

# Package ‘animalcules’

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**Title** Interactive microbiome analysis toolkit

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**Description** animalcules is an R package for utilizing up-to-date data analytics, visualization methods, and machine learning models to provide users an easy-to-use interactive microbiome analysis framework. It can be used as a standalone software package or users can explore their data with the accompanying interactive R Shiny application. Traditional microbiome analysis such as alpha/beta diversity and differential abundance analysis are enhanced, while new methods like biomarker identification are introduced by animalcules. Powerful interactive and dynamic figures generated by animalcules enable users to understand their data better and discover new insights.

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---

alpha\_div\_boxplot      *Alpha diversity boxplot*

---

**Description**

Alpha diversity boxplot

**Usage**

```
alpha_div_boxplot(MAE, tax_level, condition,  
  alpha_metric = c("inverse_simpson", "gini_simpson", "shannon",  
  "fisher", "coverage"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
condition	Which condition to group samples
alpha_metric	Which alpha diversity metric to use

**Value**

A plotly object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')  
toy_data <- readRDS(data_dir)  
p <- alpha_div_boxplot(toy_data,  
  tax_level = 'genus',  
  condition = 'DISEASE',  
  alpha_metric = 'shannon')  
  
p
```

---

alpha\_div\_test      *Get alpha diversity*

---

**Description**

Get alpha diversity

**Usage**

```
alpha_div_test(sam_table, alpha_stat)
```

**Arguments**

sam_table	A dataframe with 2 cols, richness and condition
alpha_stat	Wilcoxon rank sum test or T-test for the test

**Value**

A dataframe

**Examples**

```
df_test <- data.frame(richness = seq_len(10),
  condition = c(rep(1,5), rep(0,5)))
alpha_div_test(df_test,alpha_stat='Wilcoxon rank sum test')
```

---

counts_to_logcpm	<i>Covert a counts table to a relative abundances table</i>
------------------	---

---

**Description**

Covert a counts table to a relative abundances table

**Usage**

```
counts_to_logcpm(counts_table)
```

**Arguments**

counts\_table    A organism x sample data frame of counts

**Value**

A organism x sample data frame of logcpm counts

**Examples**

```
logcpm <- counts_to_logcpm(as.data.frame(matrix(seq_len(12),4)))
```

---

counts_to_relabu	<i>Covert a counts table to a relative abundances table</i>
------------------	---

---

**Description**

Covert a counts table to a relative abundances table

**Usage**

```
counts_to_relabu(counts_table)
```

**Arguments**

counts\_table    A organism x sample data frame of counts

**Value**

A organism x sample data frame of relative abundances

**Examples**

```
counts_to_relabu(matrix(seq_len(12),4))
```

---

df_char_to_factor	<i>Factorize all categorical columns</i>
-------------------	--

---

**Description**

Factorize all categorical columns

**Usage**

```
df_char_to_factor(df)
```

**Arguments**

df                    A sample x condition data frame

**Value**

A sample x condition data frame

**Examples**

```
df_char_to_factor(matrix(seq_len(12)))
```

---

differential_abundance	<i>Differential abundance analysis</i>
------------------------	--

---

**Description**

Differential abundance analysis

**Usage**

```
differential_abundance(MAE, tax_level, input_da_condition = c(),
  input_da_condition_covariate = NULL, min_num_filter = 5,
  input_da_padj_cutoff = 0.05, method = "DESeq2")
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
input_da_condition	Which condition is the target condition
input_da_condition_covariate	Covariates added to linear function
min_num_filter	Minimum number reads mapped to this microbe
input_da_padj_cutoff	adjusted pValue cutoff
method	choose between DESeq2 and limma

**Value**

A output dataframe

**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
differential_abundance(toy_data,
  tax_level="phylum",
  input_da_condition=c("DISEASE"),
  min_num_filter = 2,
  input_da_padj_cutoff = 0.5,
  method = "DESeq2")
```

---

dimred\_pca

*Dimensionality reduction through PCA*

---

**Description**

Dimensionality reduction through PCA

**Usage**

```
dimred_pca(MAE, tax_level, color, shape = NULL, pcx = 1, pcy = 2,
  pcz = NULL, datatype = c("logcpm", "relabu", "counts"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
color	A condition to color data points by e.g. "AGE"
shape	A condition to shape data points by e.g. "SEX"
pcx	Principal component on the x-axis e.g. 1
pcy	Principal component on the y-axis e.g. 2
pcz	Principal component on the z-axis e.g. 3
datatype	Datatype to use e.g. c("logcpm", "relabu", "counts")

**Value**

A list with a plotly object and summary table

**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
result <- dimred_pcoa(toy_data,
                      tax_level="genus",
                      color="AGE",
                      shape="DISEASE",
                      pcx=1,
                      pcy=2,
                      datatype="logcpm")

result$plot
result$table
```

---

 dimred\_pcoa

*Dimensionality reduction through PCoA*


---

**Description**

Dimensionality reduction through PCoA

**Usage**

```
dimred_pcoa(MAE, tax_level, color, shape = NULL, axx = 1, axy = 2,
            axz = NULL, method = c("bray", "jaccard"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
color	A condition to color data points by e.g. "AGE"
shape	A condition to shape data points by e.g. "SEX"
axx	Principle coordinate on the x-axis e.g. 1
axy	Principle coordinate on the y-axis e.g. 2
axz	Principle coordinate on the z-axis e.g. 2
method	Method to use e.g. c("bray", "jaccard")

**Value**

A list with a plotly object and summary table

**Examples**

```

data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
result <- dimred_pcoa(toy_data,
                      tax_level="genus",
                      color="AGE",
                      shape="DISEASE",
                      axx=1,
                      axy=2,
                      method="bray")

result$plot
result$table

```

---

dimred\_tsne

*Dimensionality reduction through t-SNE*


---

**Description**

Dimensionality reduction through t-SNE

**Usage**

```

dimred_tsne(MAE, tax_level, color, shape = NULL, k = c("2D", "3D"),
            initial_dims = 30, perplexity = 10, datatype = c("logcpm",
            "relabu", "counts"), tsne_cache = NULL)

```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
color	A condition to color data points by e.g. "AGE"
shape	A condition to shape data points by e.g. "SEX"
k	Plot dimensions e.g. c("2D","3D")
initial_dims	The number of dimensions to use in reduction method
perplexity	Optimal number of neighbors
datatype	Datatype to use e.g. c("logcpm", "relabu", "counts")
tsne_cache	Pass the cached data back into the function

**Value**

A list with a plotly object and cached data



**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
p <- dimred_tsne(toy_data,
                 tax_level="phylum",
                 color="AGE",
                 shape="GROUP",
                 k="3D",
                 initial_dims=30,
                 perplexity=10,
                 datatype="logcpm")
p
```

---

diversities

*Get alpha diversity*

---

**Description**

Get alpha diversity

**Usage**

```
diversities(counts_table, index = "all", zeroes = TRUE)
```

**Arguments**

counts_table	A dataframe with organism x sample
index	One of inverse_simpson,gini_simpson,shannon,fisher,coverage
zeroes	A boolean for whether to ignore zero values

**Value**

A list of alpha diversity

**Examples**

```
diversities(matrix(seq_len(12), nrow = 3),index="shannon")
```

---

diversities\_help      *Get alpha diversity*

---

**Description**

Get alpha diversity

**Usage**

```
diversities_help(counts_table, index = "all", zeroes = TRUE)
```

**Arguments**

counts\_table      A dataframe with organism x sample  
 index              one of inverse\_simpson,gini\_simpson,shannon,fisher,coverage  
 zeroes             A boolean for whether to ignore zero values

**Value**

A list of alpha diversity

**Examples**

```
diversities_help(matrix(seq_len(12), nrow = 3),index='shannon')
```

---

diversity\_beta\_boxplot  
                          *Beta diversity boxplot*

---

**Description**

Beta diversity boxplot

**Usage**

```
diversity_beta_boxplot(MAE, tax_level, input_beta_method,  
                         input_select_beta_condition)
```

**Arguments**

MAE                 A multi-assay experiment object  
 tax\_level          The taxon level used for organisms  
 input\_beta\_method  
                       bray, jaccard  
 input\_select\_beta\_condition  
                       Which condition to group samples

**Value**

A plotly object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
p <- diversity_beta_boxplot(toy_data,
                           tax_level = 'genus',
                           input_beta_method = 'bray',
                           input_select_beta_condition = 'DISEASE')
p
```

---

diversity\_beta\_heatmap

*Beta diversity heatmap*

---

**Description**

Beta diversity heatmap

**Usage**

```
diversity_beta_heatmap(MAE, tax_level, input_beta_method,
                       input_bdhm_select_conditions, input_bdhm_sort_by = c("nosort",
"conditions"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
input_beta_method	bray, jaccard
input_bdhm_select_conditions	Which condition to group samples
input_bdhm_sort_by	Sorting option e.g. "nosort", "conditions"

**Value**

A plotly object

**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
p <- diversity_beta_heatmap(toy_data,
                           tax_level = "genus",
                           input_beta_method = "bray",
                           input_bdhm_select_conditions = "DISEASE",
```

```

input_bdhm_sort_by = "conditions")
p

```

---

diversity\_beta\_test    *Beta diversity test (by default we use bray-curtis distance)*

---

### Description

Beta diversity test (by default we use bray-curtis distance)

### Usage

```

diversity_beta_test(MAE, tax_level, input_beta_method,
  input_select_beta_condition, input_select_beta_stat_method,
  input_num_permutation_permanova = 999)

```

### Arguments

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
input_beta_method	bray, jaccard
input_select_beta_condition	Which condition to group samples
input_select_beta_stat_method	PERMANOVA, Kruskal-Wallis, Wilcoxon test
input_num_permutation_permanova	number of permutations

### Value

A plotly object

### Examples

```

data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
p <- diversity_beta_test(toy_data,
  tax_level = 'genus',
  input_beta_method = 'bray',
  input_select_beta_condition = 'DISEASE',
  input_select_beta_stat_method = 'PERMANOVA',
  input_num_permutation_permanova = 999)
p

```

---

do\_alpha\_div\_test      *Alpha diversity statistical test*

---

**Description**

Alpha diversity statistical test

**Usage**

```
do_alpha_div_test(MAE, tax_level, condition,
  alpha_metric = c("inverse_simpson", "gini_simpson", "shannon",
    "fisher", "coverage"), alpha_stat = c("Wilcoxon rank sum test",
    "T-test", "Kruskal-Wallis"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
condition	Which condition to group samples
alpha_metric	Which alpha diversity metric to use
alpha_stat	Which stat test to use

**Value**

A dataframe

**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
p <- do_alpha_div_test(toy_data,
  tax_level = "genus",
  condition = "DISEASE",
  alpha_metric = "shannon",
  alpha_stat = "Wilcoxon rank sum test")
p
```

---

filter\_categorize      *Categorize continuous variables*

---

**Description**

Categorize continuous variables

**Usage**

```
filter_categorize(sam_table, sample_condition, new_label, nbins = NULL,
  bin_breaks = c(), bin_labels = c())
```

**Arguments**

sam_table	A sample x condition dataframe
sample_condition	Continuous variable to categorize
new_label	Column name for categorized variable
nbins	Auto select ranges for n bins/categories
bin_breaks	Manually select ranges for bins/categories
bin_labels	Manually label bins/categories

**Value**

A list with an updated sample table and before/after plots

**Examples**

```
library(SummarizedExperiment)
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
microbe <- MultiAssayExperiment::experiments(toy_data)[[1]]
samples <- as.data.frame(colData(microbe))
result <- filter_categorize(samples,
                            sample_condition = 'AGE',
                            new_label='AGE_GROUP',
                            bin_breaks=c(0,55,75,100),
                            bin_labels=c('Young','Adult','Elderly'))

result$sam_table
result$plot.unbinned
result$plot.binned
```

---

filter\_summary\_bottom *Data visualization by barplot*

---

**Description**

Data visualization by barplot

**Usage**

```
filter_summary_bottom(MAE, samples_discard, filter_type, sample_condition)
```

**Arguments**

MAE	A multi-assay experiment object
samples_discard	The list of samples to filter
filter_type	Either 'By Microbes' or 'By Metadata'
sample_condition	Which condition to check e.g. 'SEX'



---

find_biomarker	<i>Identify biomarkers</i>
----------------	----------------------------

---

**Description**

Identify biomarkers

**Usage**

```
find_biomarker(MAE, tax_level, input_select_target_biomarker, nfolds = 3,
  nrepeats = 3, seed = 99, percent_top_biomarker = 0.2,
  model_name = c("logistic regression", "random forest"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
input_select_target_biomarker	Which condition is the target condition
nfolds	number of splits in CV
nrepeats	number of CVs with different random splits
seed	for repeatable research
percent_top_biomarker	Top importance percentage to pick biomarker
model_name	one of 'logistic regression', 'random forest'

**Value**

A list

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
p <- find_biomarker(toy_data,
  tax_level='genus',
  input_select_target_biomarker=c('DISEASE'),
  nfolds = 3,
  nrepeats = 3,
  seed = 99,
  percent_top_biomarker = 0.2,
  model_name = 'logistic regression')
p
```



---

find_taxonomy	<i>Find the taxonomy for unlimited tids</i>
---------------	---

---

**Description**

Find the taxonomy for unlimited tids

**Usage**

```
find_taxonomy(tids)
```

**Arguments**

tids                    Given taxonomy ids

**Value**

A list of taxon levels with information

**Examples**

```
taxonLevels <- find_taxonomy(tids=1200)
```

---

find_taxonomy_300	<i>Find the taxonomy for maximum 300 tids</i>
-------------------	---

---

**Description**

Find the taxonomy for maximum 300 tids

**Usage**

```
find_taxonomy_300(tids)
```

**Arguments**

tids                    Given taxonomy ids

**Value**

taxondata Data with the taxonomy information

**Examples**

```
taxonLevels <- find_taxonomy_300(tids=1200)
```

find\_taxon\_mat            *Find the Taxonomy Information Matrix*

---

**Description**

Find the Taxonomy Information Matrix

**Usage**

```
find_taxon_mat(names, taxonLevels)
```

**Arguments**

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

**Value**

taxmat Taxonomy Information Matrix

**Examples**

```
ids <- c("ti|54005", "ti|73001", "ti|573", "ti|228277", "ti|53458")
tids <- c("54005", "73001", "573", "228277", "53458")
taxonLevels <- find_taxonomy(tids)
tax_table <- find_taxon_mat(ids, taxonLevels)
```

---

gini\_simpson            *Get alpha diversity using gini*

---

**Description**

Get alpha diversity using gini

**Usage**

```
gini_simpson(x)
```

**Arguments**

x	A list of counts
---	------------------

**Value**

A single value

**Examples**

```
gini_simpson(seq_len(10))
```

---

grep_tid	<i>Greps the tid from the given identifier string</i>
----------	---

---

**Description**

Greps the tid from the given identifier string

**Usage**

```
grep_tid(id)
```

**Arguments**

id	Given identifier string
----	-------------------------

**Value**

tid string

**Examples**

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

---

inverse_simpson	<i>Get alpha diversity using inverse simpson</i>
-----------------	--

---

**Description**

Get alpha diversity using inverse simpson

**Usage**

```
inverse_simpson(x)
```

**Arguments**

x	A list of counts
---	------------------

**Value**

A single value

**Examples**

```
inverse_simpson(seq_len(10))
```

---

is_categorical	<i>Check if object is categorical</i>
----------------	---------------------------------------

---

**Description**

Check if object is categorical

**Usage**

```
is_categorical(v)
```

**Arguments**

v                    A single value

**Value**

Boolean

**Examples**

```
nums <- 2  
is_categorical(nums)
```

---

is_integer0	<i>check if integer(0)</i>
-------------	----------------------------

---

**Description**

check if integer(0)

**Usage**

```
is_integer0(x)
```

**Arguments**

x                    A single value

**Value**

Boolean

**Examples**

```
nums <- 2  
is_integer0(nums)
```

---

is_integer1	<i>check if integer(1)</i>
-------------	----------------------------

---

**Description**

check if integer(1)

**Usage**

```
is_integer1(x)
```

**Arguments**

x                    A single value

**Value**

Boolean

**Examples**

```
nums <- 2
is_integer1(nums)
```

---

mae_pick_organisms	<i>Modify organisms of multi-assay experiment object</i>
--------------------	--

---

**Description**

Modify organisms of multi-assay experiment object

**Usage**

```
mae_pick_organisms(MAE, isolate_organisms = NULL,
  discard_organisms = NULL)
```

**Arguments**

MAE                    A multi-assay experiment object  
isolate\_organisms        Isolate specific organisms e.g. til001, til002  
discard\_organisms        Discard specific organisms e.g. til001, til002

**Value**

A multi-assay experiment object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
subset <- mae_pick_organisms(toy_data,
isolate_organisms=c('ti|001', 'ti|002'))
```

---

mae\_pick\_samples      *Modify samples of multi-assay experiment object*

---

**Description**

Modify samples of multi-assay experiment object

**Usage**

```
mae_pick_samples(MAE, isolate_samples = NULL, discard_samples = NULL)
```

**Arguments**

MAE                    A multi-assay experiment object

isolate\_samples      Isolate specific samples e.g. c('SAM\_01', 'SAM\_02')

discard\_samples      Discard specific samples e.g. c('SAM\_01', 'SAM\_02')

**Value**

A multi-assay experiment object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
subset <- mae_pick_samples(toy_data,
isolate_samples=c('subject_9',
'subject_14'))
```

---

pct2str                    *Converts decimal percentage to string with specified digits*

---

**Description**

Converts decimal percentage to string with specified digits

**Usage**

```
pct2str(v, digits = 2)
```

**Arguments**

v	A single value
digits	number of digits

**Value**

Boolean

**Examples**

```
nums <- 0.23
pct2str(nums)
```

---

percent	<i>Format decimals to percentages</i>
---------	---------------------------------------

---

**Description**

Format decimals to percentages

**Usage**

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

**Arguments**

x	An array of decimals
digits	number of digits
format	f

**Value**

An array of formatted strings

**Examples**

```
nums <- c(0.42, 0.15, 0.4, 0.563, 0.2)
percent(nums)
```

---

relabu\_barplot

*Plot bar plots of sample and group level relative abundance*


---

**Description**

Plot bar plots of sample and group level relative abundance

**Usage**

```
relabu_barplot(MAE, tax_level, order_organisms = c(),
  sort_by = c("nosort", "conditions", "organisms"),
  group_samples = FALSE, group_conditions = "ALL",
  sample_conditions = c(), isolate_samples = c(),
  discard_samples = c(), show_legend = TRUE)
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
order_organisms	A character list of organisms to send to top
sort_by	Sort bars by one of c("nosort", "conditions", "organisms")
group_samples	A bool specifying whether to group samples
group_conditions	Group by one or more conditions e.g. "ALL" or "SEX"
sample_conditions	Plot associated conditions with samples.
isolate_samples	Isolate specific samples e.g. c("SAM_01", "SAM_02")
discard_samples	Discard specific samples e.g. c("SAM_01", "SAM_02")
show_legend	A bool specifying whether or not to show organisms legend

**Value**

A plotly object

**Examples**

```
data_dir = system.file("extdata/MAE.rds", package = "animalcules")
toy_data <- readRDS(data_dir)
p <- relabu_barplot(toy_data,
  tax_level="family",
  order_organisms=c('Retroviridae'),
  sort_by="organisms",
  sample_conditions=c('SEX', 'AGE'),
  show_legend=TRUE)
```

p



---

relabu_boxplot	<i>Plot boxplots comparing different organism prevalence across conditions</i>
----------------	--

---

**Description**

Plot boxplots comparing different organism prevalence across conditions

**Usage**

```
relabu_boxplot(MAE, tax_level, condition, organisms = c(),
  datatype = c("counts", "relative abundance", "logcpm"))
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
condition	Compare groups by condition e.g. 'SEX'
organisms	Include organisms for plotting.
datatype	counts, relative abundance, logcpm

**Value**

A plotly object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
p <- relabu_boxplot(toy_data,
  tax_level='genus',
  organisms=c('Escherichia', 'Actinomyces'),
  condition='SEX',
  datatype='logcpm')
p
```

---

relabu_heatmap	<i>Plot heatmap of sample level counts in logcpm</i>
----------------	--

---

**Description**

Plot heatmap of sample level counts in logcpm

**Usage**

```
relabu_heatmap(MAE, tax_level, sort_by = c("nosort", "conditions",
  "organisms"), sample_conditions = c(), isolate_organisms = c(),
  isolate_samples = c(), discard_samples = c(), log_cpm = TRUE)
```

**Arguments**

MAE	A multi-assay experiment object
tax_level	The taxon level used for organisms
sort_by	Sort bars by one of c('nosort', 'conditions', 'organisms')
sample_conditions	Plot conditions e.g. c('SEX', 'AGE')
isolate_organisms	Isolate specific organisms e.g. c('Hepacivirus')
isolate_samples	Isolate specific samples e.g. c('SAM_01', 'SAM_02')
discard_samples	Discard specific samples e.g. c('SAM_01', 'SAM_02')
log_cpm	Convert counts to logcpm

**Value**

A plotly object

**Examples**

```
data_dir = system.file('extdata/MAE.rds', package = 'animalcules')
toy_data <- readRDS(data_dir)
p <- relabu_heatmap(toy_data,
                    tax_level='genus',
                    sort_by='conditions',
                    sample_conditions=c('SEX', 'AGE'))

p
```

---

run_animalcules	<i>Run animalcules shiny app</i>
-----------------	----------------------------------

---

**Description**

Run animalcules shiny app

**Usage**

```
run_animalcules()
```

**Value**

The shiny app will open

**Examples**

```
## Not run:
run_animalcules()

## End(Not run)
```

---

shannon	<i>Get alpha diversity using shannon</i>
---------	--

---

**Description**

Get alpha diversity using shannon

**Usage**

```
shannon(x)
```

**Arguments**

x                    A list of counts

**Value**

A single value

**Examples**

```
shannon(seq_len(10))
```

---

simpson_index	<i>Get alpha diversity using simpson</i>
---------------	--

---

**Description**

Get alpha diversity using simpson

**Usage**

```
simpson_index(x)
```

**Arguments**

x                    A list of counts

**Value**

A single value

**Examples**

```
simpson_index(seq_len(10))
```

---

upsample_counts	<i>Upsample a counts table to a higher taxon level</i>
-----------------	--

---

**Description**

Upsample a counts table to a higher taxon level

**Usage**

```
upsample_counts(counts_table, tax_table, higher_level)
```

**Arguments**

counts_table	A organism x sample data frame of counts
tax_table	A organism x taxlev data frame of labels
higher_level	Higher taxon level to upsample to

**Value**

A organism x sample data frame of counts

**Examples**

```
toy_data <- readRDS(system.file("extdata/toy_data.rds", package = "animalcules"))
tax_table <- toy_data$tax_table
sam_table <- toy_data$sam_table
counts_table <- toy_data$counts_table
counts_table <- upsample_counts(counts_table, tax_table, "phylum")
```

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