	Row is sample, column is feature. Required
`target.vec`	y vector. Required
`nfolds`	glmnet CV nfolds
`logisticRegression`	doing logistic regression or linear regression.
`nRun`	number of glmnet runs
`alpha`	same as in glmnet

Value

signature

Examples

```
data('iris')
getSignatureFromMultipleGlmnet(iris[,1:4],
c(rep(1,100), rep(0,50)), nfolds = 3, nRun = 10)
```

GET_PAM *transform cpm counts to presence-absence matrix*

Description

transform cpm counts to presence-absence matrix

Usage

```
GET_PAM(df)
```

Arguments

df	Input data object that contains the data to be tested. Required

Value

df.output object

Examples

```
GET_PAM(data.frame(a = c(1,3,0), b = c(0,0.1,2)))
```

---

grepTid *Greps the tid from the given identifier string*

Description

Greps the tid from the given identifier string

Usage

```
grepTid(id)
```

Arguments

id	Given identifier string

Value

tid string

Examples

```
grepTid("ti|700015|org|Coriobacterium_glomerans_PW2")
```

`loadPathoscopeReports` *Loads all data from a set of PathoID reports. For each column in the PathoID report, construct a matrix where the rows are genomes and the columns are samples. Returns a list where each element is named according to the PathoID column. For example, ret[["Final.Best.Hit.Read.Numbers"]] on the result of this function will get you the final count matrix. Also includes elements "total_reads" and "total_genomes" from the first line of the PathoID report.*

Description

Loads all data from a set of PathoID reports. For each column in the PathoID report, construct a matrix where the rows are genomes and the columns are samples. Returns a list where each element is named according to the PathoID column. For example, ret[["Final.Best.Hit.Read.Numbers"]] on the result of this function will get you the final count matrix. Also includes elements "total_reads" and "total_genomes" from the first line of the PathoID report.

Usage

```
loadPathoscopeReports(reportfiles, nrows = NULL)
```

Arguments

`reportfiles`	Paths to report files
`nrows`	Option to read first N rows of PathoScope reports

Value

Returns a list where each element is named according to the PathoID column. For example, ret[["Final.Best.Hit.Read.Numbers"]] on the result of this function will get you the final count matrix. Also includes elements "total_reads" and "total_genomes" from the first line of the PathoID report.

Examples

```
input_dir <- system.file("example/data", package = "PathoStat")
reportfiles <- list.files(input_dir, pattern = "*-sam-report.tsv",
full.names = TRUE)
```

loadPstat *Load the R data(.rda) file with pathostat object*

Description

Load the R data(.rda) file with pathostat object

Usage

```
loadPstat(indir = ".", infileName = "pstat_data.rda")
```

Arguments

indir	Input Directory of the .rda file
infileName	File name of the .rda file

Value

pstat pathostat object (NULL if it does not exist)

Examples

```
data_dir <- system.file("data", package = "PathoStat")
infileName <- "pstat_data.rda"
pstat <- loadPstat(data_dir, infileName)
```

log2CPM *Compute log2(counts per mil reads) and library size for each sample*

Description

Compute log2(counts per mil reads) and library size for each sample

Usage

```
log2CPM(qcounts, lib.size = NULL)
```

Arguments

qcounts	quantile normalized counts
lib.size	default is colsums(qcounts)

Value

list containing log2(quantile counts per mil reads) and library sizes

Examples

```
log2CPM(matrix(1:12, nrow = 3))
```

`LOOAUC_simple_multiple_noplot_one_df` *LOOCV*

Description

LOOCV

Usage

```
LOOAUC_simple_multiple_noplot_one_df(df, targetVec)
```

Arguments

`df`	Row is sample, column is feature. Required
`targetVec`	y vector. Required

Value

mean auc

Examples

```
data('iris')
LOOAUC_simple_multiple_noplot_one_df(iris[,1:4],
c(rep(1,100), rep(0,50)))
```

`LOOAUC_simple_multiple_one_df` *LOOCV with ROC curve*

Description

LOOCV with ROC curve

Usage

```
LOOAUC_simple_multiple_one_df(df, targetVec)
```

Arguments

`df`	Row is sample, column is feature. Required
`targetVec`	y vector. Required

Value

the ROC

Examples

```
data('iris')
LOOAUC_simple_multiple_one_df(iris[,1:4],
c(rep(1,100), rep(0,50)))
```

PathoStat-class *PathoStat class to store PathoStat input data including phyloseq object*

Description

Contains all currently-supported BatchQC output data classes:

Details

slots:

average_count a single object of class otu_tableOrNULL

besthit_count a single object of class otu_tableOrNULL

highconf_count a single object of class otu_tableOrNULL

lowconf_count a single object of class otu_tableOrNULL

Examples

```
otumat = matrix(sample(1:100, 100, replace = TRUE), nrow = 10, ncol = 10)
rownames(otumat) <- paste0("OTU", 1:nrow(otumat))
colnames(otumat) <- paste0("Sample", 1:ncol(otumat))
taxmat = matrix(sample(letters, 70, replace = TRUE),
nrow = nrow(otumat), ncol = 7)
rownames(taxmat) <- rownames(otumat)
colnames(taxmat) <- c("Domain", "Phylum", "Class",
"Order", "Family", "Genus", "Species")
OTU = phyloseq::otu_table(otumat, taxa_are_rows = TRUE)
TAX = phyloseq::tax_table(taxmat)
physeq = phyloseq::phyloseq(OTU, TAX)
pathostat1(physeq)
```

percent *Compute percentage*

Description

Compute percentage

Usage

```
percent(x, digits = 2, format = "f")
```

Arguments

x	a number or a vector
digits	how many digit of percentage
format	numeric format, "f" for float

Value

the percentage

Examples

```
pecent.vec <- percent(c(0.9, 0.98))
```

phyloseq_to_edgeR *Convert phyloseq OTU count data into DGEList for edgeR package*

Description

Further details.

Usage

```
phyloseq_to_edgeR(physeq, group, method = "RLE", ...)
```

Arguments

physeq	(Required).
group	(Required). A character vector or factor giving the experimental group/condition for each sample/library.
method	(Optional).
...	Additional arguments passed on to

Value

dispersion

Examples

```
data_dir_test <- system.file("data", package = "PathoStat")
pstat_test <- loadPstat(indir=data_dir_test,
infileName="pstat_data_2_L1.rda")
phyloseq_to_edgeR(pstat_test, group="Sex")
```

---

plotPCAPlotly *Plot PCA*

Description

Plot PCA

Usage

```
plotPCAPlotly(df.input, condition.color.vec,
  condition.color.name = "condition", condition.shape.vec = NULL,
  condition.shape.name = "condition", columnTitle = "Title",
  pc.a = "PC1", pc.b = "PC2")
```

Arguments

df.input	Input data object that contains the data to be plotted. Required
condition.color.vec	color vector. Required
condition.color.name	color variable name. Required
condition.shape.vec	shape vector. Required
condition.shape.name	shape variable name. Required
columnTitle	Title to be displayed at top of heatmap.
pc.a	pc.1
pc.b	pc.2

Value

the plot

Examples

```
data('iris')
plotPCAPlotly(t(iris[,1:4]),
condition.color.vec = c(rep(1,100), rep(0,50)),
condition.shape.vec = c(rep(0,100), rep(1,50)))
```

`plotPCoAPlotly` *Plot PCoA*

Description

Plot PCoA

Usage

```
plotPCoAPlotly(physeq.input, condition.color.vec,
  condition.color.name = "condition", condition.shape.vec = NULL,
  condition.shape.name = "condition", method = "bray",
  columnTitle = "Title", pc.a = "Axis.1", pc.b = "Axis.2")
```

Arguments

`physeq.input`	Input data object that contains the data to be plotted. Required
`condition.color.vec`	color vector. Required
`condition.color.name`	color variable name. Required
`condition.shape.vec`	shape vector. Required
`condition.shape.name`	shape variable name. Required
`method`	which distance metric
`columnTitle`	Title to be displayed at top of heatmap.
`pc.a`	pc.1
`pc.b`	pc.2

Value

the plot

Examples

```
data_dir_test <- system.file("data", package = "PathoStat")
pstat_test <- loadPstat(indir=data_dir_test,
infileName="pstat_data_2_L1.rda")
plotPCoAPlotly(pstat_test, condition.color.vec = rbinom(33,1,0.5),
condition.shape.vec = rbinom(33,1,0.5))
```

pstat_data *pathostat object generated from example pathoscope report files*

Description

This example data consists of 33 samples from a diet study with 11 subjects taking 3 different diets in random order

Usage

```
pstat
```

Format

pathostat object extension of phyloseq-class experiment-level object:

otu_table OTU table with 41 taxa and 33 samples

sample_data Sample Data with 33 samples by 18 sample variables

tax_table Taxonomy Table with 41 taxa by 9 taxonomic ranks

sample_data Phylogenetic Tree with 41 tips and 40 internal nodes

Value

pathostat object

readPathoscopeData *Reads the data from PathoScope reports and returns a list of final guess relative abundance and count data*

Description

Reads the data from PathoScope reports and returns a list of final guess relative abundance and count data

Usage

```
readPathoscopeData(input_dir = ".",
  pathoreport_file_suffix = "-sam-report.tsv", use.input.files = FALSE,
  input.files.path.vec = NULL, input.files.name.vec = NULL)
```

Arguments

input_dir	Directory where the tsv files from PathoScope are located
pathoreport_file_suffix	PathoScope report files suffix
use.input.files	whether input dir to pathoscope files or directly pathoscope files
input.files.path.vec	vector of pathoscope file paths
input.files.name.vec	vector of pathoscope file names

Value

List of final guess relative abundance and count data

Examples

```
example_data_dir <- system.file("example/data", package = "PathoStat")
pathoreport_file_suffix <- "-sam-report.tsv"
datlist <- readPathoscopeData(example_data_dir, pathoreport_file_suffix,
input.files.name.vec = as.character(1:6))
```

---

runPathoStat *Statistical Microbiome Analysis on the pathostat input and generates a html report and produces interactive shiny app plots*

Description

Statistical Microbiome Analysis on the pathostat input and generates a html report and produces interactive shiny app plots

Usage

```
runPathoStat(pstat = NULL, report_dir = ".",
  report_option_binary = "111111111", interactive = TRUE)
```

Arguments

pstat	phyloseq extension pathostat object
report_dir	Output report directory path
report_option_binary	9 bits Binary String representing the plots to display and hide in the report
interactive	when TRUE, opens the interactive shinyApp

Value

outputfile The output file with all the statistical plots

Examples

```
runPathoStat(interactive = FALSE)
```

`savePstat` *Save the pathostat object to R data(.rda) file*

Description

Save the pathostat object to R data(.rda) file

Usage

```
savePstat(pstat, outdir = ".", outfileName = "pstat_data.rda")
```

Arguments

`pstat`	pathostat object
`outdir`	Output Directory of the .rda file
`outfileName`	File name of the .rda file

Value

outfile .rda file

Examples

```
data_dir_test <- system.file("data", package = "PathoStat")
pstat_test <- loadPstat(indir=data_dir_test,
infileName="pstat_data_2_L1.rda")
outfile <- savePstat(pstat_test)
```

`setShinyInput` *Setter function to set the shinyInput option*

Description

Setter function to set the shinyInput option

Usage

```
setShinyInput(x)
```

Arguments

`x`	shinyInput option

Value

shinyInput option

Examples

```
setShinyInput(NULL)
```

---

setShinyInputCombat *Setter function to set the shinyInputCombat option*

Description

Setter function to set the shinyInputCombat option

Usage

```
setShinyInputCombat(x)
```

Arguments

x	shinyInputCombat option

Value

shinyInputCombat option

Examples

```
setShinyInputCombat(NULL)
```

---

setShinyInputOrig *Setter function to set the shinyInputOrig option*

Description

Setter function to set the shinyInputOrig option

Usage

```
setShinyInputOrig(x)
```

Arguments

x	shinyInputOrig option

Value

shinyInputOrig option

Examples

```
setShinyInputOrig(NULL)
```

---

summarizeTable *Summarize sample*

Description

Creates a table of summary metrics

Usage

```
summarizeTable(pstat)
```

Arguments

pstat	Input pstat

Value

A data.frame object of summary metrics.

Examples

```
data_dir_test <- system.file("data", package = "PathoStat")
pstat_test <- loadPstat(indir=data_dir_test,
infileName="pstat_data_2_L1.rda")
st.tmp <- summarizeTable(pstat_test)
```

TranslateIdToTaxLevel *Find the taxonomy for the given taxon id name*

Description

Find the taxonomy for the given taxon id name

Usage

```
TranslateIdToTaxLevel(pstat, input.id.vec, tax.level)
```

Arguments

pstat	pathostat object
input.id.vec	names containing id
tax.level	target taxon level

Value

target taxon level names

Examples

```
data_dir_test <- system.file("data", package = "PathoStat")
pstat_test <- loadPstat(indir=data_dir_test,
infileName="pstat_data_2_L1.rda")
names.new <- TranslateIdToTaxLevel(pstat_test,
c("ti|862962|org|Bacteroides_fragilis_638R",
"ti|697329|org|Ruminococcus_albus_7" ),
"genus")
```

Wilcox_Test_df *Mann-whitney test for a dataframe*

Description

Mann-whitney test for a dataframe

Usage

```
Wilcox_Test_df(df, label.vec.num, pvalue.cutoff = 0.05)
```

Arguments

df	Input data object that contains the data to be tested. Required
label.vec.num	The target binary condition. Required
pvalue.cutoff	choose p-value cut-off

Value

df.output object

Examples

```
data('iris')
Wilcox_Test_df(t(iris[,1:4]),
c(rep(1,100), rep(0,50)))
```

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