

Package ‘tidybulk’

May 15, 2024

Type Package

Title Brings transcriptomics to the tidyverse

Version 1.16.0

Description This is a collection of utility functions that allow to perform exploration of and calculations to RNA sequencing data, in a modular, pipe-friendly and tidy fashion.

License GPL-3

Depends R (>= 4.1.0), ttf service (>= 0.3.6)

Imports tibble, readr, dplyr (>= 1.1.0), magrittr, tidyr, stringi, stringr, rlang, purrr, tidyselect, preprocessCore, stats, parallel, utils, lifecycle, scales, SummarizedExperiment, GenomicRanges, methods, S4Vectors, crayon, Matrix

Suggests BiocStyle, testthat, vctrs, AnnotationDbi, BiocManager, Rsubread, e1071, edgeR, limma, org.Hs.eg.db, org.Mm.eg.db, sva, GGally, knitr, qpdf, covr, Seurat, KernSmooth, Rtsne, ggplot2, widyr, clusterProfiler, msigdb, DESeq2, broom, survival, boot, betareg, tidyHeatmap, pasilla, ggrepel, devtools, functional, survminer, tidySummarizedExperiment, markdown, uwot, matrixStats, igraph, EGSEA, IRanges, here, glmmSeq, pbapply, pbmcapply, lme4, glmmTMB, MASS, pkgconfig

VignetteBuilder knitr

RdMacros lifecycle

Biarch true

biocViews AssayDomain, Infrastructure, RNASeq, DifferentialExpression, GeneExpression, Normalization, Clustering, QualityControl, Sequencing, Transcription, Transcriptomics

Encoding UTF-8

LazyData true

RoxygenNote 7.3.1

LazyDataCompression xz

URL <https://github.com/stemangiola/tidybulk>

BugReports <https://github.com/stemangiola/tidybulk/issues>

git_url <https://git.bioconductor.org/packages/tidybulk>

git_branch RELEASE_3_19

git_last_commit 3c5b1ff

git_last_commit_date 2024-04-30

Repository Bioconductor 3.19

Date/Publication 2024-05-14

Author Stefano Mangiola [aut, cre],
Maria Doyle [ctb]

Maintainer Stefano Mangiola <mangiolastefano@gmail.com>

Contents

adjust_abundance	3
aggregate_duplicates	7
arrange	10
as_matrix	11
as_SummarizedExperiment	12
bind_cols	13
bind_rows	14
breast_tcga_mini_SE	15
check_if_counts_is_na	15
check_if_duplicated_genes	16
check_if_wrong_input	16
cluster_elements	17
counts_ensembl	20
deconvolve_cellularity	20
describe_transcript	23
distinct	24
ensembl_symbol_mapping	25
ensembl_to_symbol	25
fill_missing_abundance	26
filter	28
flybaseIDs	29
get_bibliography	30
get_reduced_dimensions_UMAP_bulk	31
get_reduced_dimensions_UMAP_bulk_SE	32
group_by	33
identify_abundant	34
impute_missing_abundance	36
inner_join	39
keep_abundant	40
keep_variable	43
log10_reverse_trans	45
logit_trans	46

mutate	46
pivot_sample	48
pivot_transcript	49
quantile_normalise_abundance	50
reduce_dimensions	53
reexports	57
remove_redundancy	57
rename	61
rotate_dimensions	62
rowwise	65
scale_abundance	66
se	69
se_mini	69
summarise	69
symbol_to_entrez	71
test_differential_abundance	72
test_differential_cellularity	78
test_gene_enrichment	81
test_gene_overrepresentation	85
test_gene_rank	88
test_stratification_cellularity	91
tidybulk	94
tidybulk_SAM_BAM	95
tximeta_summarizeToGene_object	96
unnest	96
vignette_manuscript_signature_boxplot	97
vignette_manuscript_signature_tsne	98
vignette_manuscript_signature_tsne2	98
X_cibersort	98
%>%	99

Index**100**

adjust_abundance	<i>Adjust transcript abundance for unwanted variation</i>
------------------	---

Description

adjust_abundance() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with an additional adjusted abundance column. This method uses scaled counts if present.

Usage

```
adjust_abundance(  
  .data,  
  .formula = NULL,  
  .factor_unwanted = NULL,  
  .factor_of_interest = NULL,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "combat_seq",  
  action = "add",  
  ...,  
  log_transform = NULL,  
  transform = NULL,  
  inverse_transform = NULL  
)  
  
## S4 method for signature 'spec_tbl_df'  
adjust_abundance(  
  .data,  
  .formula = NULL,  
  .factor_unwanted = NULL,  
  .factor_of_interest = NULL,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "combat_seq",  
  action = "add",  
  ...,  
  log_transform = NULL,  
  transform = NULL,  
  inverse_transform = NULL  
)  
  
## S4 method for signature 'tbl_df'  
adjust_abundance(  
  .data,  
  .formula = NULL,  
  .factor_unwanted = NULL,  
  .factor_of_interest = NULL,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "combat_seq",  
  action = "add",  
  ...,  
  log_transform = NULL,  
  transform = NULL,  
  inverse_transform = NULL  
)
```

```
    inverse_transform = NULL
  )

## S4 method for signature 'tidybulk'
adjust_abundance(
  .data,
  .formula = NULL,
  .factor_unwanted = NULL,
  .factor_of_interest = NULL,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "combat_seq",
  action = "add",
  ...,
  log_transform = NULL,
  transform = NULL,
  inverse_transform = NULL
)

## S4 method for signature 'SummarizedExperiment'
adjust_abundance(
  .data,
  .formula = NULL,
  .factor_unwanted = NULL,
  .factor_of_interest = NULL,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "combat_seq",
  action = "add",
  ...,
  log_transform = NULL,
  transform = NULL,
  inverse_transform = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
adjust_abundance(
  .data,
  .formula = NULL,
  .factor_unwanted = NULL,
  .factor_of_interest = NULL,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "combat_seq",
  action = "add",
```

```

    ...,
    log_transform = NULL,
    transform = NULL,
    inverse_transform = NULL
  )

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.formula</code>	DEPRECATED - A formula with no response variable, representing the desired linear model where the first covariate is the factor of interest and the second covariate is the unwanted variation (of the kind <code>~ factor_of_interest + batch</code>)
<code>.factor_unwanted</code>	A tidy select, e.g. <code>column names without double quotation. c(batch, country)</code> These are the factor that we want to adjust for, including unwanted batcheffect, and unwanted biological effects.
<code>.factor_of_interest</code>	A tidy select, e.g. <code>column names without double quotation. c(treatment)</code> These are the factor that we want to preserve.
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>method</code>	A character string. Methods include <code>combat_seq</code> (default), <code>combat</code> and <code>limma_remove_batch_effect</code> .
<code>action</code>	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).
<code>...</code>	Further parameters passed to the function <code>sva::ComBat</code>
<code>log_transform</code>	DEPRECATED - A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)
<code>transform</code>	DEPRECATED - A function that will transform the counts, by default it is <code>log1p</code> for RNA sequencing data, but for avoiding transformation you can use identity
<code>inverse_transform</code>	DEPRECATED - A function that is the inverse of transform (e.g. <code>expm1</code> is inverse of <code>log1p</code>). This is needed to transform back the counts after analysis.

Details

```
'r lifecycle::badge("maturing")'
```

This function adjusts the abundance for (known) unwanted variation. At the moment just an unwanted covariate is allowed at a time using Combat (DOI: 10.1093/bioinformatics/bts034)

Underlying method: `sva::ComBat(data, batch = my_batch, mod = design, prior.plots = FALSE, ...)`

Value

A consistent object (to the input) with additional columns for the adjusted counts as ‘<COUNT COLUMN>_adjusted‘

A consistent object (to the input) with additional columns for the adjusted counts as ‘<COUNT COLUMN>_adjusted‘

A consistent object (to the input) with additional columns for the adjusted counts as ‘<COUNT COLUMN>_adjusted‘

A consistent object (to the input) with additional columns for the adjusted counts as ‘<COUNT COLUMN>_adjusted‘

A ‘SummarizedExperiment‘ object

A ‘SummarizedExperiment‘ object

Examples

```
cm = tidybulk::se_mini
cm$batch = 0
cm$batch[colnames(cm) %in% c("SRR1740035", "SRR1740043")] = 1

cm |>
  identify_abundant() |>
  adjust_abundance( .factor_unwanted = batch, .factor_of_interest = condition, method="combat"
  )
```

aggregate_duplicates	<i>Aggregates multiple counts from the same samples (e.g., from iso-forms), concatenates other character columns, and averages other numeric columns</i>
----------------------	--

Description

aggregate_duplicates() takes as input A ‘tbl‘ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment‘ (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with aggregated transcripts that were duplicated.

Usage

```
aggregate_duplicates(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
```

```
    aggregation_function = sum,
    keep_integer = TRUE
  )

## S4 method for signature 'spec_tbl_df'
aggregate_duplicates(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  aggregation_function = sum,
  keep_integer = TRUE
)

## S4 method for signature 'tbl_df'
aggregate_duplicates(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  aggregation_function = sum,
  keep_integer = TRUE
)

## S4 method for signature 'tidybulk'
aggregate_duplicates(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  aggregation_function = sum,
  keep_integer = TRUE
)

## S4 method for signature 'SummarizedExperiment'
aggregate_duplicates(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  aggregation_function = sum,
  keep_integer = TRUE
)

## S4 method for signature 'RangedSummarizedExperiment'
aggregate_duplicates(
  .data,
  .sample = NULL,
```



```
.transcript = NULL,
.abundance = NULL,
aggregation_function = sum,
keep_integer = TRUE
)
```

Arguments

.data	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
.sample	The name of the sample column
.transcript	The name of the transcript/gene column
.abundance	The name of the transcript/gene abundance column
aggregation_function	A function for counts aggregation (e.g., sum, median, or mean)
keep_integer	A boolean. Whether to force the aggregated counts to integer

Details

```
'r lifecycle::badge("maturing")'
```

This function aggregates duplicated transcripts (e.g., isoforms, ensembl). For example, we often have to convert ensembl symbols to gene/transcript symbol, but in doing so we have to deal with duplicates. 'aggregate_duplicates' takes a tibble and column names (as symbols; for 'sample', 'transcript' and 'count') as arguments and returns a tibble with aggregate transcript with the same name. All the rest of the column are appended, and factors and boolean are appended as characters.

Underlying custom method: `data |> filter(n_aggr > 1) |> group_by(!.sample,!.transcript) |> dplyr::mutate(!.abundance := !.abundance |> aggregation_function())`

Value

A consistent object (to the input) with aggregated transcript abundance and annotation
 A consistent object (to the input) with aggregated transcript abundance and annotation
 A consistent object (to the input) with aggregated transcript abundance and annotation
 A consistent object (to the input) with aggregated transcript abundance and annotation
 A 'SummarizedExperiment' object
 A 'SummarizedExperiment' object

Examples

```
# Create a aggregation column
se_mini = tidybulk::se_mini
SummarizedExperiment::rowData(se_mini)$gene_name = rownames(se_mini)

aggregate_duplicates(
  se_mini,
```

```
.transcript = gene_name
)
```

arrange

Arrange rows by column values

Description

‘arrange()’ order the rows of a data frame rows by the values of selected columns.

Unlike other dplyr verbs, ‘arrange()’ largely ignores grouping; you need to explicit mention grouping variables (or use ‘by_group = TRUE’) in order to group by them, and functions of variables are evaluated once per data frame, not once per group.

Arguments

.data	A data frame, data frame extension (e.g. a tibble), or a lazy data frame (e.g. from dbplyr or dtplyr). See <i>*Methods*</i> , below, for more details.
...	<[‘tidy-eval’][dplyr_tidy_eval]> Variables, or functions or variables. Use [desc()] to sort a variable in descending order.
.by_group	If TRUE, will sort first by grouping variable. Applies to grouped data frames only.

Details

Locales The sort order for character vectors will depend on the collating sequence of the locale in use: see [locales()].

Missing values Unlike base sorting with ‘sort()’, ‘NA’ are: * always sorted to the end for local data, even when wrapped with ‘desc()’. * treated differently for remote data, depending on the backend.

Value

An object of the same type as ‘.data’.

* All rows appear in the output, but (usually) in a different place. * Columns are not modified. * Groups are not modified. * Data frame attributes are preserved.

A tibble

Methods

This function is a ***generic***, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

The following methods are currently available in loaded packages:

See Also

Other single table verbs: [filter\(\)](#), [mutate\(\)](#), [rename\(\)](#), [summarise\(\)](#)

Examples

```
arrange(mtcars, cyl, disp)
```

as_matrix	<i>Get matrix from tibble</i>
-----------	-------------------------------

Description

Get matrix from tibble

Usage

```
as_matrix(tbl, rownames = NULL, do_check = TRUE)
```

Arguments

tbl	A tibble
rownames	The column name of the input tibble that will become the rownames of the output matrix
do_check	A boolean

Value

A matrix

Examples

```
tibble(.feature = "CD3G", count=1) |> as_matrix(rownames=.feature)
```

`as_SummarizedExperiment`*as_SummarizedExperiment*

Description

`as_SummarizedExperiment()` creates a ‘SummarizedExperiment’ object from a ‘tbl’ or ‘tidybulk’
tbl formatted as | <SAMPLE> | <TRANSCRIPT> | <COUNT> | <...> |

Usage

```
as_SummarizedExperiment(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL  
)  
  
## S4 method for signature 'spec_tbl_df'  
as_SummarizedExperiment(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL  
)  
  
## S4 method for signature 'tbl_df'  
as_SummarizedExperiment(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL  
)  
  
## S4 method for signature 'tidybulk'  
as_SummarizedExperiment(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL  
)
```

Arguments

<code>.data</code>	A tibble
<code>.sample</code>	The name of the sample column

.transcript	The name of the transcript/gene column
.abundance	The name of the transcript/gene abundance column

Value

- A ‘SummarizedExperiment’ object
- A ‘SummarizedExperiment’ object
- A ‘SummarizedExperiment’ object
- A ‘SummarizedExperiment’ object

bind_cols	<i>Left join datasets</i>
-----------	---------------------------

Description

Left join datasets

Arguments

x	tbls to join. (See dplyr)
y	tbls to join. (See dplyr)
by	A character vector of variables to join by. (See dplyr)
copy	If x and y are not from the same data source, and copy is TRUE, then y will be copied into the same src as x. (See dplyr)
suffix	If there are non-joined duplicate variables in x and y, these suffixes will be added to the output to disambiguate them. Should be a character vector of length 2. (See dplyr)
...	Data frames to combine (See dplyr)

Value

A tt object

Examples

```
annotation = tidybulk::se_mini |> tidybulk() |> as_tibble() |> distinct(.sample) |> mutate(source = "AU")
tidybulk::se_mini |> tidybulk() |> as_tibble() |> left_join(annotation)
```

bind_rows

*Efficiently bind multiple data frames by row and column***Description**

This is an efficient implementation of the common pattern of ‘do.call(rbind, dfs)’ or ‘do.call(cbind, dfs)’ for binding many data frames into one.

Arguments

...	<p>Data frames to combine.</p> <p>Each argument can either be a data frame, a list that could be a data frame, or a list of data frames.</p> <p>When row-binding, columns are matched by name, and any missing columns will be filled with NA.</p> <p>When column-binding, rows are matched by position, so all data frames must have the same number of rows. To match by value, not position, see mutate_joins.</p>
.id	<p>Data frame identifier.</p> <p>When ‘.id’ is supplied, a new column of identifiers is created to link each row to its original data frame. The labels are taken from the named arguments to ‘bind_rows()’. When a list of data frames is supplied, the labels are taken from the names of the list. If no names are found a numeric sequence is used instead.</p>
add.cell.ids	<p>from Seurat 3.0 A character vector of length(x = c(x, y)). Appends the corresponding values to the start of each objects’ cell names.</p>

Details

The output of ‘bind_rows()’ will contain a column if that column appears in any of the inputs.

Value

‘bind_rows()’ and ‘bind_cols()’ return the same type as the first input, either a data frame, ‘tbl_df’, or ‘grouped_df’.

Examples

```
data(se_mini)

se_mini_tidybulk = se_mini |> tidybulk()
bind_rows(  se_mini_tidybulk, se_mini_tidybulk  )

tt_bind = se_mini_tidybulk |> select(time, condition)
se_mini_tidybulk |> bind_cols(tt_bind)
```

breast_tcga_mini_SE	<i>Needed for vignette breast_tcga_mini_SE</i>
---------------------	--

Description

Needed for vignette breast_tcga_mini_SE

Usage

```
breast_tcga_mini_SE
```

Format

An object of class SummarizedExperiment with 500 rows and 251 columns.

check_if_counts_is_na	<i>Check whether there are NA counts</i>
-----------------------	--

Description

Check whether there are NA counts

Usage

```
check_if_counts_is_na(.data, .abundance)
```

Arguments

.data	A tibble of read counts
.abundance	A character name of the read count column

Value

A tbl

`check_if_duplicated_genes`*Check whether there are duplicated genes/transcripts*

Description

Check whether there are duplicated genes/transcripts

Usage

```
check_if_duplicated_genes(  
  .data,  
  .sample = sample,  
  .transcript = transcript,  
  .abundance = `read count`  
)
```

Arguments

<code>.data</code>	A tibble of read counts
<code>.sample</code>	A character name of the sample column
<code>.transcript</code>	A character name of the transcript/gene column
<code>.abundance</code>	A character name of the read count column

Value

A tbl

`check_if_wrong_input` *Check whether there are NA counts*

Description

Check whether there are NA counts

Usage

```
check_if_wrong_input(.data, list_input, expected_type)
```

Arguments

<code>.data</code>	A tibble of read counts
<code>list_input</code>	A list
<code>expected_type</code>	A character string

Value

A tbl

cluster_elements	<i>Get clusters of elements (e.g., samples or transcripts)</i>
------------------	--

Description

cluster_elements() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and identify clusters in the data.

Usage

```
cluster_elements(  
  .data,  
  .element = NULL,  
  .feature = NULL,  
  .abundance = NULL,  
  method,  
  of_samples = TRUE,  
  transform = log1p,  
  action = "add",  
  ...,  
  log_transform = NULL  
)  
  
## S4 method for signature 'spec_tbl_df'  
cluster_elements(  
  .data,  
  .element = NULL,  
  .feature = NULL,  
  .abundance = NULL,  
  method,  
  of_samples = TRUE,  
  transform = log1p,  
  action = "add",  
  ...,  
  log_transform = NULL  
)  
  
## S4 method for signature 'tbl_df'  
cluster_elements(  
  .data,  
  .element = NULL,  
  .feature = NULL,
```

```
.abundance = NULL,
method,
of_samples = TRUE,
transform = log1p,
action = "add",
...,
log_transform = NULL
)

## S4 method for signature 'tidybulk'
cluster_elements(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  transform = log1p,
  action = "add",
  ...,
  log_transform = NULL
)

## S4 method for signature 'SummarizedExperiment'
cluster_elements(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  transform = log1p,
  action = "add",
  ...,
  log_transform = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
cluster_elements(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  transform = log1p,
  action = "add",
  ...,
```

```
    log_transform = NULL
  )
```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.element</code>	The name of the element column (normally samples).
<code>.feature</code>	The name of the feature column (normally transcripts/genes)
<code>.abundance</code>	The name of the column including the numerical value the clustering is based on (normally transcript abundance)
<code>method</code>	A character string. The cluster algorithm to use, at the moment k-means is the only algorithm included.
<code>of_samples</code>	A boolean. In case the input is a tidybulk object, it indicates Whether the element column will be sample or transcript column
<code>transform</code>	A function that will tranform the counts, by default it is log1p for RNA sequencing data, but for avoinding tranformation you can use identity
<code>action</code>	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).
<code>...</code>	Further parameters passed to the function kmeans
<code>log_transform</code>	DEPRECATED - A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)

Details

```
'r lifecycle::badge("maturing")'
```

identifies clusters in the data, normally of samples. This function returns a tibble with additional columns for the cluster annotation. At the moment only k-means (DOI: 10.2307/2346830) and SNN clustering (DOI:10.1016/j.cell.2019.05.031) is supported, the plan is to introduce more clustering methods.

Underlying method for kmeans `do.call(kmeans(.data, iter.max = 1000, ...))`

Underlying method for SNN `.data Seurat::CreateSeuratObject() Seurat::ScaleData(display.progress = TRUE,num.cores = 4, do.par = TRUE) Seurat::FindVariableFeatures(selection.method = "vst") Seurat::RunPCA(npcs = 30) Seurat::FindNeighbors() Seurat::FindClusters(method = "igraph", ...)`

Value

A tbl object with additional columns with cluster labels

A tbl object with additional columns with cluster labels

A tbl object with additional columns with cluster labels

A tbl object with additional columns with cluster labels

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
cluster_elements(tidybulk::se_mini, centers = 2, method="kmeans")
```

counts_ensembl	<i>Counts with ensembl annotation</i>
----------------	---------------------------------------

Description

Counts with ensembl annotation

Usage

```
counts_ensembl
```

Format

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 119 rows and 6 columns.

deconvolve_cellularity	<i>Get cell type proportions from samples</i>
------------------------	---

Description

`deconvolve_cellularity()` takes as input A ‘tbl’ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment’ (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a consistent object (to the input) with the estimated cell type abundance for each sample

Usage

```
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
  action = "add",
  ...
)
```

```
## S4 method for signature 'spec_tbl_df'
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
  action = "add",
  ...
)

## S4 method for signature 'tbl_df'
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
  action = "add",
  ...
)

## S4 method for signature 'tidybulk'
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
  action = "add",
  ...
)

## S4 method for signature 'SummarizedExperiment'
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
```

```

    action = "add",
    ...
)

## S4 method for signature 'RangedSummarizedExperiment'
deconvolve_cellularity(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  reference = NULL,
  method = "cibersort",
  prefix = "",
  action = "add",
  ...
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>reference</code>	A data frame. The methods cibersort and llsr can accept a custom rectangular dataframe with genes as rows names, cell types as column names and gene-transcript abundance as values. For exemplar tidybulk::X_cibersort. The transcript/cell_type data frame of integer transcript abundance. If NULL, the default reference for each algorithm will be used. For llsr will be LM22.
<code>method</code>	A character string. The method to be used. At the moment Cibersort (default, can accept custom reference), epic (can accept custom reference) and llsr (linear least squares regression, can accept custom reference), mcp_counter, quantiseq, xcell are available.
<code>prefix</code>	A character string. The prefix you would like to add to the result columns. It is useful if you want to reshape data.
<code>action</code>	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).
<code>...</code>	Further parameters passed to the function Cibersort

Details

`'r lifecycle::badge("maturing")'`

This function infers the cell type composition of our samples (with the algorithm Cibersort; Newman et al., 10.1038/nmeth.3337).

Underlying method: CIBERSORT(Y = data, X = reference, ...)

Value

A consistent object (to the input) including additional columns for each cell type estimated
 A consistent object (to the input) including additional columns for each cell type estimated
 A consistent object (to the input) including additional columns for each cell type estimated
 A consistent object (to the input) including additional columns for each cell type estimated
 A ‘SummarizedExperiment’ object
 A ‘SummarizedExperiment’ object

Examples

```
# Subsetting for time efficiency
tidybulk::se_mini |> deconvolve_cellularity(cores = 1)
```

describe_transcript	<i>Get DESCRIPTION from gene SYMBOL for Human and Mouse</i>
---------------------	---

Description

Get DESCRIPTION from gene SYMBOL for Human and Mouse

```
describe_transcript
describe_transcript
describe_transcript
describe_transcript
describe_transcript
describe_transcript
describe_transcript
```

Usage

```
describe_transcript(.data, .transcript = NULL)

## S4 method for signature 'spec_tbl_df'
describe_transcript(.data, .transcript = NULL)

## S4 method for signature 'tbl_df'
describe_transcript(.data, .transcript = NULL)

## S4 method for signature 'tidybulk'
describe_transcript(.data, .transcript = NULL)

.describe_transcript_SE(.data, .transcript = NULL)
```

```
## S4 method for signature 'SummarizedExperiment'
describe_transcript(.data, .transcript = NULL)

## S4 method for signature 'RangedSummarizedExperiment'
describe_transcript(.data, .transcript = NULL)
```

Arguments

- .data A tt or tbl object.
- .transcript A character. The name of the gene symbol column.

Value

- A tbl
- A consistent object (to the input) including additional columns for transcript symbol
- A consistent object (to the input) including additional columns for transcript symbol
- A consistent object (to the input) including additional columns for transcript symbol
- A ‘SummarizedExperiment’ object
- A consistent object (to the input) including additional columns for transcript symbol
- A consistent object (to the input) including additional columns for transcript symbol

Examples

```
describe_transcript(tidybulk::se_mini)
```

distinct	<i>distinct</i>
----------	-----------------

Description

distinct

Arguments

- .data A tbl. (See dplyr)
- ... Data frames to combine (See dplyr)
- .keep_all If TRUE, keep all variables in .data. If a combination of ... is not distinct, this keeps the first row of values. (See dplyr)

Value

A tt object

Examples

```
tidybulk::se_mini |> tidybulk() |> distinct()
```

ensembl_symbol_mapping

Data set

Description

Data set

Usage

```
ensembl_symbol_mapping
```

Format

An object of class `spec_tbl_df` (inherits from `tbl_df`, `tbl`, `data.frame`) with 291249 rows and 3 columns.

ensembl_to_symbol

Add transcript symbol column from ensembl id for human and mouse data

Description

`ensembl_to_symbol()` takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a consistent object (to the input) with the additional transcript symbol column

Usage

```
ensembl_to_symbol(.data, .ensembl, action = "add")
```

```
## S4 method for signature 'spec_tbl_df'  
ensembl_to_symbol(.data, .ensembl, action = "add")
```

```
## S4 method for signature 'tbl_df'  
ensembl_to_symbol(.data, .ensembl, action = "add")
```

```
## S4 method for signature 'tidybulk'  
ensembl_to_symbol(.data, .ensembl, action = "add")
```

Arguments

<code>.data</code>	a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.ensembl</code>	A character string. The column that represents ensembl gene id
<code>action</code>	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).

Details**[Questioning]**

This is useful since different resources use ensembl IDs while others use gene symbol IDs. At the moment this works for human (genes and transcripts) and mouse (genes) data.

Value

A consistent object (to the input) including additional columns for transcript symbol

A consistent object (to the input) including additional columns for transcript symbol

A consistent object (to the input) including additional columns for transcript symbol

A consistent object (to the input) including additional columns for transcript symbol

Examples

```
# This function was designed for data.frame
# Convert from SummarizedExperiment for this example. It is NOT recommended.

tidybulk::se_mini |> tidybulk() |> as_tibble() |> ensembl_to_symbol(.feature)
```

fill_missing_abundance

Fill transcript abundance if missing from sample-transcript pairs

Description

`fill_missing_abundance()` takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a consistent object (to the input) with new observations

Usage

```

fill_missing_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  fill_with
)

## S4 method for signature 'spec_tbl_df'
fill_missing_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  fill_with
)

## S4 method for signature 'tbl_df'
fill_missing_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  fill_with
)

## S4 method for signature 'tidybulk'
fill_missing_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  fill_with
)

```

Arguments

.data	A 'tbl' formatted as <SAMPLE> <TRANSCRIPT> <COUNT> <...>
.sample	The name of the sample column
.transcript	The name of the transcript column
.abundance	The name of the transcript abundance column
fill_with	A numerical abundance with which fill the missing data points

Details**[Questioning]**

This function fills the abundance of missing sample-transcript pair using the median of the sample group defined by the formula

Value

- A consistent object (to the input) non-sparse abundance
- A consistent object (to the input) with filled abundance
- A consistent object (to the input) with filled abundance
- A consistent object (to the input) with filled abundance

Examples

```
print("Not run for build time.")

# tidybulk::se_mini |> fill_missing_abundance( fill_with = 0)
```

filter	<i>Subset rows using column values</i>
--------	--

Description

'filter()' retains the rows where the conditions you provide a 'TRUE'. Note that, unlike base sub-setting with '[', rows where the condition evaluates to 'NA' are dropped.

Arguments

- .data A tbl. (See dplyr)
- ... <['tidy-eval'] [dplyr_tidy_eval]> Logical predicates defined in terms of the variables in '.data'. Multiple conditions are combined with '&'. Only rows where the condition evaluates to 'TRUE' are kept.
- .preserve when 'FALSE' (the default), the grouping structure is recalculated based on the resulting data, otherwise it is kept as is.

Details

dplyr is not yet smart enough to optimise filtering optimisation on grouped datasets that don't need grouped calculations. For this reason, filtering is often considerably faster on [ungroup()]ed data.

Value

- An object of the same type as '.data'.
- * Rows are a subset of the input, but appear in the same order.
- * Columns are not modified.
- * The number of groups may be reduced (if '.preserve' is not 'TRUE').
- * Data frame attributes are preserved.

Useful filter functions

* ['=='], ['>'], ['>='] etc * ['&'], ['|'], ['_'], [xor()] * [is.na()] * [between()], [near()]

Grouped tibbles

Because filtering expressions are computed within groups, they may yield different results on grouped tibbles. This will be the case as soon as an aggregating, lagging, or ranking function is involved. Compare this ungrouped filtering:

The former keeps rows with 'mass' greater than the global average whereas the latter keeps rows with 'mass' greater than the gender average.

Methods

This function is a **generic**, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

The following methods are currently available in loaded packages:

See Also

[filter_all()], [filter_if()] and [filter_at()].

Other single table verbs: [arrange\(\)](#), [mutate\(\)](#), [rename\(\)](#), [summarise\(\)](#)

Examples

```
data(se)

se |> tidybulk() |> filter(dex=="untrt")

# Learn more in ?dplyr_tidy_eval
```

flybaseIDs

flybaseIDs

Description

flybaseIDs

Usage

flybaseIDs

Format

An object of class character of length 14599.

get_bibliography	<i>Produces the bibliography list of your workflow</i>
------------------	--

Description

get_bibliography() takes as input a ‘tidybulk’

Usage

```
get_bibliography(.data)

## S4 method for signature 'tbl'
get_bibliography(.data)

## S4 method for signature 'tbl_df'
get_bibliography(.data)

## S4 method for signature 'spec_tbl_df'
get_bibliography(.data)

## S4 method for signature 'tidybulk'
get_bibliography(.data)

## S4 method for signature 'SummarizedExperiment'
get_bibliography(.data)

## S4 method for signature 'RangedSummarizedExperiment'
get_bibliography(.data)
```

Arguments

.data	A ‘tbl’ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment’ (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
-------	---

Details

‘r lifecycle::badge("maturing")’

This methods returns the bibliography list of your workflow from the internals of a tidybulk object (attr(., "internals"))

Value

NULL. It prints a list of bibliography references for the software used through the workflow.

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

Examples

```
get_bibliography(tidybulk::se_mini)
```

```
get_reduced_dimensions_UMAP_bulk
```

Get UMAP

Description

Get UMAP

Usage

```
get_reduced_dimensions_UMAP_bulk(  
  .data,  
  .element = NULL,  
  .feature = NULL,  
  .abundance = NULL,  
  .dims = 2,  
  top = 500,  
  of_samples = TRUE,  
  transform = log1p,  
  scale = TRUE,  
  calculate_for_pca_dimensions = min(20, top),  
  ...  
)
```

Arguments

<code>.data</code>	A tibble
<code>.element</code>	A column symbol. The column that is used to calculate distance (i.e., normally samples)
<code>.feature</code>	A column symbol. The column that is represents entities to cluster (i.e., normally genes)
<code>.abundance</code>	A column symbol with the value the clustering is based on (e.g., 'count')
<code>.dims</code>	A integer vector corresponding to principal components of interest (e.g., 1:6)
<code>top</code>	An integer. How many top genes to select
<code>of_samples</code>	A boolean

calculate_for_pca_dimensions	An integer of length one. The number of PCA dimensions to based the UMAP calculatio on. If NULL all variable features are considered
...	Further parameters passed to the function uwot
log_transform	A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)

Value

A tibble with additional columns

get_reduced_dimensions_UMAP_bulk_SE
Get UMAP

Description

Get UMAP

Usage

```
get_reduced_dimensions_UMAP_bulk_SE(
  .data,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
  scale = NULL,
  calculate_for_pca_dimensions = min(20, top),
  ...
)
```

Arguments

.data	A tibble
.dims	A integer vector corresponding to principal components of interest (e.g., 1:6)
top	An integer. How many top genes to select
of_samples	A boolean
transform	A function that will tranform the counts, by default it is log1p for RNA sequencing data, but for avoinding tranformation you can use identity
calculate_for_pca_dimensions	An integer of length one. The number of PCA dimensions to based the UMAP calculatio on. If NULL all variable features are considered
...	Further parameters passed to the function uwot
.abundance	A column symbol with the value the clustering is based on (e.g., 'count')

.feature	A column symbol. The column that is represents entities to cluster (i.e., normally genes)
.element	A column symbol. The column that is used to calculate distance (i.e., normally samples)

Value

A tibble with additional columns

group_by	<i>Group by one or more variables</i>
----------	---------------------------------------

Description

Most data operations are done on groups defined by variables. 'group_by()' takes an existing tbl and converts it into a grouped tbl where operations are performed "by group". 'ungroup()' removes grouping.

Arguments

.data	A tbl. (See dplyr)
...	In 'group_by()', variables or computations to group by. In 'ungroup()', variables to remove from the grouping.
.add	When 'FALSE', the default, 'group_by()' will override existing groups. To add to the existing groups, use '.add = TRUE'. This argument was previously called 'add', but that prevented creating a new grouping variable called 'add', and conflicts with our naming conventions.
.drop	When '.drop = TRUE', empty groups are dropped. See [group_by_drop_default()] for what the default value is for this argument.

Value

A [grouped data frame][grouped_df()], unless the combination of '...' and 'add' yields a non empty set of grouping columns, a regular (ungrouped) data frame otherwise.

Methods

These function are **generic**s, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

Methods available in currently loaded packages:

Examples

```
by_cyl <- mtcars |> group_by(cyl)
```

identify_abundant	<i>find abundant transcripts</i>
-------------------	----------------------------------

Description

identify_abundant() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```
identify_abundant(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  factor_of_interest = NULL,  
  minimum_counts = 10,  
  minimum_proportion = 0.7  
)  
  
## S4 method for signature 'spec_tbl_df'  
identify_abundant(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  factor_of_interest = NULL,  
  minimum_counts = 10,  
  minimum_proportion = 0.7  
)  
  
## S4 method for signature 'tbl_df'  
identify_abundant(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  factor_of_interest = NULL,  
  minimum_counts = 10,  
  minimum_proportion = 0.7  
)  
  
## S4 method for signature 'tidybulk'  
identify_abundant(  
  .data,
```

```

        .sample = NULL,
        .transcript = NULL,
        .abundance = NULL,
        factor_of_interest = NULL,
        minimum_counts = 10,
        minimum_proportion = 0.7
    )

## S4 method for signature 'SummarizedExperiment'
identify_abundant(
    .data,
    .sample = NULL,
    .transcript = NULL,
    .abundance = NULL,
    factor_of_interest = NULL,
    minimum_counts = 10,
    minimum_proportion = 0.7
)

## S4 method for signature 'RangedSummarizedExperiment'
identify_abundant(
    .data,
    .sample = NULL,
    .transcript = NULL,
    .abundance = NULL,
    factor_of_interest = NULL,
    minimum_counts = 10,
    minimum_proportion = 0.7
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>factor_of_interest</code>	The name of the column of the factor of interest. This is used for defining sample groups for the filtering process. It uses the filterByExpr function from edgeR.
<code>minimum_counts</code>	A real positive number. It is the threshold of count per million that is used to filter transcripts/genes out from the scaling procedure.
<code>minimum_proportion</code>	A real positive number between 0 and 1. It is the threshold of proportion of samples for each transcripts/genes that have to be characterised by a cmp bigger than the threshold to be included for scaling procedure.

Details

```
'r lifecycle::badge("maturing")'
```

At the moment this function uses edgeR (DOI: 10.1093/bioinformatics/btp616)

Underlying method: `edgeR::filterByExpr(data, min.count = minimum_counts, group = string_factor_of_interest, min.prop = minimum_proportion)`

Value

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
identify_abundant(
  tidybulk::se_mini
)
```

```
impute_missing_abundance
```

impute transcript abundance if missing from sample-transcript pairs

Description

`impute_missing_abundance()` takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a consistent object (to the input) with additional sample-transcript pairs with imputed transcript abundance.

Usage

```
impute_missing_abundance(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  suffix = "",  
  force_scaling = FALSE  
)  
  
## S4 method for signature 'spec_tbl_df'  
impute_missing_abundance(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  suffix = "",  
  force_scaling = FALSE  
)  
  
## S4 method for signature 'tbl_df'  
impute_missing_abundance(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  suffix = "",  
  force_scaling = FALSE  
)  
  
## S4 method for signature 'tidybulk'  
impute_missing_abundance(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  suffix = "",  
  force_scaling = FALSE  
)  
  
## S4 method for signature 'SummarizedExperiment'  
impute_missing_abundance(  
  .data,  
  .formula,
```

```

    .sample = NULL,
    .transcript = NULL,
    .abundance = NULL,
    suffix = "",
    force_scaling = FALSE
  )

## S4 method for signature 'RangedSummarizedExperiment'
impute_missing_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  suffix = "",
  force_scaling = FALSE
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.formula</code>	A formula with no response variable, representing the desired linear model where the first covariate is the factor of interest and the second covariate is the unwanted variation (of the kind <code>~ factor_of_interest + batch</code>)
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>suffix</code>	A character string. This is added to the imputed count column names. If empty the count column are overwritten
<code>force_scaling</code>	A boolean. In case a abundance-containing column is not scaled (columns with <code>_scale</code> suffix), setting <code>force_scaling = TRUE</code> will result in a scaling by library size, to compensating for a possible difference in sequencing depth.

Details

```
'r lifecycle::badge("maturing")'
```

This function imputes the abundance of missing sample-transcript pair using the median of the sample group defined by the formula

Value

A consistent object (to the input) non-sparse abundance
 A consistent object (to the input) with imputed abundance
 A consistent object (to the input) with imputed abundance

- A consistent object (to the input) with imputed abundance
- A ‘SummarizedExperiment’ object
- A ‘SummarizedExperiment’ object

Examples

```
res =  
  impute_missing_abundance(  
    tidybulk::se_mini,  
    ~ condition  
  )
```

inner_join	<i>Inner join datasets</i>
------------	----------------------------

Description

- Inner join datasets
- Right join datasets
- Full join datasets

Arguments

- x tbls to join. (See dplyr)
- y tbls to join. (See dplyr)
- by A character vector of variables to join by. (See dplyr)
- copy If x and y are not from the same data source, and copy is TRUE, then y will be copied into the same src as x. (See dplyr)
- suffix If there are non-joined duplicate variables in x and y, these suffixes will be added to the output to disambiguate them. Should be a character vector of length 2. (See dplyr)
- ... Data frames to combine (See dplyr)

Value

- A tt object
- A tt object
- A tt object

Examples

```
annotation = tidybulk::se_mini |> tidybulk() |> as_tibble() |> distinct(.sample) |> mutate(source = "AU")
tidybulk::se_mini |> tidybulk() |> as_tibble() |> inner_join(annotation)
```

```
annotation = tidybulk::se_mini |> tidybulk() |> as_tibble() |> distinct(.sample) |> mutate(source = "AU")
tidybulk::se_mini |> tidybulk() |> as_tibble() |> right_join(annotation)
```

```
annotation = tidybulk::se_mini |> tidybulk() |> as_tibble() |> distinct(.sample) |> mutate(source = "AU")
tidybulk::se_mini |> tidybulk() |> as_tibble() |> full_join(annotation)
```

keep_abundant	<i>Keep abundant transcripts</i>
---------------	----------------------------------

Description

keep_abundant() takes as input A ‘tbl’ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment’ (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```
keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

## S4 method for signature 'spec_tbl_df'
keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

## S4 method for signature 'tbl_df'
```



```

keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

## S4 method for signature 'tidybulk'
keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

## S4 method for signature 'SummarizedExperiment'
keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

## S4 method for signature 'RangedSummarizedExperiment'
keep_abundant(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  factor_of_interest = NULL,
  minimum_counts = 10,
  minimum_proportion = 0.7
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
--------------------	---

<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>factor_of_interest</code>	The name of the column of the factor of interest. This is used for defining sample groups for the filtering process. It uses the <code>filterByExpr</code> function from <code>edgeR</code> .
<code>minimum_counts</code>	A real positive number. It is the threshold of count per million that is used to filter transcripts/genes out from the scaling procedure.
<code>minimum_proportion</code>	A real positive number between 0 and 1. It is the threshold of proportion of samples for each transcripts/genes that have to be characterised by a cmp bigger than the threshold to be included for scaling procedure.

Details

[Questioning]

At the moment this function uses `edgeR` (DOI: 10.1093/bioinformatics/btp616)

Underlying method: `edgeR::filterByExpr(data, min.count = minimum_counts, group = string_factor_of_interest, min.prop = minimum_proportion)`

Value

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A ‘SummarizedExperiment’ object

A ‘SummarizedExperiment’ object

Examples

```
keep_abundant(
  tidybulk::se_mini
)
```

keep_variable	<i>Keep variable transcripts</i>
---------------	----------------------------------

Description

keep_variable() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```
keep_variable(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  top = 500,  
  transform = log1p,  
  log_transform = TRUE  
)  
  
## S4 method for signature 'spec_tbl_df'  
keep_variable(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  top = 500,  
  transform = log1p,  
  log_transform = NULL  
)  
  
## S4 method for signature 'tbl_df'  
keep_variable(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  top = 500,  
  transform = log1p,  
  log_transform = NULL  
)  
  
## S4 method for signature 'tidybulk'  
keep_variable(  
  .data,
```

```

    .sample = NULL,
    .transcript = NULL,
    .abundance = NULL,
    top = 500,
    transform = log1p,
    log_transform = NULL
  )

## S4 method for signature 'SummarizedExperiment'
keep_variable(.data, top = 500, transform = log1p)

## S4 method for signature 'RangedSummarizedExperiment'
keep_variable(.data, top = 500, transform = log1p)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>top</code>	Integer. Number of top transcript to consider
<code>transform</code>	A function that will tranform the counts, by default it is log1p for RNA sequencing data, but for avoinding tranformation you can use identity
<code>log_transform</code>	DEPRECATED - A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)

Details

'r lifecycle::badge("maturing")'

At the moment this function uses edgeR <https://doi.org/10.1093/bioinformatics/btp616>

Value

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

Underlying method: `s <- rowMeans((x - rowMeans(x)) ^ 2)` `o <- order(s, decreasing = TRUE)` `x <- x[o[1L:top], , drop = FALSE]` `variable_transcripts = rownames(x)`

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A ‘SummarizedExperiment’ object

A ‘SummarizedExperiment’ object

Examples

```
keep_variable(tidybulk::se_mini, top = 500)
```

log10_reverse_trans	<i>log10_reverse_trans</i>
---------------------	----------------------------

Description

it perform log scaling and reverse the axis. Useful to plot negative log probabilities. To not be used directly but with ggplot (e.g. `scale_y_continuous(trans = "log10_reverse")`)

Usage

```
log10_reverse_trans()
```

Details

```
‘r lifecycle::badge("maturing")‘
```

Value

A scales object

Examples

```
library(ggplot2)
library(tibble)

tibble(pvalue = c(0.001, 0.05, 0.1), fold_change = 1:3) %>%
  ggplot(aes(fold_change , pvalue)) +
  geom_point() +
  scale_y_continuous(trans = "log10_reverse")
```

logit_trans	<i>logit scale</i>
-------------	--------------------

Description

it perform logit scaling with right axis formatting. To not be used directly but with ggplot (e.g. `scale_y_continuous(trans = "log10_reverse")`)

Usage

```
logit_trans()
```

Details

`‘r lifecycle::badge("maturing")‘`

Value

A scales object

Examples

```
library(ggplot2)
library(tibble)

tibble(pvalue = c(0.001, 0.05, 0.1), fold_change = 1:3) %>%
  ggplot(aes(fold_change , pvalue)) +
  geom_point() +
  scale_y_continuous(trans = "log10_reverse")
```

mutate	<i>Create, modify, and delete columns</i>
--------	---

Description

`‘mutate()‘` adds new variables and preserves existing ones; `‘transmute()‘` adds new variables and drops existing ones. New variables overwrite existing variables of the same name. Variables can be removed by setting their value to `‘NULL‘`.

Arguments

`.data` A tbl. (See `dplyr`)

`...` `<[‘tidy-eval’][dplyr_tidy_eval]>` Name-value pairs. The name gives the name of the column in the output.

The value can be:

- * A vector of length 1, which will be recycled to the correct length.
- * A vector the same length as the current group (or the whole data frame if ungrouped).
- * ‘NULL’, to remove the column.
- * A data frame or tibble, to create multiple columns in the output.

Value

An object of the same type as ‘.data’.

For ‘mutate()’:

- * Rows are not affected.
- * Existing columns will be preserved unless explicitly modified.
- * New columns will be added to the right of existing columns.
- * Columns given value ‘NULL’ will be removed
- * Groups will be recomputed if a grouping variable is mutated.
- * Data frame attributes are preserved.

For ‘transmute()’:

- * Rows are not affected.
- * Apart from grouping variables, existing columns will be removed unless explicitly kept.
- * Column order matches order of expressions.
- * Groups will be recomputed if a grouping variable is mutated.
- * Data frame attributes are preserved.

Useful mutate functions

- * `[‘+’]`, `[‘-’]`, `[log()]`, etc., for their usual mathematical meanings
- * `[lead()]`, `[lag()]`
- * `[dense_rank()]`, `[min_rank()]`, `[percent_rank()]`, `[row_number()]`, `[cume_dist()]`, `[ntile()]`
- * `[cumsum()]`, `[cummean()]`, `[cummin()]`, `[cummax()]`, `[cumany()]`, `[cumall()]`
- * `[na_if()]`, `[coalesce()]`
- * `[if_else()]`, `[recode()]`, `[case_when()]`

Grouped tibbles

Because mutating expressions are computed within groups, they may yield different results on grouped tibbles. This will be the case as soon as an aggregating, lagging, or ranking function is involved. Compare this ungrouped mutate:

With the grouped equivalent:

The former normalises ‘mass’ by the global average whereas the latter normalises by the averages within gender levels.

Methods

These functions are **generic**s, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

Methods available in currently loaded packages:

See Also

Other single table verbs: [arrange\(\)](#), [filter\(\)](#), [rename\(\)](#), [summarise\(\)](#)

Examples

```
# Newly created variables are available immediately
mtcars |> as_tibble() |> mutate(
  cyl2 = cyl * 2,
  cyl4 = cyl2 * 2
)
```

`pivot_sample`

Extract sample-wise information

Description

`pivot_sample()` takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a 'tbl' with only sample-related columns

Usage

```
pivot_sample(.data, .sample = NULL)

## S4 method for signature 'spec_tbl_df'
pivot_sample(.data, .sample = NULL)

## S4 method for signature 'tbl_df'
pivot_sample(.data, .sample = NULL)

## S4 method for signature 'tidybulk'
pivot_sample(.data, .sample = NULL)

## S4 method for signature 'SummarizedExperiment'
pivot_sample(.data, .sample = NULL)

## S4 method for signature 'RangedSummarizedExperiment'
pivot_sample(.data, .sample = NULL)
```


Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.sample</code>	The name of the sample column

Details

```
'r lifecycle::badge("maturing")'
```

This function extracts only sample-related information for downstream analysis (e.g., visualisation). It is disruptive in the sense that it cannot be passed anymore to tidybulk function.

Value

A 'tbl' with transcript-related information

A consistent object (to the input)

A consistent object (to the input)

Examples

```
pivot_sample(tidybulk::se_mini )
```

<code>pivot_transcript</code>	<i>Extract transcript-wise information</i>
-------------------------------	--

Description

`pivot_transcript()` takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a 'tbl' with only transcript-related columns

Usage

```
pivot_transcript(.data, .transcript = NULL)

## S4 method for signature 'spec_tbl_df'
pivot_transcript(.data, .transcript = NULL)

## S4 method for signature 'tbl_df'
pivot_transcript(.data, .transcript = NULL)

## S4 method for signature 'tidybulk'
pivot_transcript(.data, .transcript = NULL)
```

```
## S4 method for signature 'SummarizedExperiment'
pivot_transcript(.data, .transcript = NULL)

## S4 method for signature 'RangedSummarizedExperiment'
pivot_transcript(.data, .transcript = NULL)
```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.transcript</code>	The name of the transcript column

Details

'r lifecycle::badge("maturing")'

This function extracts only transcript-related information for downstream analysis (e.g., visualisation). It is disruptive in the sense that it cannot be passed anymore to tidybulk function.

Value

A 'tbl' with transcript-related information
 A consistent object (to the input)
 A consistent object (to the input)

Examples

```
pivot_transcript(tidybulk::se_mini )
```

quantile_normalise_abundance

Normalise by quantiles the counts of transcripts/genes

Description

`quantile_normalise_abundance()` takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and Scales transcript abundance compensating for sequencing depth (e.g., with TMM algorithm, Robinson and Oshlack doi.org/10.1186/gb-2010-11-3-r25).

Usage

```
quantile_normalise_abundance(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "limma_normalize_quantiles",  
  action = "add"  
)  
  
## S4 method for signature 'spec_tbl_df'  
quantile_normalise_abundance(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "limma_normalize_quantiles",  
  action = "add"  
)  
  
## S4 method for signature 'tbl_df'  
quantile_normalise_abundance(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "limma_normalize_quantiles",  
  action = "add"  
)  
  
## S4 method for signature 'tidybulk'  
quantile_normalise_abundance(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "limma_normalize_quantiles",  
  action = "add"  
)  
  
## S4 method for signature 'SummarizedExperiment'  
quantile_normalise_abundance(  
  .data,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "limma_normalize_quantiles",  
  action = NULL
```

```

)

## S4 method for signature 'RangedSummarizedExperiment'
quantile_normalise_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "limma_normalize_quantiles",
  action = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>method</code>	A character string. Either "limma_normalize_quantiles" for <code>limma::normalizeQuantiles</code> or "preprocesscore_normalize_quantiles_use_target" for <code>preprocessCore::normalize.quantiles.use.target</code> for large-scale dataset, where <code>limma</code> could not be compatible.
<code>action</code>	A character string between "add" (default) and "only". "add" joins the new information to the input tbl (default), "only" return a non-redundant tbl with the just new information.

Details

`'r lifecycle::badge("maturing")'`

Scales transcript abundance compensating for sequencing depth (e.g., with TMM algorithm, Robinson and Oshlack doi.org/10.1186/gb-2010-11-3-r25). Lowly transcribed transcripts/genes (defined with `minimum_counts` and `minimum_proportion` parameters) are filtered out from the scaling procedure. The scaling inference is then applied back to all unfiltered data.

Underlying method `edgeR::calcNormFactors(.data, method = c("TMM", "TMMwsp", "RLE", "upperquartile"))`

Value

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
tidybulk::se_mini |>
  quantile_normalise_abundance()
```

reduce_dimensions	<i>Dimension reduction of the transcript abundance data</i>
-------------------	---

Description

reduce_dimensions() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and calculates the reduced dimensional space of the transcript abundance.

Usage

```
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
  scale = TRUE,
  action = "add",
  ...,
  log_transform = NULL
)

## S4 method for signature 'spec_tbl_df'
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
```

```
    scale = TRUE,
    action = "add",
    ...,
    log_transform = NULL
)

## S4 method for signature 'tbl_df'
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
  scale = TRUE,
  action = "add",
  ...,
  log_transform = NULL
)

## S4 method for signature 'tidybulk'
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
  scale = TRUE,
  action = "add",
  ...,
  log_transform = NULL
)

## S4 method for signature 'SummarizedExperiment'
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
```

```

    top = 500,
    of_samples = TRUE,
    transform = log1p,
    scale = TRUE,
    action = "add",
    ...,
    log_transform = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
reduce_dimensions(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  .dims = 2,
  top = 500,
  of_samples = TRUE,
  transform = log1p,
  scale = TRUE,
  action = "add",
  ...,
  log_transform = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.element</code>	The name of the element column (normally samples).
<code>.feature</code>	The name of the feature column (normally transcripts/genes)
<code>.abundance</code>	The name of the column including the numerical value the clustering is based on (normally transcript abundance)
<code>method</code>	A character string. The dimension reduction algorithm to use (PCA, MDS, tSNE).
<code>.dims</code>	An integer. The number of dimensions your are interested in (e.g., 4 for returning the first four principal components).
<code>top</code>	An integer. How many top genes to select for dimensionality reduction
<code>of_samples</code>	A boolean. In case the input is a tidybulk object, it indicates Whether the element column will be sample or transcript column
<code>transform</code>	A function that will tranform the counts, by default it is log1p for RNA sequencing data, but for avoiding tranformation you can use identity
<code>scale</code>	A boolean for method="PCA", this will be passed to the 'prcomp' function. It is not included in the ... argument because although the default for 'prcomp' if FALSE, it is advisable to set it as TRUE.

action	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).
...	Further parameters passed to the function prcomp if you choose method="PCA" or Rtsne if you choose method="tSNE"
log_transform	DEPRECATED - A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)

Details

```
‘r lifecycle::badge("maturing")‘
```

This function reduces the dimensions of the transcript abundances. It can use multi-dimensional scaling (MDS; DOI.org/10.1186/gb-2010-11-3-r25), principal component analysis (PCA), or tSNE (Jesse Krijthe et al. 2018)

Underlying method for PCA: prcomp(scale = scale, ...)

Underlying method for MDS: limma::plotMDS(ndim = .dims, plot = FALSE, top = top)

Underlying method for tSNE: Rtsne::Rtsne(data, ...)

Underlying method for UMAP:

```
df_source = .data |>
```

```
# Filter NA symbol filter(!.feature |> is.na() |> not()) |>
```

```
# Prepare data frame distinct(!.feature,!element,!abundance) |>
```

```
# Filter most variable genes keep_variable_transcripts(top) |> reduce_dimensions(method="PCA",
.dims = calculate_for_pca_dimensions, action="get" ) |> as_matrix(rownames = quo_name(element))
|> uwot::tmap(...)
```

Value

A tbl object with additional columns for the reduced dimensions

A tbl object with additional columns for the reduced dimensions

A tbl object with additional columns for the reduced dimensions

A tbl object with additional columns for the reduced dimensions

A ‘SummarizedExperiment’ object

A ‘SummarizedExperiment’ object

Examples

```
counts.MDS =
  tidybulk::se_mini |>
  identify_abundant() |>
  reduce_dimensions( method="MDS", .dims = 3)
```

```
counts.PCA =
  tidybulk::se_mini |>
```



```
identify_abundant() |>
reduce_dimensions(method="PCA", .dims = 3)
```

reexports

*Objects exported from other packages***Description**

These objects are imported from other packages. Follow the links below to see their documentation.

dplyr [do](#), [select](#)

tibble [as_tibble](#), [tibble](#)

remove_redundancy

Drop redundant elements (e.g., samples) for which feature (e.g., transcript/gene) abundances are correlated

Description

remove_redundancy() takes as input A ‘tbl’ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment’ (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) for correlation method or |<DIMENSION 1>|<DIMENSION 2>|<...>| for reduced_dimensions method, and returns a consistent object (to the input) with dropped elements (e.g., samples).

Usage

```
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column,
  Dim_b_column,
  log_transform = NULL
)
```

```
## S4 method for signature 'spec_tbl_df'
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column = NULL,
  Dim_b_column = NULL,
  log_transform = NULL
)
```

```
## S4 method for signature 'tbl_df'
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column = NULL,
  Dim_b_column = NULL,
  log_transform = NULL
)
```

```
## S4 method for signature 'tidybulk'
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column = NULL,
  Dim_b_column = NULL,
  log_transform = NULL
)
```

```
## S4 method for signature 'SummarizedExperiment'
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column = NULL,
  Dim_b_column = NULL,
  log_transform = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
remove_redundancy(
  .data,
  .element = NULL,
  .feature = NULL,
  .abundance = NULL,
  method,
  of_samples = TRUE,
  correlation_threshold = 0.9,
  top = Inf,
  transform = identity,
  Dim_a_column = NULL,
  Dim_b_column = NULL,
  log_transform = NULL
)
```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.element</code>	The name of the element column (normally samples).
<code>.feature</code>	The name of the feature column (normally transcripts/genes)
<code>.abundance</code>	The name of the column including the numerical value the clustering is based on (normally transcript abundance)
<code>method</code>	A character string. The method to use, correlation and reduced_dimensions are available. The latter eliminates one of the most proximal pairs of samples in PCA reduced dimensions.
<code>of_samples</code>	A boolean. In case the input is a tidybulk object, it indicates Whether the element column will be sample or transcript column
<code>correlation_threshold</code>	A real number between 0 and 1. For correlation based calculation.

top	An integer. How many top genes to select for correlation based method
transform	A function that will transform the counts, by default it is log1p for RNA sequencing data, but for avoiding transformation you can use identity
Dim_a_column	A character string. For reduced_dimension based calculation. The column of one principal component
Dim_b_column	A character string. For reduced_dimension based calculation. The column of another principal component
log_transform	DEPRECATED - A boolean, whether the value should be log-transformed (e.g., TRUE for RNA sequencing data)

Details

```
'r lifecycle::badge("maturing")'
```

This function removes redundant elements from the original data set (e.g., samples or transcripts). For example, if we want to define cell-type specific signatures with low sample redundancy. This function returns a tibble with dropped redundant elements (e.g., samples). Two redundancy estimation approaches are supported: (i) removal of highly correlated clusters of elements (keeping a representative) with `method="correlation"`; (ii) removal of most proximal element pairs in a reduced dimensional space.

Underlying method for correlation: `widyr::pairwise_cor(sample, transcript, count, sort = TRUE, diag = FALSE, upper = FALSE)`

Underlying custom method for reduced dimensions: `select_closest_pairs = function(df) couples <- df |> head(n = 0)`

```
while (df |> nrow() > 0) pair <- df |> arrange(dist) |> head(n = 1) couples <- couples |> bind_rows(pair)
df <- df |> filter( !sample 1' ; sample 2' )
```

```
couples
```

Value

A tibble object with with dropped redundant elements (e.g., samples).

A tibble object with with dropped redundant elements (e.g., samples).

A tibble object with with dropped redundant elements (e.g., samples).

A tibble object with with dropped redundant elements (e.g., samples).

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
tidybulk::se_mini |>
identify_abundant() |>
  remove_redundancy(
    .element = sample,
    .feature = transcript,
    .abundance = count,
```

```

      method = "correlation"
    )

counts.MDS =
  tidybulk::se_mini |>
  identify_abundant() |>
  reduce_dimensions( method="MDS", .dims = 3)

remove_redundancy(
  counts.MDS,
  Dim_a_column = `Dim1`,
  Dim_b_column = `Dim2`,
  .element = sample,
  method = "reduced_dimensions"
)

```

 rename

Rename columns

Description

Rename individual variables using ‘new_name = old_name’ syntax.

Arguments

.data	A tbl. (See dplyr)
...	<[‘tidy-select’][dplyr_tidy_select]> Use ‘new_name = old_name’ to rename selected variables.

Value

An object of the same type as ‘.data’. * Rows are not affected. * Column names are changed; column order is preserved * Data frame attributes are preserved. * Groups are updated to reflect new names.

Scoped selection and renaming

Use the three scoped variants ([rename_all()], [rename_if()], [rename_at()]) to renaming a set of variables with a function.

Methods

This function is a **generic**, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

The following methods are currently available in loaded packages:

See Also

Other single table verbs: [arrange\(\)](#), [filter\(\)](#), [mutate\(\)](#), [summarise\(\)](#)

Examples

```
iris <- as_tibble(iris) # so it prints a little nicer
rename(iris, petal_length = Petal.Length)
```

rotate_dimensions	<i>Rotate two dimensions (e.g., principal components) of an arbitrary angle</i>
-------------------	---

Description

rotate_dimensions() takes as input a 'tbl' formatted as | <DIMENSION 1> | <DIMENSION 2> | <...> | and calculates the rotated dimensional space of the transcript abundance.

Usage

```
rotate_dimensions(
  .data,
  dimension_1_column,
  dimension_2_column,
  rotation_degrees,
  .element = NULL,
  of_samples = TRUE,
  dimension_1_column_rotated = NULL,
  dimension_2_column_rotated = NULL,
  action = "add"
)

## S4 method for signature 'spec_tbl_df'
rotate_dimensions(
  .data,
  dimension_1_column,
  dimension_2_column,
  rotation_degrees,
  .element = NULL,
  of_samples = TRUE,
  dimension_1_column_rotated = NULL,
  dimension_2_column_rotated = NULL,
  action = "add"
)

## S4 method for signature 'tbl_df'
rotate_dimensions(
```

```
.data,  
dimension_1_column,  
dimension_2_column,  
rotation_degrees,  
.element = NULL,  
of_samples = TRUE,  
dimension_1_column_rotated = NULL,  
dimension_2_column_rotated = NULL,  
action = "add"  
)  
  
## S4 method for signature 'tidybulk'  
rotate_dimensions(  
  .data,  
  dimension_1_column,  
  dimension_2_column,  
  rotation_degrees,  
  .element = NULL,  
  of_samples = TRUE,  
  dimension_1_column_rotated = NULL,  
  dimension_2_column_rotated = NULL,  
  action = "add"  
)  
  
## S4 method for signature 'SummarizedExperiment'  
rotate_dimensions(  
  .data,  
  dimension_1_column,  
  dimension_2_column,  
  rotation_degrees,  
  .element = NULL,  
  of_samples = TRUE,  
  dimension_1_column_rotated = NULL,  
  dimension_2_column_rotated = NULL,  
  action = "add"  
)  
  
## S4 method for signature 'RangedSummarizedExperiment'  
rotate_dimensions(  
  .data,  
  dimension_1_column,  
  dimension_2_column,  
  rotation_degrees,  
  .element = NULL,  
  of_samples = TRUE,  
  dimension_1_column_rotated = NULL,  
  dimension_2_column_rotated = NULL,  
  action = "add"
```

)

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>dimension_1_column</code>	A character string. The column of the dimension 1
<code>dimension_2_column</code>	A character string. The column of the dimension 2
<code>rotation_degrees</code>	A real number between 0 and 360
<code>.element</code>	The name of the element column (normally samples).
<code>of_samples</code>	A boolean. In case the input is a tidybulk object, it indicates Whether the element column will be sample or transcript column
<code>dimension_1_column_rotated</code>	A character string. The column of the rotated dimension 1 (optional)
<code>dimension_2_column_rotated</code>	A character string. The column of the rotated dimension 2 (optional)
<code>action</code>	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).

Details

```
'r lifecycle::badge("maturing")'
```

This function to rotate two dimensions such as the reduced dimensions.

Underlying custom method: `rotation = function(m, d) // r = the angle // m data matrix r = d * pi / 180 ((bind_rows(c('1' = cos(r), '2' = -sin(r)), c('1' = sin(r), '2' = cos(r))))> as_matrix())`

Value

A tbl object with additional columns for the reduced dimensions. additional columns for the rotated dimensions. The rotated dimensions will be added to the original data set as '<NAME OF DIMENSION> rotated <ANGLE>' by default, or as specified in the input arguments.

A tbl object with additional columns for the reduced dimensions. additional columns for the rotated dimensions. The rotated dimensions will be added to the original data set as '<NAME OF DIMENSION> rotated <ANGLE>' by default, or as specified in the input arguments.

A tbl object with additional columns for the reduced dimensions. additional columns for the rotated dimensions. The rotated dimensions will be added to the original data set as '<NAME OF DIMENSION> rotated <ANGLE>' by default, or as specified in the input arguments.

A tbl object with additional columns for the reduced dimensions. additional columns for the rotated dimensions. The rotated dimensions will be added to the original data set as '<NAME OF DIMENSION> rotated <ANGLE>' by default, or as specified in the input arguments.

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
counts.MDS =
  tidybulk::se_mini |>
  identify_abundant() |>
  reduce_dimensions( method="MDS", .dims = 3)

counts.MDS.rotated = rotate_dimensions(counts.MDS, `Dim1`, `Dim2`, rotation_degrees = 45, .element = sample)
```

rowwise

*Group input by rows***Description**

See [\[this repository\]\(https://github.com/jennybc/row-oriented-workflows\)](https://github.com/jennybc/row-oriented-workflows) for alternative ways to perform row-wise operations.

Arguments

data	Input data frame.
...	Variables to be preserved when calling summarise(). This is typically a set of variables whose combination uniquely identify each row. NB: unlike group_by() you can not create new variables here but instead you can select multiple variables with (e.g.) everything().

Details

‘rowwise()’ is used for the results of [do()] when you create list-variables. It is also useful to support arbitrary complex operations that need to be applied to each row.

Currently, rowwise grouping only works with data frames. Its main impact is to allow you to work with list-variables in [summarise()] and [mutate()] without having to use [[1]]. This makes ‘summarise()’ on a rowwise tbl effectively equivalent to [plyr::ldply()].

Value

A consistent object (to the input)

A ‘tbl’

Examples

```
df <- expand.grid(x = 1:3, y = 3:1)
df_done <- df |> rowwise()
```

scale_abundance	<i>Scale the counts of transcripts/genes</i>
-----------------	--

Description

scale_abundance() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and Scales transcript abundance compensating for sequencing depth (e.g., with TMM algorithm, Robinson and Oshlack doi.org/10.1186/gb-2010-11-3-r25).

Usage

```
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = "add",
  reference_selection_function = NULL
)

## S4 method for signature 'spec_tbl_df'
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = "add",
  reference_selection_function = NULL
)

## S4 method for signature 'tbl_df'
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = "add",
```

```

    reference_selection_function = NULL
  )

## S4 method for signature 'tidybulk'
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = "add",
  reference_selection_function = NULL
)

## S4 method for signature 'SummarizedExperiment'
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = NULL,
  reference_selection_function = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
scale_abundance(
  .data,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "TMM",
  reference_sample = NULL,
  .subset_for_scaling = NULL,
  action = NULL,
  reference_selection_function = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.sample</code>	The name of the sample column

<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>method</code>	A character string. The scaling method passed to the back-end function (i.e., <code>edgeR::calcNormFactors</code> ; "TMM", "TMMwsp", "RLE", "upperquartile")
<code>reference_sample</code>	A character string. The name of the reference sample. If NULL the sample with highest total read count will be selected as reference.
<code>.subset_for_scaling</code>	A gene-wise quosure condition. This will be used to filter rows (features/genes) of the dataset. For example
<code>action</code>	A character string between "add" (default) and "only". "add" joins the new information to the input tbl (default), "only" return a non-redundant tbl with the just new information.
<code>reference_selection_function</code>	DEPRECATED. please use <code>reference_sample</code> .

Details

```
'r lifecycle::badge("maturing")'
```

Scales transcript abundance compensating for sequencing depth (e.g., with TMM algorithm, Robinson and Oshlack doi.org/10.1186/gb-2010-11-3-r25). Lowly transcribed transcripts/genes (defined with `minimum_counts` and `minimum_proportion` parameters) are filtered out from the scaling procedure. The scaling inference is then applied back to all unfiltered data.

Underlying method `edgeR::calcNormFactors(.data, method = c("TMM", "TMMwsp", "RLE", "upperquartile"))`

Value

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A tbl object with additional columns with scaled data as '`<NAME OF COUNT COLUMN>_scaled`'

A 'SummarizedExperiment' object

A 'SummarizedExperiment' object

Examples

```
tidybulk::se_mini |>
  identify_abundant() |>
  scale_abundance()
```

se	<i>SummarizedExperiment</i>
----	-----------------------------

Description

SummarizedExperiment

Usage

se

Format

An object of class RangedSummarizedExperiment with 100 rows and 8 columns.

se_mini	<i>SummarizedExperiment mini for vignette</i>
---------	---

Description

SummarizedExperiment mini for vignette

Usage

se_mini

Format

An object of class SummarizedExperiment with 527 rows and 5 columns.

summarise	<i>Summarise each group to fewer rows</i>
-----------	---

Description

‘summarise()’ creates a new data frame. It will have one (or more) rows for each combination of grouping variables; if there are no grouping variables, the output will have a single row summarising all observations in the input. It will contain one column for each grouping variable and one column for each of the summary statistics that you have specified.

‘summarise()’ and ‘summarize()’ are synonyms.

Arguments

`.data` A tbl. (See `dplyr`)

`...` `<['tidy-eval'] [dplyr_tidy_eval]>` Name-value pairs of summary functions. The name will be the name of the variable in the result.

The value can be:

- * A vector of length 1, e.g. `'min(x)'`, `'n()'`, or `'sum(is.na(y))'`.
- * A vector of length 'n', e.g. `'quantile()'`.
- * A data frame, to add multiple columns from a single expression.

Value

An object `_usually_` of the same type as `'data'`.

* The rows come from the underlying `'group_keys()'`. * The columns are a combination of the grouping keys and the summary expressions that you provide. * If `'x'` is grouped by more than one variable, the output will be another `[grouped_df]` with the right-most group removed. * If `'x'` is grouped by one variable, or is not grouped, the output will be a `[tibble]`. * Data frame attributes are **not** preserved, because `'summarise()'` fundamentally creates a new data frame.

Useful functions

* Center: `[mean()]`, `[median()]` * Spread: `[sd()]`, `[IQR()]`, `[mad()]` * Range: `[min()]`, `[max()]`, `[quantile()]` * Position: `[first()]`, `[last()]`, `[nth()]`, * Count: `[n()]`, `[n_distinct()]` * Logical: `[any()]`, `[all()]`

Backend variations

The data frame backend supports creating a variable and using it in the same summary. This means that previously created summary variables can be further transformed or combined within the summary, as in `[mutate()]`. However, it also means that summary variables with the same names as previous variables overwrite them, making those variables unavailable to later summary variables.

This behaviour may not be supported in other backends. To avoid unexpected results, consider using new names for your summary variables, especially when creating multiple summaries.

Methods

This function is a **generic**, which means that packages can provide implementations (methods) for other classes. See the documentation of individual methods for extra arguments and differences in behaviour.

The following methods are currently available in loaded packages:

See Also

Other single table verbs: `arrange()`, `filter()`, `mutate()`, `rename()`

Examples

```
# A summary applied to ungrouped tbl returns a single row

mtcars |>
  summarise(mean = mean(displ))
```

symbol_to_entrez	<i>Get ENTREZ id from gene SYMBOL</i>
------------------	---------------------------------------

Description

Get ENTREZ id from gene SYMBOL

Usage

```
symbol_to_entrez(.data, .transcript = NULL, .sample = NULL)
```

Arguments

.data	A tt or tbl object.
.transcript	A character. The name of the gene symbol column.
.sample	The name of the sample column

Value

A tbl

Examples

```
# This function was designed for data.frame
# Convert from SummarizedExperiment for this example. It is NOT recommended.

tidybulk::se_mini |> tidybulk() |> as_tibble() |> symbol_to_entrez(.transcript = .feature, .sample = .sample)
```

test_differential_abundance

Perform differential transcription testing using edgeR quasi-likelihood (QLT), edgeR likelihood-ratio (LR), limma-voom, limma-voom-with-quality-weights or DESeq2

Description

test_differential_abundance() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```
test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
  action = "add",
  ...,
  significance_threshold = NULL,
  fill_missing_values = NULL,
  .contrasts = NULL
)

## S4 method for signature 'spec_tbl_df'
test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
```



```

    action = "add",
    ...,
    significance_threshold = NULL,
    fill_missing_values = NULL,
    .contrasts = NULL
)

## S4 method for signature 'tbl_df'
test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
  action = "add",
  ...,
  significance_threshold = NULL,
  fill_missing_values = NULL,
  .contrasts = NULL
)

## S4 method for signature 'tidybulk'
test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
  action = "add",
  ...,
  significance_threshold = NULL,
  fill_missing_values = NULL,
  .contrasts = NULL
)

## S4 method for signature 'SummarizedExperiment'
```

```

test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
  action = "add",
  ...,
  significance_threshold = NULL,
  fill_missing_values = NULL,
  .contrasts = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
test_differential_abundance(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  contrasts = NULL,
  method = "edgeR_quasi_likelihood",
  test_above_log2_fold_change = NULL,
  scaling_method = "TMM",
  omit_contrast_in_colnames = FALSE,
  prefix = "",
  action = "add",
  ...,
  significance_threshold = NULL,
  fill_missing_values = NULL,
  .contrasts = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
<code>.formula</code>	A formula representing the desired linear model. If there is more than one factor, they should be in the order factor of interest + additional factors.
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column

.abundance	The name of the transcript/gene abundance column
contrasts	This parameter takes the format of the contrast parameter of the method of choice. For edgeR and limma-voom is a character vector. For DESeq2 is a list including a character vector of length three. The first covariate is the one the model is tested against (e.g., ~ factor_of_interest)
method	A string character. Either "edgeR_quasi_likelihood" (i.e., QLF), "edgeR_likelihood_ratio" (i.e., LRT), "edger_robust_likelihood_ratio", "DESeq2", "limma_voom", "limma_voom_sample_weights"
test_above_log2_fold_change	A positive real value. This works for edgeR and limma_voom methods. It uses the 'treat' function, which tests that the difference in abundance is bigger than this threshold rather than zero https://pubmed.ncbi.nlm.nih.gov/19176553 .
scaling_method	A character string. The scaling method passed to the back-end functions: edgeR and limma-voom (i.e., edgeR::calcNormFactors; "TMM", "TMMwsp", "RLE", "upperquartile"). Setting the parameter to \"none\" will skip the compensation for sequencing-depth for the method edgeR or limma-voom.
omit_contrast_in_colnames	If just one contrast is specified you can choose to omit the contrast label in the colnames.
prefix	A character string. The prefix you would like to add to the result columns. It is useful if you want to compare several methods.
action	A character string. Whether to join the new information to the input tbl (add), or just get the non-redundant tbl with the new information (get).
...	Further arguments passed to some of the internal functions. Currently, it is needed just for internal debug.
significance_threshold	DEPRECATED - A real between 0 and 1 (usually 0.05).
fill_missing_values	DEPRECATED - A boolean. Whether to fill missing sample/transcript values with the median of the transcript. This is rarely needed.
.contrasts	DEPRECATED - This parameter takes the format of the contrast parameter of the method of choice. For edgeR and limma-voom is a character vector. For DESeq2 is a list including a character vector of length three. The first covariate is the one the model is tested against (e.g., ~ factor_of_interest)

Details

'r lifecycle::badge("maturing")'

This function provides the option to use edgeR <https://doi.org/10.1093/bioinformatics/btp616>, limma-voom <https://doi.org/10.1186/gb-2014-15-2-r29>, limma_voom_sample_weights <https://doi.org/10.1093/nar/gkv412> or DESeq2 <https://doi.org/10.1186/s13059-014-0550-8> to perform the testing. All methods use raw counts, irrespective of if scale_abundance or adjust_abundance have been calculated, therefore it is essential to add covariates such as batch effects (if applicable) in the formula.

Underlying method for edgeR framework:

```
.data |>
# Filter keep_abundant( factor_of_interest = !(as.symbol(parse_formula(.formula)[1])), minimum_counts
= minimum_counts, minimum_proportion = minimum_proportion ) |>
# Format select(!!.transcript,!!.sample,!!.abundance) |> spread(!!.sample,!!.abundance) |> as_matrix(rownames
= !!!.transcript)
# edgeR edgeR::DGEList(counts = .) |> edgeR::calcNormFactors(method = scaling_method) |>
edgeR::estimateDisp(design) |>
# Fit edgeR::glmQLFit(design) |> // or glmFit according to choice edgeR::glmQLFTest(coef = 2,
contrast = my_contrasts) // or glmLRT according to choice
Underlying method for DESeq2 framework:
keep_abundant( factor_of_interest = !(as.symbol(parse_formula(.formula)[[1]]), minimum_counts
= minimum_counts, minimum_proportion = minimum_proportion ) |>
# DESeq2 DESeq2::DESeqDataSet(design = .formula) |> DESeq2::DESeq() |> DESeq2::results()
Underlying method for glmmSeq framework:
counts = .data assay(my_assay)
# Create design matrix for dispersion, removing random effects design = model.matrix( object =
.formula |> lme4::nobars(), data = metadata )
dispersion = counts |> edgeR::estimateDisp(design = design)
glmmSeq( .formula, countdata = counts , metadata = metadata |> as.data.frame(), dispersion =
dispersion, progress = TRUE, method = method |> str_remove("(?i)^glmmSeq_" ), )
```

Value

A consistent object (to the input) with additional columns for the statistics from the test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A ‘SummarizedExperiment’ object

A ‘SummarizedExperiment’ object

Examples

```
# edgeR

tidybulk::se_mini |>
identify_abundant() |>
test_differential_abundance( ~ condition )

# The function `test_differential_abundance` operates with contrasts too
```

```

tidybulk::se_mini |>
identify_abundant(factor_of_interest = condition) |>
test_differential_abundance(
  ~ 0 + condition,
  contrasts = c( "conditionTRUE - conditionFALSE")
)

# DESeq2 - equivalent for limma-voom

my_se_mini = tidybulk::se_mini
my_se_mini$condition = factor(my_se_mini$condition)

# demonstrating with `fitType` that you can access any arguments to DESeq()
my_se_mini |>
  identify_abundant(factor_of_interest = condition) |>
    test_differential_abundance( ~ condition, method="deseq2", fitType="local")

# testing above a log2 threshold, passes along value to lfcThreshold of results()
res <- my_se_mini |>
  identify_abundant(factor_of_interest = condition) |>
    test_differential_abundance( ~ condition, method="deseq2",
      fitType="local",
      test_above_log2_fold_change=4 )

# Use random intercept and random effect models

se_mini[1:50,] |>
  identify_abundant(factor_of_interest = condition) |>
  test_differential_abundance(
    ~ condition + (1 + condition | time),
    method = "glmmseq_lme4", cores = 1
  )

# confirm that lfcThreshold was used
## Not run:
  res |>
    mcols() |>
    DESeq2::DESeqResults() |>
    DESeq2::plotMA()

## End(Not run)

# The function `test_differential_abundance` operates with contrasts too

my_se_mini |>
identify_abundant() |>
test_differential_abundance(
  ~ 0 + condition,
  contrasts = list(c("condition", "TRUE", "FALSE")),
  method="deseq2",
  fitType="local"
)

```

`test_differential_cellularity`*Add differential tissue composition information to a tbl*

Description

`test_differential_cellularity()` takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with `library(tidySummarizedExperiment)`) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```
test_differential_cellularity(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "cibersort",  
  reference = X_cibersort,  
  significance_threshold = 0.05,  
  ...  
)  
  
## S4 method for signature 'spec_tbl_df'  
test_differential_cellularity(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "cibersort",  
  reference = X_cibersort,  
  significance_threshold = 0.05,  
  ...  
)  
  
## S4 method for signature 'tbl_df'  
test_differential_cellularity(  
  .data,  
  .formula,  
  .sample = NULL,  
  .transcript = NULL,  
  .abundance = NULL,  
  method = "cibersort",  
  reference = X_cibersort,
```

```

    significance_threshold = 0.05,
    ...
)

## S4 method for signature 'tidybulk'
test_differential_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  significance_threshold = 0.05,
  ...
)

## S4 method for signature 'SummarizedExperiment'
test_differential_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  significance_threshold = 0.05,
  ...
)

## S4 method for signature 'RangedSummarizedExperiment'
test_differential_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  significance_threshold = 0.05,
  ...
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
--------------------	---

<code>.formula</code>	A formula representing the desired linear model. The formula can be of two forms: multivariable (recommended) or univariable. Respectively: <code>"factor_of_interest ~ ."</code> or <code>"~ factor_of_interest"</code> . The dot represents cell-type proportions, and it is mandatory. If censored regression is desired (coxph) the formula should be of the form <code>"survival::Surv(y, dead) ~ ."</code>
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>method</code>	A string character. Either <code>"cibersort"</code> , <code>"epic"</code> or <code>"llsr"</code> . The regression method will be chosen based on being multivariable: lm or cox-regression (both on logit-transformed proportions); or univariable: beta or cox-regression (on logit-transformed proportions). See <code>.formula</code> for multi- or univariable choice.
<code>reference</code>	A data frame. The transcript/cell_type data frame of integer transcript abundance
<code>significance_threshold</code>	A real between 0 and 1 (usually 0.05).
<code>...</code>	Further parameters passed to the method <code>deconvolve_cellularity</code>

Details

```
'r lifecycle::badge("maturing")'
```

This routine applies a deconvolution method (e.g., Cibersort; DOI: 10.1038/nmeth.3337) and passes the proportions inferred into a generalised linear model (DOI:dx.doi.org/10.1007/s11749-010-0189-z) or a cox regression model (ISBN: 978-1-4757-3294-8)

Underlying method for the generalised linear model: `data |> deconvolve_cellularity(!!.sample, !!.transcript, !!.abundance, method=method, reference = reference, action="get", ...) [..] betareg::betareg(.my_formula, .)`

Underlying method for the cox regression: `data |> deconvolve_cellularity(!!.sample, !!.transcript, !!.abundance, method=method, reference = reference, action="get", ...) [..] mutate(.proportion_0_corrected = .proportion_0_corrected |> boot::logit()) survival::coxph(.my_formula, .)`

Value

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A ‘SummarizedExperiment’ object

A ‘SummarizedExperiment’ object

Examples

```
# Regular regression
test_differential_cellularity(
  tidybulk::se_mini ,
  . ~ condition,
  cores = 1
)
```



```
# Cox regression - multiple

tidybulk::se_mini |>

# Test
test_differential_cellularity(
  survival::Surv(days, dead) ~ .,
  cores = 1
)
```

test_gene_enrichment	<i>analyse gene enrichment with EGSEA</i>
----------------------	---

Description

test_gene_enrichment() takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a 'tbl' of gene set information

Usage

```
test_gene_enrichment(
  .data,
  .formula,
  .sample = NULL,
  .entrez,
  .abundance = NULL,
  contrasts = NULL,
  methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
    "kegg_metabolism", "kegg_signaling"),
  species,
  cores = 10,
  method = NULL,
  .contrasts = NULL
)

## S4 method for signature 'spec_tbl_df'
test_gene_enrichment(
  .data,
  .formula,
  .sample = NULL,
  .entrez,
  .abundance = NULL,
```

```

contrasts = NULL,
methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
  "kegg_metabolism", "kegg_signaling"),
species,
cores = 10,
method = NULL,
.contrasts = NULL
)

```

```
## S4 method for signature 'tbl_df'
```

```

test_gene_enrichment(
  .data,
  .formula,
  .sample = NULL,
  .entrez,
  .abundance = NULL,
  contrasts = NULL,
  methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
    "kegg_metabolism", "kegg_signaling"),
  species,
  cores = 10,
  method = NULL,
  .contrasts = NULL
)

```

```
## S4 method for signature 'tidybulk'
```

```

test_gene_enrichment(
  .data,
  .formula,
  .sample = NULL,
  .entrez,
  .abundance = NULL,
  contrasts = NULL,
  methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
    "kegg_metabolism", "kegg_signaling"),
  species,
  cores = 10,
  method = NULL,
  .contrasts = NULL
)

```

```
## S4 method for signature 'SummarizedExperiment'
```

```

test_gene_enrichment(
  .data,
  .formula,

```

```

    .sample = NULL,
    .entrez,
    .abundance = NULL,
    contrasts = NULL,
    methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
    gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
                  "kegg_metabolism", "kegg_signaling"),
    species,
    cores = 10,
    method = NULL,
    .contrasts = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
test_gene_enrichment(
  .data,
  .formula,
  .sample = NULL,
  .entrez,
  .abundance = NULL,
  contrasts = NULL,
  methods = c("camera", "roast", "safe", "gage", "padog", "globaltest", "ora"),
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease",
                "kegg_metabolism", "kegg_signaling"),
  species,
  cores = 10,
  method = NULL,
  .contrasts = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.formula</code>	A formula with no response variable, representing the desired linear model
<code>.sample</code>	The name of the sample column
<code>.entrez</code>	The ENTREZ ID of the transcripts/genes
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>contrasts</code>	This parameter takes the format of the contrast parameter of the method of choice. For edgeR and limma-voom is a character vector. For DESeq2 is a list including a character vector of length three. The first covariate is the one the model is tested against (e.g., <code>~ factor_of_interest</code>)
<code>methods</code>	A character vector. One or 3 or more methods to use in the testing (currently EGSEA errors if 2 are used). Type <code>EGSEA::egsea.base()</code> to see the supported GSE methods.

gene_sets	A character vector or a list. It can take one or more of the following built-in collections as a character vector: c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease", "kegg_metabolism", "kegg_signaling"), to be used with EGSEA buildIdx. c1 is human specific. Alternatively, a list of user-supplied gene sets can be provided, to be used with EGSEA buildCustomIdx. In that case, each gene set is a character vector of Entrez IDs and the names of the list are the gene set names.
species	A character. It can be human, mouse or rat.
cores	An integer. The number of cores available
method	DEPRECATED. Please use methods.
.contrasts	DEPRECATED - This parameter takes the format of the contrast parameter of the method of choice. For edgeR and limma-voom is a character vector. For DESeq2 is a list including a character vector of length three. The first covariate is the one the model is tested against (e.g., ~ factor_of_interest)

Details

```
'r lifecycle::badge("maturing")'
```

This wrapper executes ensemble gene enrichment analyses of the dataset using EGSEA (DOI:0.12688/f1000research.12544.1

```
dge = data |> keep_abundant( factor_of_interest = !!as.symbol(parse_formula(.formula)[[1]]), !!sample, !!entrez, !!abundance )
```

```
# Make sure transcript names are adjacent [...] as_matrix(rownames = !!entrez) edgeR::DGEList(counts = .)
```

```
idx = buildIdx(entrezIDs = rownames(dge), species = species, msigdb.gsets = msigdb.gsets, kegg.exclude = kegg.exclude)
```

```
dge |>
```

```
# Calculate weights limma::voom(design, plot = FALSE) |>
```

```
# Execute EGSEA egsea( contrasts = my_contrasts, baseGSEAs = methods, gs.annots = idx, sort.by = "med.rank", num.threads = cores, report = FALSE )
```

Value

A consistent object (to the input)

A consistent object (to the input)

A consistent object (to the input)

A consistent object (to the input)

A consistent object (to the input)

A consistent object (to the input)

Examples

```
## Not run:
```

```
library(SummarizedExperiment)
```

```

se = tidybulk::se_mini
rowData( se)$entrez = rownames(se )
df_entrez = aggregate_duplicates(se,.transcript = entrez )

library("EGSEA")

test_gene_enrichment(
df_entrez,
~ condition,
.sample = sample,
.entrez = entrez,
.abundance = count,
      methods = c("roast" , "safe", "gage" , "padog" , "globaltest", "ora" ),
      gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease", "kegg_metabolism", "kegg_signal",
species="human",
cores = 2
)

## End(Not run)

```

test_gene_overrepresentation

analyse gene over-representation with GSEA

Description

test_gene_overrepresentation() takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a 'tbl' with the GSEA statistics

Usage

```

test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'spec_tbl_df'
test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,

```

```
    species,
    .sample = NULL,
    gene_sets = NULL,
    gene_set = NULL
  )

## S4 method for signature 'tbl_df'
test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'tidybulk'
test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'SummarizedExperiment'
test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
test_gene_overrepresentation(
  .data,
  .entrez,
  .do_test,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)
```

)

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.entrez</code>	The ENTREZ ID of the transcripts/genes
<code>.do_test</code>	A boolean column name symbol. It indicates the transcript to check
<code>species</code>	A character. For example, human or mouse. MSigDB uses the latin species names (e.g., <code>"Mus musculus"</code> , <code>"Homo sapiens"</code>)
<code>.sample</code>	The name of the sample column
<code>gene_sets</code>	A character vector. The subset of MSigDB datasets you want to test against (e.g. <code>"C2"</code>). If NULL all gene sets are used (suggested). This argument was added to avoid time overflow of the examples.
<code>gene_set</code>	DEPRECATED. Use <code>gene_sets</code> instead.

Details

```
'r lifecycle::badge("maturing")'
```

This wrapper execute gene enrichment analyses of the dataset using a list of transcripts and GSEA. This wrapper uses clusterProfiler (DOI: doi.org/10.1089/omi.2011.0118) on the back-end.

Undelying method: `msigdbr::msigdbr(species = species) |> nest(data = -gs_cat) |> mutate(test = map(data, ~ clusterProfiler::enricher(my_entrez_rank, TERM2GENE=.x |> select(gs_name, entrez_gene), pvalueCutoff = 1) |> as_tibble()))`

Value

A consistent object (to the input)
 A 'spec_tbl_df' object
 A 'tbl_df' object
 A 'tidybulk' object
 A 'SummarizedExperiment' object
 A 'RangedSummarizedExperiment' object

Examples

```
print("Not run for build time.")

#se_mini = aggregate_duplicates(tidybulk::se_mini, .transcript = entrez)
#df_entrez = mutate(df_entrez, do_test = feature %in% c("TNFRSF4", "PLCH2", "PADI4", "PAX7"))

## Not run:
test_gene_overrepresentation(
  df_entrez,
  .sample = sample,
```

```
.entrez = entrez,
.do_test = do_test,
species="Homo sapiens",
  gene_sets =c("C2")
)

## End(Not run)
```

test_gene_rank	<i>analyse gene rank with GSEA</i>
----------------	------------------------------------

Description

test_gene_rank() takes as input a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a 'tbl' with the GSEA statistics

Usage

```
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'spec_tbl_df'
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7"),
  gene_set = NULL
)

## S4 method for signature 'tbl_df'
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
```



```

    gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7"),
    gene_set = NULL
)

## S4 method for signature 'tidybulk'
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
  gene_sets = c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7"),
  gene_set = NULL
)

## S4 method for signature 'SummarizedExperiment'
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

## S4 method for signature 'RangedSummarizedExperiment'
test_gene_rank(
  .data,
  .entrez,
  .arrange_desc,
  species,
  .sample = NULL,
  gene_sets = NULL,
  gene_set = NULL
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
<code>.entrez</code>	The ENTREZ ID of the transcripts/genes
<code>.arrange_desc</code>	A column name of the column to arrange in decreasing order
<code>species</code>	A character. For example, human or mouse. MSigDB uses the latin species names (e.g., <code>"Mus musculus"</code> , <code>"Homo sapiens"</code>)
<code>.sample</code>	The name of the sample column

gene_sets	A character vector or a list. It can take one or more of the following built-in collections as a character vector: c("h", "c1", "c2", "c3", "c4", "c5", "c6", "c7", "kegg_disease", "kegg_metabolism", "kegg_signaling"), to be used with EGSEA buildIdx. c1 is human specific. Alternatively, a list of user-supplied gene sets can be provided, to be used with EGSEA buildCustomIdx. In that case, each gene set is a character vector of Entrez IDs and the names of the list are the gene set names.
gene_set	DEPRECATED. Use gene_sets instead.

Details

[Maturing]

This wrapper execute gene enrichment analyses of the dataset using a list of transcripts and GSEA. This wrapper uses clusterProfiler (DOI: doi.org/10.1089/omi.2011.0118) on the back-end.

Undelying method: # Get gene sets signatures msigdb::msigdb(species = species)

Filter specific gene_sets if specified. This was introduced to speed up examples executionS when(!is.null(gene_sets) ~ filter(., gs_cat ~ (.)) >

Execute calculation nest(data = -gs_cat) > mutate(fit = map(data, ~ clusterProfiler::GSEA(my_entrez_rank, TERM2GENE=.x) > select(gs_name, entrez_gene), pvalueCutoff = 1)

))

Value

A consistent object (to the input)

A 'spec_tbl_df' object

A 'tbl_df' object

A 'tidybulk' object

A 'SummarizedExperiment' object

A 'RangedSummarizedExperiment' object

Examples

```
print("Not run for build time.")
```

```
## Not run:
```

```
df_entrez = tidybulk::se_mini
```

```
df_entrez = mutate(df_entrez, do_test = .feature %in% c("TNFRSF4", "PLCH2", "PADI4", "PAX7"))
```

```
df_entrez = df_entrez |> test_differential_abundance(~ condition)
```

```
test_gene_rank(
  df_entrez,
  .sample = .sample,
  .entrez = entrez,
  species="Homo sapiens",
  gene_sets =c("C2"),
```

```

    .arrange_desc = logFC
  )

  ## End(Not run)

```

```
test_stratification_cellularity
```

Test of stratification of biological replicates based on tissue composition, one cell-type at the time, using Kaplan-meier curves.

Description

test_stratification_cellularity() takes as input A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment)) and returns a consistent object (to the input) with additional columns for the statistics from the hypothesis test.

Usage

```

test_stratification_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  ...
)

## S4 method for signature 'spec_tbl_df'
test_stratification_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  ...
)

## S4 method for signature 'tbl_df'
test_stratification_cellularity(
  .data,
  .formula,

```

```

    .sample = NULL,
    .transcript = NULL,
    .abundance = NULL,
    method = "cibersort",
    reference = X_cibersort,
    ...
)

## S4 method for signature 'tidybulk'
test_stratification_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  ...
)

## S4 method for signature 'SummarizedExperiment'
test_stratification_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  ...
)

## S4 method for signature 'RangedSummarizedExperiment'
test_stratification_cellularity(
  .data,
  .formula,
  .sample = NULL,
  .transcript = NULL,
  .abundance = NULL,
  method = "cibersort",
  reference = X_cibersort,
  ...
)

```

Arguments

<code>.data</code>	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with <code>library(tidySummarizedExperiment)</code>)
--------------------	---

<code>.formula</code>	A formula representing the desired linear model. The formula can be of two forms: multivariable (recommended) or univariable. Respectively: <code>"factor_of_interest ~ ."</code> or <code>"~ factor_of_interest"</code> . The dot represents cell-type proportions, and it is mandatory. If censored regression is desired (coxph) the formula should be of the form <code>"survival::Surv(y, dead) ~ ."</code>
<code>.sample</code>	The name of the sample column
<code>.transcript</code>	The name of the transcript/gene column
<code>.abundance</code>	The name of the transcript/gene abundance column
<code>method</code>	A string character. Either <code>"cibersort"</code> , <code>"epic"</code> or <code>"llsr"</code> . The regression method will be chosen based on being multivariable: lm or cox-regression (both on logit-transformed proportions); or univariable: beta or cox-regression (on logit-transformed proportions). See <code>.formula</code> for multi- or univariable choice.
<code>reference</code>	A data frame. The transcript/cell_type data frame of integer transcript abundance
<code>...</code>	Further parameters passed to the method <code>deconvolve_cellularity</code>

Details

```
'r lifecycle::badge("maturing")'
```

This routine applies a deconvolution method (e.g., Cibersort; DOI: 10.1038/nmeth.3337) and passes the proportions inferred into a generalised linear model (DOI:dx.doi.org/10.1007/s11749-010-0189-z) or a cox regression model (ISBN: 978-1-4757-3294-8)

Underlying method for the test: `data |> deconvolve_cellularity(!!.sample, !!.transcript, !!.abundance, method=method, reference = reference, action="get", ...) [..] |> mutate(.high_cellularity = .proportion > median(.proportion)) |> survival::survdiff(data = data, .my_formula)`

Value

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

A consistent object (to the input) with additional columns for the statistics from the hypothesis test (e.g., log fold change, p-value and false discovery rate).

Examples

```
tidybulk::se_mini |>
test_stratification_cellularity(
  survival::Surv(days, dead) ~ .,
  cores = 1
)
```

tidybulk	<i>Creates an annotated 'tidybulk' tibble from a 'tbl' or 'SummarizedExperiment' object</i>
----------	---

Description

tidybulk() creates an annotated 'tidybulk' tibble from a 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))

Usage

```
tidybulk(.data, .sample, .transcript, .abundance, .abundance_scaled = NULL)

## S4 method for signature 'spec_tbl_df'
tidybulk(.data, .sample, .transcript, .abundance, .abundance_scaled = NULL)

## S4 method for signature 'tbl_df'
tidybulk(.data, .sample, .transcript, .abundance, .abundance_scaled = NULL)

## S4 method for signature 'SummarizedExperiment'
tidybulk(.data, .sample, .transcript, .abundance, .abundance_scaled = NULL)

## S4 method for signature 'RangedSummarizedExperiment'
tidybulk(.data, .sample, .transcript, .abundance, .abundance_scaled = NULL)
```

Arguments

.data	A 'tbl' (with at least three columns for sample, feature and transcript abundance) or 'SummarizedExperiment' (more convenient if abstracted to tibble with library(tidySummarizedExperiment))
.sample	The name of the sample column
.transcript	The name of the transcript/gene column
.abundance	The name of the transcript/gene abundance column
.abundance_scaled	The name of the transcript/gene scaled abundance column

Details

'r lifecycle::badge("maturing")'

This function creates a tidybulk object and is useful if you want to avoid to specify .sample, .transcript and .abundance arguments all the times. The tidybulk object have an attribute called internals where these three arguments are stored as metadata. They can be extracted as attr(<object>, "internals").

Value

- A ‘tidybulk’ object
- A ‘tidybulk’ object
- A ‘tidybulk’ object
- A ‘tidybulk’ object
- A ‘tidybulk’ object

Examples

```
tidybulk(tidybulk::se_mini)
```

tidybulk_SAM_BAM	<i>Creates a ‘tt’ object from a list of file names of BAM/SAM</i>
------------------	---

Description

tidybulk_SAM_BAM() creates a ‘tt’ object from A ‘tbl’ (with at least three columns for sample, feature and transcript abundance) or ‘SummarizedExperiment’ (more convenient if abstracted to tibble with library(tidySummarizedExperiment))

Usage

```
tidybulk_SAM_BAM(file_names, genome = "hg38", ...)

## S4 method for signature 'character,character'
tidybulk_SAM_BAM(file_names, genome = "hg38", ...)
```

Arguments

- file_names A character vector
- genome A character string specifying an in-built annotation used for read summarization. It has four possible values including "mm10", "mm9", "hg38" and "hg19"
- ... Further parameters passed to the function Rsubread::featureCounts

Details

‘r lifecycle::badge("maturing")’

This function is based on FeatureCounts package (DOI: 10.1093/bioinformatics/btt656). This function creates a tidybulk object and is useful if you want to avoid to specify .sample, .transcript and .abundance arguments all the times. The tidybulk object have an attribute called internals where these three arguments are stored as metadata. They can be extracted as attr(<object>, "internals").

Underlying core function Rsubread::featureCounts(annot.inbuilt = genome,nthreads = n_cores, ...)

Value

A ‘tidybulk’ object
A ‘tidybulk’ object

tximeta_summarizeToGene_object
<i>Needed for tests tximeta_summarizeToGene_object, It is Summarized-Experiment from tximeta</i>

Description

Needed for tests tximeta_summarizeToGene_object, It is SummarizedExperiment from tximeta

Usage

tximeta_summarizeToGene_object

Format

An object of class RangedSummarizedExperiment with 10 rows and 1 columns.

unnest	<i>unnest</i>
--------	---------------

Description

unnest
nest

Arguments

data	A tbl. (See tidyr)
cols	<[‘tidy-select’][tidyr_tidy_select]> Columns to unnest. If you ‘unnest()’ multiple columns, parallel entries must be of compatible sizes, i.e. they’re either equal or length 1 (following the standard tidyverse recycling rules).
names_sep	If ‘NULL’, the default, the names will be left as is. In ‘nest()’, inner names will come from the former outer names; in ‘unnest()’, the new outer names will come from the inner names. If a string, the inner and outer names will be used together. In ‘nest()’, the names of the new outer columns will be formed by pasting together the outer and the inner column names, separated by ‘names_sep’. In ‘unnest()’, the new inner names will have the outer names (+ ‘names_sep’) automatically stripped. This makes ‘names_sep’ roughly symmetric between nesting and unnesting.

keep_empty	See tidyr::unnest
names_repair	See tidyr::unnest
ptype	See tidyr::unnest
.drop	See tidyr::unnest
.id	tidyr::unnest
.sep	tidyr::unnest
.preserve	See tidyr::unnest
.data	A tbl. (See tidyr)
...	Name-variable pairs of the form new_col = c(col1, col2, col3) (See tidyr)

Value

A tidySummarizedExperiment object or a tibble depending on input

A tt object

Examples

```
tidybulk::se_mini |> tidybulk() |> nest( data = -.feature) |> unnest(data)
```

```
tidybulk::se_mini %>% tidybulk() %>% nest( data = -.feature)
```

vignette_manuscript_signature_boxplot

Needed for vignette vignette_manuscript_signature_boxplot

Description

Needed for vignette vignette_manuscript_signature_boxplot

Usage

```
vignette_manuscript_signature_boxplot
```

Format

An object of class tbl_df (inherits from tbl, data.frame) with 899 rows and 12 columns.

vignette_manuscript_signature_tsne
<i>Needed for vignette vignette_manuscript_signature_tsne</i>

Description

Needed for vignette vignette_manuscript_signature_tsne

Usage

vignette_manuscript_signature_tsne

Format

An object of class spec_tbl_df (inherits from tbl_df, tbl, data.frame) with 283 rows and 10 columns.

vignette_manuscript_signature_tsne2
<i>Needed for vignette vignette_manuscript_signature_tsne2</i>

Description

Needed for vignette vignette_manuscript_signature_tsne2

Usage

vignette_manuscript_signature_tsne2

Format

An object of class tbl_df (inherits from tbl, data.frame) with 283 rows and 9 columns.

X_cibersort	<i>Cibersort reference</i>
-------------	----------------------------

Description

Cibersort reference

Usage

X_cibersort

Format

An object of class data.frame with 547 rows and 22 columns.

`%>%`*Pipe operator*

Description

See `magrittr::%>%` for details.

Usage

```
lhs %>% rhs
```

Arguments

<code>lhs</code>	A value or the <code>magrittr</code> placeholder.
<code>rhs</code>	A function call using the <code>magrittr</code> semantics.

Value

The result of calling `'rhs(lhs)'`.

Index

* datasets

- breast_tcga_mini_SE, [15](#)
- counts_ensembl, [20](#)
- ensembl_symbol_mapping, [25](#)
- flybaseIDs, [29](#)
- se, [69](#)
- se_mini, [69](#)
- tximeta_summarizeToGene_object, [96](#)
- vignette_manuscript_signature_boxplot, [97](#)
- vignette_manuscript_signature_tsne, [98](#)
- vignette_manuscript_signature_tsne2, [98](#)
- X_cibersort, [98](#)

* grouping functions

- group_by, [33](#)

* internal

- %>%, [99](#)
- check_if_counts_is_na, [15](#)
- check_if_duplicated_genes, [16](#)
- check_if_wrong_input, [16](#)
- get_reduced_dimensions_UMAP_bulk, [31](#)
- get_reduced_dimensions_UMAP_bulk_SE, [32](#)
- reexports, [57](#)

* single table verbs

- arrange, [10](#)
- filter, [28](#)
- mutate, [46](#)
- rename, [61](#)
- summarise, [69](#)

- .describe_transcript_SE
(describe_transcript), [23](#)

- %>%, [99](#), [99](#)

- adjust_abundance, [3](#)

- adjust_abundance, RangedSummarizedExperiment-method
(adjust_abundance), [3](#)

- adjust_abundance, spec_tbl_df-method
(adjust_abundance), [3](#)

- adjust_abundance, SummarizedExperiment-method
(adjust_abundance), [3](#)

- adjust_abundance, tbl_df-method
(adjust_abundance), [3](#)

- adjust_abundance, tidybulk-method
(adjust_abundance), [3](#)

- aggregate_duplicates, [7](#)

- aggregate_duplicates, RangedSummarizedExperiment-method
(aggregate_duplicates), [7](#)

- aggregate_duplicates, spec_tbl_df-method
(aggregate_duplicates), [7](#)

- aggregate_duplicates, SummarizedExperiment-method
(aggregate_duplicates), [7](#)

- aggregate_duplicates, tbl_df-method
(aggregate_duplicates), [7](#)

- aggregate_duplicates, tidybulk-method
(aggregate_duplicates), [7](#)

- arrange, [10](#), [29](#), [48](#), [62](#), [70](#)

- as_matrix, [11](#)

- as_SummarizedExperiment, [12](#)

- as_SummarizedExperiment, spec_tbl_df-method
(as_SummarizedExperiment), [12](#)

- as_SummarizedExperiment, tbl_df-method
(as_SummarizedExperiment), [12](#)

- as_SummarizedExperiment, tidybulk-method
(as_SummarizedExperiment), [12](#)

- as_tibble, [57](#)

- as_tibble(reexports), [57](#)

- bind_cols, [13](#)

- bind_rows, [14](#)

- breast_tcga_mini_SE, [15](#)

- check_if_counts_is_na, [15](#)

- check_if_duplicated_genes, [16](#)

- check_if_wrong_input, [16](#)

- cluster_elements, [17](#)

cluster_elements, RangedSummarizedExperiment-method
 (cluster_elements), 17
 cluster_elements, spec_tbl_df-method
 (cluster_elements), 17
 cluster_elements, SummarizedExperiment-method
 (cluster_elements), 17
 cluster_elements, tbl_df-method
 (cluster_elements), 17
 cluster_elements, tidybulk-method
 (cluster_elements), 17
 counts_ensembl, 20

 deconvolve_cellularity, 20
 deconvolve_cellularity, RangedSummarizedExperiment-method
 (deconvolve_cellularity), 20
 deconvolve_cellularity, spec_tbl_df-method
 (deconvolve_cellularity), 20
 deconvolve_cellularity, SummarizedExperiment-method
 (deconvolve_cellularity), 20
 deconvolve_cellularity, tbl_df-method
 (deconvolve_cellularity), 20
 deconvolve_cellularity, tidybulk-method
 (deconvolve_cellularity), 20
 describe_transcript, 23
 describe_transcript, RangedSummarizedExperiment-method
 (describe_transcript), 23
 describe_transcript, spec_tbl_df-method
 (describe_transcript), 23
 describe_transcript, SummarizedExperiment-method
 (describe_transcript), 23
 describe_transcript, tbl_df-method
 (describe_transcript), 23
 describe_transcript, tidybulk-method
 (describe_transcript), 23
 distinct, 24
 do, 57
 do (reexports), 57

 ensembl_symbol_mapping, 25
 ensembl_to_symbol, 25
 ensembl_to_symbol, spec_tbl_df-method
 (ensembl_to_symbol), 25
 ensembl_to_symbol, tbl_df-method
 (ensembl_to_symbol), 25
 ensembl_to_symbol, tidybulk-method
 (ensembl_to_symbol), 25

 fill_missing_abundance, 26
 fill_missing_abundance, spec_tbl_df-method
 (fill_missing_abundance), 26
 fill_missing_abundance, tbl_df-method
 (fill_missing_abundance), 26
 fill_missing_abundance, tidybulk-method
 (fill_missing_abundance), 26
 filter, 11, 28, 48, 62, 70
 flybaseIDs, 29
 full_join (inner_join), 39

 get_bibliography, 30
 get_bibliography, RangedSummarizedExperiment-method
 (get_bibliography), 30
 get_bibliography, spec_tbl_df-method
 (get_bibliography), 30
 get_bibliography, SummarizedExperiment-method
 (get_bibliography), 30
 get_bibliography, tbl-method
 (get_bibliography), 30
 get_bibliography, tbl_df-method
 (get_bibliography), 30
 get_bibliography, tidybulk-method
 (get_bibliography), 30
 get_reduced_dimensions_UMAP_bulk, 31
 get_reduced_dimensions_UMAP_bulk_SE, 32
 group_by, 33

 identify_abundant, 34
 identify_abundant, RangedSummarizedExperiment-method
 (identify_abundant), 34
 identify_abundant, spec_tbl_df-method
 (identify_abundant), 34
 identify_abundant, SummarizedExperiment-method
 (identify_abundant), 34
 identify_abundant, tbl_df-method
 (identify_abundant), 34
 identify_abundant, tidybulk-method
 (identify_abundant), 34
 impute_missing_abundance, 36
 impute_missing_abundance, RangedSummarizedExperiment-method
 (impute_missing_abundance), 36
 impute_missing_abundance, spec_tbl_df-method
 (impute_missing_abundance), 36
 impute_missing_abundance, SummarizedExperiment-method
 (impute_missing_abundance), 36
 impute_missing_abundance, tbl_df-method
 (impute_missing_abundance), 36

- impute_missing_abundance, tidybulk-method
(impute_missing_abundance), 36
- inner_join, 39
- keep_abundant, 40
- keep_abundant, RangedSummarizedExperiment-method
(keep_abundant), 40
- keep_abundant, spec_tbl_df-method
(keep_abundant), 40
- keep_abundant, SummarizedExperiment-method
(keep_abundant), 40
- keep_abundant, tbl_df-method
(keep_abundant), 40
- keep_abundant, tidybulk-method
(keep_abundant), 40
- keep_variable, 43
- keep_variable, RangedSummarizedExperiment-method
(keep_variable), 43
- keep_variable, spec_tbl_df-method
(keep_variable), 43
- keep_variable, SummarizedExperiment-method
(keep_variable), 43
- keep_variable, tbl_df-method
(keep_variable), 43
- keep_variable, tidybulk-method
(keep_variable), 43
- left_join (bind_cols), 13
- log10_reverse_trans, 45
- logit_trans, 46
- mutate, 11, 29, 46, 62, 70
- nest (unnest), 96
- pivot_sample, 48
- pivot_sample, RangedSummarizedExperiment-method
(pivot_sample), 48
- pivot_sample, spec_tbl_df-method
(pivot_sample), 48
- pivot_sample, SummarizedExperiment-method
(pivot_sample), 48
- pivot_sample, tbl_df-method
(pivot_sample), 48
- pivot_sample, tidybulk-method
(pivot_sample), 48
- pivot_transcript, 49
- pivot_transcript, RangedSummarizedExperiment-method
(pivot_transcript), 49
- pivot_transcript, spec_tbl_df-method
(pivot_transcript), 49
- pivot_transcript, SummarizedExperiment-method
(pivot_transcript), 49
- pivot_transcript, tbl_df-method
(pivot_transcript), 49
- pivot_transcript, tidybulk-method
(pivot_transcript), 49
- quantile_normalise_abundance, 50
- quantile_normalise_abundance, RangedSummarizedExperiment-method
(quantile_normalise_abundance), 50
- quantile_normalise_abundance, spec_tbl_df-method
(quantile_normalise_abundance), 50
- quantile_normalise_abundance, SummarizedExperiment-method
(quantile_normalise_abundance), 50
- quantile_normalise_abundance, tbl_df-method
(quantile_normalise_abundance), 50
- quantile_normalise_abundance, tidybulk-method
(quantile_normalise_abundance), 50
- reduce_dimensions, 53
- reduce_dimensions, RangedSummarizedExperiment-method
(reduce_dimensions), 53
- reduce_dimensions, spec_tbl_df-method
(reduce_dimensions), 53
- reduce_dimensions, SummarizedExperiment-method
(reduce_dimensions), 53
- reduce_dimensions, tbl_df-method
(reduce_dimensions), 53
- reduce_dimensions, tidybulk-method
(reduce_dimensions), 53
- reexports, 57
- remove_redundancy, 57
- remove_redundancy, RangedSummarizedExperiment-method
(remove_redundancy), 57
- remove_redundancy, spec_tbl_df-method
(remove_redundancy), 57
- remove_redundancy, SummarizedExperiment-method
(remove_redundancy), 57
- remove_redundancy, tbl_df-method
(remove_redundancy), 57
- remove_redundancy, tidybulk-method
(remove_redundancy), 57

rename, [11](#), [29](#), [48](#), [61](#), [70](#)
 right_join(inner_join), [39](#)
 rotate_dimensions, [62](#)
 rotate_dimensions, RangedSummarizedExperiment-method [78](#)
 (rotate_dimensions), [62](#)
 rotate_dimensions, spec_tbl_df-method
 (rotate_dimensions), [62](#)
 rotate_dimensions, SummarizedExperiment-method
 (rotate_dimensions), [62](#)
 rotate_dimensions, tbl_df-method
 (rotate_dimensions), [62](#)
 rotate_dimensions, tidybulk-method
 (rotate_dimensions), [62](#)
 rowwise, [65](#)

 scale_abundance, [66](#)
 scale_abundance, RangedSummarizedExperiment-method
 (scale_abundance), [66](#)
 scale_abundance, spec_tbl_df-method
 (scale_abundance), [66](#)
 scale_abundance, SummarizedExperiment-method
 (scale_abundance), [66](#)
 scale_abundance, tbl_df-method
 (scale_abundance), [66](#)
 scale_abundance, tidybulk-method
 (scale_abundance), [66](#)
 se, [69](#)
 se_mini, [69](#)
 select, [57](#)
 select(reexports), [57](#)
 summarise, [11](#), [29](#), [48](#), [62](#), [69](#)
 symbol_to_entrez, [71](#)

 test_differential_abundance, [72](#)
 test_differential_abundance, RangedSummarizedExperiment-method
 (test_differential_abundance), [72](#)
 test_differential_abundance, spec_tbl_df-method
 (test_differential_abundance), [72](#)
 test_differential_abundance, SummarizedExperiment-method
 (test_differential_abundance), [72](#)
 test_differential_abundance, tbl_df-method
 (test_differential_abundance), [72](#)
 test_differential_abundance, tidybulk-method
 (test_differential_abundance), [72](#)

 test_differential_cellularity, [78](#)
 test_differential_cellularity, RangedSummarizedExperiment-method
 (test_differential_cellularity), [78](#)
 test_differential_cellularity, spec_tbl_df-method
 (test_differential_cellularity), [78](#)
 test_differential_cellularity, SummarizedExperiment-method
 (test_differential_cellularity), [78](#)
 test_differential_cellularity, tbl_df-method
 (test_differential_cellularity), [78](#)
 test_differential_cellularity, tidybulk-method
 (test_differential_cellularity), [78](#)

 test_gene_enrichment, [81](#)
 test_gene_enrichment, RangedSummarizedExperiment-method
 (test_gene_enrichment), [81](#)
 test_gene_enrichment, spec_tbl_df-method
 (test_gene_enrichment), [81](#)
 test_gene_enrichment, SummarizedExperiment-method
 (test_gene_enrichment), [81](#)
 test_gene_enrichment, tbl_df-method
 (test_gene_enrichment), [81](#)
 test_gene_enrichment, tidybulk-method
 (test_gene_enrichment), [81](#)
 test_gene_overrepresentation, [85](#)
 test_gene_overrepresentation, RangedSummarizedExperiment-method
 (test_gene_overrepresentation), [85](#)
 test_gene_overrepresentation, spec_tbl_df-method
 (test_gene_overrepresentation), [85](#)
 test_gene_overrepresentation, SummarizedExperiment-method
 (test_gene_overrepresentation), [85](#)
 test_gene_overrepresentation, tbl_df-method
 (test_gene_overrepresentation), [85](#)
 test_gene_overrepresentation, tidybulk-method
 (test_gene_overrepresentation), [85](#)

 test_gene_rank, [88](#)
 test_gene_rank, RangedSummarizedExperiment-method
 (test_gene_rank), [88](#)
 test_gene_rank, spec_tbl_df-method
 (test_gene_rank), [88](#)

test_gene_rank, SummarizedExperiment-method
 (test_gene_rank), 88

test_gene_rank, tbl_df-method
 (test_gene_rank), 88

test_gene_rank, tidybulk-method
 (test_gene_rank), 88

test_stratification_cellularity, 91

test_stratification_cellularity, RangedSummarizedExperiment-method
 (test_stratification_cellularity),
 91

test_stratification_cellularity, spec_tbl_df-method
 (test_stratification_cellularity),
 91

test_stratification_cellularity, SummarizedExperiment-method
 (test_stratification_cellularity),
 91

test_stratification_cellularity, tbl_df-method
 (test_stratification_cellularity),
 91

test_stratification_cellularity, tidybulk-method
 (test_stratification_cellularity),
 91

tibble, 57

tibble (reexports), 57

tidybulk, 94

tidybulk, RangedSummarizedExperiment-method
 (tidybulk), 94

tidybulk, spec_tbl_df-method (tidybulk),
 94

tidybulk, SummarizedExperiment-method
 (tidybulk), 94

tidybulk, tbl_df-method (tidybulk), 94

tidybulk_SAM_BAM, 95

tidybulk_SAM_BAM, character, character-method
 (tidybulk_SAM_BAM), 95

tximeta_summarizeToGene_object, 96

unnest, 96

vignette_manuscript_signature_boxplot,
 97

vignette_manuscript_signature_tsne, 98

vignette_manuscript_signature_tsne2,
 98

X_cibersort, 98