Package ‘ERSSA’

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Description The ERSSA package takes user supplied RNA-seq differential expression dataset and calculates the number of differentially expressed genes at varying biological replicate levels. This allows the user to determine, without relying on any a priori assumptions, whether sufficient differential detection has been achieved with their RNA-seq dataset.
Depends R (>= 4.0.0)
Imports edgeR (>= 3.23.3), DESeq2 (>= 1.21.16), ggplot2 (>= 3.0.0), RColorBrewer (>= 1.1-2), plyr (>= 1.8.4), BiocParallel (>= 1.15.8), aapglm (>= 1.4.2), grDevices, stats, utils
Suggests BiocStyle, knitr, rmarkdown
VignetteBuilder knitr
biocViews ImmunoOncology, GeneExpression, Transcription, DifferentialExpression, RNASEq, MultipleComparison, QualityControl
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URL https://github.com/zshao1/ERSSA
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Contents

combinations.partial .......................................................... 2
comb_gen ................................................................. 2
condition_table.full .......................................................... 4
condition_table.partial ....................................................... 4
count_filter ................................................................. 4
count_table.filtered.partial ................................................ 5
count_table.full .................................................................. 5
count_table.partial ............................................................ 6
deg.partial ............................................................................ 6
erssa ................................................................. 7
erssa_deseq2 ............................................................ 10
erssa_deseq2_parallel ..................................................... 12
erssa_edger ............................................................. 14
erssa_edger_parallel ........................................................... 15
ggplot2_dotplot ............................................................. 18
ggplot2_intersectPlot ........................................................ 19
ggplot2_marginPlot ............................................................. 20
ggplot2_TPR_FPRPlot .......................................................... 21

Index 23

combinations.partial Example list of combinations generated by comb_gen function.

Description

Generated with example sample set that contains 4 replicates each of heart and muscle from GTEx. 5 combinations generated per replicate level. Used for testing purposes and to shorten run time.

comb_gen Calculate unique combinations of samples at varying replicate number

Description

comb_gen function takes the list of samples in each condition and generate unique combination of sample names that allow subsampling at varying replicate numbers.

Usage

comb_gen(condition_table = NULL, n_repetition = 30)
**comb_gen**

**Arguments**

- **condition_table**
  A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample condition (e.g. Control, Treatment).

- **n_repetition**
  The number of maximum unique combinations to generate at each replicate level. More tests will be performed with a bigger value, but run time also increases linearly. Default set to 30 unique combinations.

**Details**

At each replicate number (2 to N-1), the total number of unique combination of samples is computed. For example, 10 condition A samples subsampled at replicate number of 2 has 45 unique combinations.

When the total number of possible combinations at a particular replicate number is more than the specified x number of repetition (default=30), then only x unique combinations are selected.

When the total number of possible combination is smaller than the specified x number of repetitions, then only unique combinations are selected. For example, 10 samples subsample for 9 replicates has 10 unique combinations and only 10 combinations will be selected instead of 30.

This is repeated for both conditions and another level of combination is performed to combine samples from the two conditions. Again, only x number of unique combinations selected. When total unique combination is smaller than x, then all unique combinations are selected.

Selected combinations of samples at each replicate number are then returned.

**Value**

A list of character vectors containing sample combinations. Each element in the list corresponds to a replicate level. Each combination within the character vector is a single string with sample names separated by semicolon.

**Author(s)**

Zixuan Shao, <Zixuanshao.zach@gmail.com>

**Examples**

# Use example condition_table
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(condition_table.partial, package = "ERSSA")

combinations.partial = comb_gen(condition_table.partial, n_repetition=5)
**condition_table.full**  
*Example table of sample names and conditions*

**Description**

Example condition table with two columns. Column 1 contains sample name, column 2 contains condition name. Use in conjunction with count_table. Contains 10 GTEx samples each from heart and muscle.

---

**condition_table.partial**  
*Example table of sample names and conditions*

**Description**

Example condition table with two columns. Column 1 contains sample name, column 2 contains condition name. Use in conjunction with count_table. A partial condition table containing 4 replicates each of heart and muscle. Used for testing purposes and to shorten run time.

---

**count_filter**  
*Filter RNA-seq expression table*

**Description**

`count_filter` function filters the RNA-seq count table to remove non- and low-expression genes at an defined average CPM cutoff (Default=1).

**Usage**

```r
count_filter(count_table = NULL, cutoff = 1)
```

**Arguments**

- `count_table` - A RNA-seq count matrix with genes on each row and samples on each column.
- `cutoff` - Any gene with average CPM below this cutoff value will be filtered out.

**Value**

The filtered count table.

**Author(s)**

Zixuan Shao, <Zixuanshao.zach@gmail.com>
Examples

```r
# load simple GTEx example count table
# example dataset containing 1000 genes, 4 replicates
data(count_table.partial, package = "ERSSA")

# filter the counts
count_table.filtered.partial = count_filter(count_table.partial)
```

---

**count_table.filtered.partial**

Example count table of GTEx RNA-seq experiment, filtered by `count_filter` function

---

**Description**

A filtered version of the example `count_table.partial`. Contains 974 genes that passed the filter. Used for testing purposes and to shorten run time.

**References**

https://jhubiostatistics.shinyapps.io/recount/


---

**count_table.full**

Example count table of GTEx RNA-seq experiment

---

**Description**

Count table generated using data downloaded from Recount2 website with processed Raw GTEx dataset. Table has samples on columns and genes on rows. Contains 10 samples each from heart and muscle.
References

https://jhubiostatistics.shinyapps.io/recount/


---

count_table.partial  Example count table of GTEx RNA-seq experiment

Description

Count table generated using data downloaded from Recount2 website that processed Raw GTEx dataset. Table has samples on columns and genes on rows. This is a partial count table containing 1000 genes and 4 replicates each from heart and muscle. Used for testing purposes and to shorten run time.

References

https://jhubiostatistics.shinyapps.io/recount/


---

deg.partial  Example list of DE genes generated by edgeR

Description

Generated using object count_table.filtered.partial and control='heart' as inputs to erssa_edger function. Default parameters used. Contains list of list of vectors. Each vector contains DE genes at a particular replicate level generated by edgeR in a given sample combination. Used for testing purposes and to shorten run time.
Description

ERSSA is a package designed to test whether an currently available RNA-seq dataset has sufficient biological replicates to detect a majority of differentially expressed (DE) genes between two conditions. Base on the number of biological replicates available, the algorithm subsamples at step-wise replicate levels and uses existing differentially expression analysis softwares (e.g. edgeR and DESeq2) to identify the number of DE genes. This process is repeated for a given number of times with unique combinations of samples to generate a distribution of DE genes at each replicate level. Compare to existing RNA-seq sample size analysis algorithms, ERSSA does not rely on any a priori assumptions about the dataset, but rather uses an user-supplied pilot RNA-seq dataset to determine whether the current replicate level is sufficient to detect a majority of DE genes.

Usage

erssa(
  count_table = NULL,
  condition_table = NULL,
  DE_ctrl_cond = NULL,
  filter_cutoff = 1,
  counts_filtered = FALSE,
  comb_gen_repeat = 30,
  DE_software = "edgeR",
  DE_cutoff_stat = 0.05,
  DE_cutoff_Abs_logFC = 1,
  DE_save_table = FALSE,
  marginalPlot_stat = "median",
  TPR_FPR_stat = "mean",
  path = ".",
  num_workers = 1,
  save_log = FALSE,
  save_plot = TRUE
)

Arguments

count_table  A RNA-seq count matrix with genes on each row and samples on each column. If count_table has already been filtered to remove non- or low-expressing genes, then counts_filtered argument should be changed to TRUE.

condition_table  A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample conditions (e.g. Control, Treatment).

DE_ctrl_cond  The name of control condition in the comparison. Must be one of the two conditions in the condition table.
filter_cutoff
The average CPM threshold set for filtering genes. Default to 1.

counts_filtered
Boolean. Whether count table has already been filtered. Default = FALSE with the function run filtering by average CPM at the cutoff specified by filter_cutoff value.

comb_gen_repeat
The number of maximum unique combinations to generate at each replicate level. More tests will be performed with a bigger value, but run time also increases linearly. Default set to 30 unique combinations at maximum.

DE_software
The name of DE analysis software to use. Current options include "edgeR" and "DESeq2". Default to "edgeR".

DE_cutoff_stat
The cutoff in FDR or adjusted p-value used to determine whether a gene is differentially expressed. Genes with lower FDR or adjusted p-value pass the cutoff. Default = 0.05.

DE_cutoff_Abs_logFC
The cutoff in abs(log2FoldChange) for differential expression consideration. Genes with higher abs(log2FoldChange) pass the cutoff. Default = 1.

DE_save_table
Boolean. The results of differential expression tests can be saved to the drive for further analysis. Default setting does not save the results to save drive space. Default = FALSE.

marginalPlot_stat
The statistic used for plotting of values in marginal plot function. Options include 'mean', 'median'. Default='median'.

TPR_FPR_stat
The statistics used to summarize TPR and FPR at each replicate level in ggplot2_TPR_FPRPlot function. Options include 'mean', 'median'. Default = 'mean'.

path
The path to which the plots and results will be saved. Default to current working directory.

num_workers
Number of nodes to use for parallel computing the DE tests

save_log
Boolean. Whether to save runtime parameters in log file. Defualt to false.

save_plot
Boolean. Whether to save ggplot2 plots to drive. Default to true.

Details

erssa function is a wrapper that calls several ERSSA functions in sequence. For additional description of the functions called, please see their respective manual.

For the majority of current RNA-seq analysis, RNA-seq samples are aligned to the reference, followed by running quantification packages to generate count tables. ERSSA can then take the unfiltered count table and remove non- to low-expressing genes with count_filter function. Alternatively, a filtered count table can be supplied and filtering will be skipped.

Next, unique combinations of samples at various biological replicate levels will be generated by comb_gen function and passed to a differential expression analysis software for statistical testing for DE genes. The pipeline currently supports edgeR and DESeq2, but additional software support can be easily added.
The generated differential expression results are then analyzed by several plotting functions briefly described here. `ggplot2_dotplot` function plots the trend in DE gene identification. `ggplot2_marginPlot` function plots the marginal change in the number of DE genes as replicate level increases. `ggplot2_intersectPlot` function plots the number of DE genes that is common across combinations. `ggplot2_TPR_FPRPlot` function plots the TPR and FPR of DE detection using the full dataset’s list of DE gene as the ground truth. Base on insights from these plots, the user can determine whether a desirable level of DE gene discovery has been reached.

At the default setting, the results of statistical tests are not saved, only the list of DE genes is. However, all of the test results can be optionally saved for further analysis.

At default setting, only one CPU node is employed and depend on the number of tests that needs to be done, the calculations can take some time to complete. If additional nodes are available, additional nodes can be employed by specifying the `num_workers` argument. Parallel computing requires BiocParallel package.

The results including list of DE genes and `ggplot2` objects are returned. All runtime parameters can optionally be saved in a log file named "erssa.log".

**Value**

A list of objects generated during the analysis is returned:

- `count_table.filtered`: filtered count table
- `samp.name.comb`: the samples involved in each statistical test
- `list.of.DE.genes`: list of DE genes in each statistical test
- `gg.dotplot.obj`: a list of objects that can be used to recreate the dot plot. See function `ggplot2_dotplot` manual for more detail.
- `gg.marinPlot.obj`: a list of objects that can be used to recreate the marginal num. of DE genes plot. See function `ggplot2_marginPlot` manual for more detail.
- `gg.intersectPlot.obj`: a list of objects that can be used to recreate the num. of intersect genes plot. See function `ggplot2_intersectPlot` manual for more detail.
- `gg.TPR_FPRPlot.obj`: a list of objects that can be used to recreate the TPR vs. FPR plot. See function `ggplot2_TPR_FPRPlot` manual for more detail.

**Author(s)**

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**References**


Examples

# load example dataset containing 1000 genes, 4 replicates and 5 comb. per
# rep. level
data(condition_table.partial, package = "ERSSA")
data(count_table.partial, package = "ERSSA")

# run erssa with the "partial" dataset, use default edgeR for DE
ssa = erssa(count_table.partial, condition_table.partial,
DE_ctrl_cond='heart')

# run erssa with the "full" dataset containing 10 replicates per heart and
# muscle, all genes included.
# Remove comments to run
# set.seed(1)
# data(condition_table.full, package="ERSSA")
# data(count_table.full, package="ERSSA")
# ssa = erssa(count_table.full, condition_table.full, DE_ctrl_cond='heart')

erssa_deseq2

Run DESeq2 for computed sample combinations

Description

erssa_deseq2 function runs DESeq2 Wald test to identify differentially expressed (DE) genes for each sample combination computed by comb_gen function. A gene is considered to be differentially expressed by defined padj (Default=0.05) and log2FoldChange (Default=1) values. As an option, the function can also save the DESeq2 result tables as csv files to the drive.

Usage

erssa_deseq2(
  count_table.filtered = NULL,
  combinations = NULL,
  condition_table = NULL,
  control = NULL,
  cutoff_stat = 0.05,
  cutoff_Abs_logFC = 1,
  save_table = FALSE,
  path = ".")

Arguments

count_table.filtered
  Count table pre-filtered to remove non- to low- expressing genes. Can be the output of count_filter function.

combinations
  List of combinations that is produced by comb_gen function.
**erssa_deseq2**

condition_table  
A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample condition (e.g. Control, Treatment).

control  
One of the condition names that will serve as control.

cutoff_stat  
The cutoff in padj for DE consideration. Genes with lower padj pass the cutoff. Default = 0.05.

cutoff_Abs_logFC  
The cutoff in abs(log2FoldChange) for differential expression consideration. Genes with higher abs(log2FoldChange) pass the cutoff. Default = 1.

save_table  
Boolean. When set to TRUE, function will, in addition, save the generated DESeq2 result table as csv files. The files are saved on the drive in the working directory in a new folder named "ERSSA_DESeq2_table". Tables are saved separately by the replicate level. Default = FALSE.

path  
Path to which the files will be saved. Default to current working directory.

**Details**

The main function calls DESeq2 functions to perform Wald test for each computed combinations generated by comb_gen. In all tests, the pair-wise test sets the condition defined in the object "control" as the control condition.

In typical usage, after each test, the list of differentially expressed genes are filtered by padj and log2FoldChange values and only the filtered gene names are saved for further analysis. However, it is also possible to save all of the generated result tables to the drive for additional analysis that is outside the scope of this package.

**Value**

A list of list of vectors. Top list contains elements corresponding to replicate levels. Each child list contains elements corresponding to each combination at the respective replicate level. The child vectors contain differentially expressed gene names.

**Author(s)**

Zixuan Shao, <Zixuanshao.zach@gmail.com>

**References**


**Examples**

```r
# load example filtered count_table, condition_table and combinations  
# generated by comb_gen function  
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.  
# level  
data(count_table.filtered.partial, package = "ERSSA")  
data(combinations.partial, package = "ERSSA")
```
data(condition_table.partial, package = "ERSSA")

# run erssa_deseq2 with heart condition as control
deg.partial = erssa_deseq2(count_table.filtered.partial,
combinations.partial, condition_table.partial, control='heart')

**erssa_deseq2_parallel**  
*Run DESeq2 for computed sample combinations with parallel computing*

**Description**

`erssa_deseq2_parallel` function performs the same calculation as `erssa_deseq2` except now employs BiocParallel to perform parallel DESeq2 calculations. This function runs DESeq2 Wald test to identify differentially expressed (DE) genes for each sample combination computed by `comb_gen` function. A gene is considered to be differentially expressed by defined `padj` (Default=0.05) and `log2FoldChange` (Default=1) values. As an option, the function can also save the DESeq2 result tables as csv files to the drive.

**Usage**

```r
erssa_deseq2_parallel(
    count_table.filtered = NULL,
    combinations = NULL,
    condition_table = NULL,
    control = NULL,
    cutoff_stat = 0.05,
    cutoff_Abs_logFC = 1,
    save_table = FALSE,
    path = ".",
    num_workers = 1
)
```

**Arguments**

- `count_table.filtered`  
  Count table pre-filtered to remove non- to low- expressing genes. Can be the output of `count_filter` function.

- `combinations`  
  List of combinations that is produced by `comb_gen` function.

- `condition_table`  
  A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample condition (e.g. Control, Treatment).

- `control`  
  One of the condition names that will serve as control.

- `cutoff_stat`  
  The cutoff in `padj` for DE consideration. Genes with lower `padj` pass the cutoff. Default = 0.05.
cutoff_Abs_logFC
The cutoff in abs(log2FoldChange) for differential expression consideration. Genes with higher abs(log2FoldChange) pass the cutoff. Default = 1.

save_table
Boolean. When set to TRUE, function will, in addition, save the generated DESeq2 result table as csv files. The files are saved on the drive in the working directory in a new folder named "ERSSA_DESeq2_table". Tables are saved separately by the replicate level. Default = FALSE.

path
Path to which the files will be saved. Default to current working directory.

num_workers
Number of workers for parallel computing. Default=1.

Details
The main function calls DESeq2 functions to perform Wald test for each computed combinations generated by comb_gen. In all tests, the pair-wise test sets the condition defined in the object "control" as the control condition.

In typical usage, after each test, the list of differentially expressed genes are filtered by padj and log2FoldChange values and only the filtered gene names are saved for further analysis. However, it is also possible to save all of the generated result tables to the drive for additional analysis that is outside the scope of this package.

Value
A list of list of vectors. Top list contains elements corresponding to replicate levels. Each child list contains elements corresponding to each combination at the respective replicate level. The child vectors contain differentially expressed gene names.

Author(s)
Zixuan Shao, <Zixuanshao.zach@gmail.com>

References

Examples
# load example filtered count_table, condition_table and combinations
# generated by comb_gen function
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep. # level
data(count_table.filtered.partial, package = "ERSSA")
data(combinations.partial, package = "ERSSA")
data(condition_table.partial, package = "ERSSA")

# run erssa_deseq2_parallel with heart condition as control
deg.partial = erssa_deseq2_parallel(count_table.filtered.partial,
erssa_edger function runs classic edgeR method to identify differentially expressed (DE) genes for each sample combination computed by comb_gen function. A gene is considered to be differentially expressed by defined FDR (Default=0.05) and logFC (Default=1) values. As an option, the function can also save the edgeR topTags tables as csv files to the drive.

**Usage**

```r
erssa_edger(
  count_table.filtered = NULL,
  combinations = NULL,
  condition_table = NULL,
  control = NULL,
  cutoff_stat = 0.05,
  cutoff_Abs_logFC = 1,
  save_table = FALSE,
  path = "."
)
```

**Arguments**

- **count_table.filtered**
  - Count table pre-filtered to remove non- to low- expressing genes. Can be the output of count_filter function.

- **combinations**
  - List of combinations that is produced by comb_gen function.

- **condition_table**
  - A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample condition (e.g. Control, Treatment).

- **control**
  - One of the condition names that will serve as control.

- **cutoff_stat**
  - The cutoff in FDR for DE consideration. Genes with lower FDR pass the cutoff. Default = 0.05.

- **cutoff_Abs_logFC**
  - The cutoff in abs(logFC) for differential expression consideration. Genes with higher abs(logFC) pass the cutoff. Default = 1.

- **save_table**
  - Boolean. When set to TRUE, function will, in addition, save the generated edgeR TopTags tables as csv files. The files are saved on the drive in the working directory in a new folder named "ERSSA_edgeR_table". Tables are saved separately by the replicate level. Default = FALSE.

- **path**
  - Path to which the files will be saved. Default to current working directory.
Details

The main function calls edgeR functions to perform exact test for each computed combinations generated by comb_gen. In all tests, the pair-wise test sets the condition defined in the object "control" as the control condition.

In typical usage, after each test, the list of differentially expressed genes are filtered by FDR and log2FC values and only the filtered gene names are saved for further analysis. However, it is also possible to save all of the generated TopTags table to the drive for additional analysis that is outside the scope of this package.

Value

A list of list of vectors. Top list contains elements corresponding to replicate levels. Each child list contains elements corresponding to each combination at the respective replicate level. The child vectors contain differentially expressed gene names.

Author(s)

Zixuan Shao, <Zixuan.shao.zach@gmail.com>

References


Examples

# load example filtered count_table, condition_table and combinations
# generated by comb_gen function
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(count_table.filtered.partial, package = "ERSSA")
data(combinations.partial, package = "ERSSA")
data(condition_table.partial, package = "ERSSA")

#run erssa_edger with heart condition as control
deg.partial = erssa_edger(count_table.filtered.partial, combinations.partial, condition_table.partial, control='heart')

erssa_edger_parallel  Run edgeR for computed sample combinations with parallel computing
Description

erssa_edger_parallel function performs the same calculation as erssa_edger except now employs BiocParallel to perform parallel edgeR calculations. This function runs classic edgeR method to identify differentially expressed (DE) genes for each sample combination computed by comb_gen function. A gene is considered to be differentially expressed by defined FDR (Default=0.05) and logFC (Default=1) values. As an option, the function can also save the edgeR topTags tables as csv files to the drive.

Usage

erssa_edger_parallel(
  count_table.filtered = NULL,
  combinations = NULL,
  condition_table = NULL,
  control = NULL,
  cutoff_stat = 0.05,
  cutoff_Abs_logFC = 1,
  save_table = FALSE,
  path = ".",
  num_workers = 1
)

Arguments

count_table.filtered
  Count table pre-filtered to remove non- to low- expressing genes. Can be the output of count_filter function.

combinations
  List of combinations that is produced by comb_gen function.

condition_table
  A condition table with two columns and each sample as a row. Column 1 contains sample names and Column 2 contains sample condition (e.g. Control, Treatment).

control
  One of the condition names that will serve as control.

cutoff_stat
  The cutoff in FDR for DE consideration. Genes with lower FDR pass the cutoff. Default = 0.05.

cutoff_Abs_logFC
  The cutoff in abs(logFC) for differential expression consideration. Genes with higher abs(logFC) pass the cutoff. Default = 1.

save_table
  Boolean. When set to TRUE, function will, in addition, save the generated edgeR TopTags table as csv files. The files are saved on the drive in the working directory in a new folder named "ERSSA_edgeR_table". Tables are saved separately by the replicate level. Default = FALSE.

path
  Path to which the files will be saved. Default to current working directory.

num_workers
  Number of workers for parallel computing. Default=1.
Details

The main function calls edgeR functions to perform exact test for each computed combinations generated by comb_gen. In all tests, the pair-wise test sets the condition defined in the object "control" as the control condition.

In typical usage, after each test, the list of differentially expressed genes are filtered by FDR and log2FC values and only the filtered gene names are saved for further analysis. However, it is also possible to save all of the generated TopTags table to the drive for additional analysis that is outside the scope of this package.

Value

A list of list of vectors. Top list contains elements corresponding to replicate levels. Each child list contains elements corresponding to each combination at the respective replicate level. The child vectors contain differentially expressed gene names.

Author(s)

Zixuan Shao, <Zixuanshao.zach@gmail.com>

References


Examples

# load example filtered count_table, condition_table and combinations
# generated by comb_gen function
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(count_table.filtered.partial, package = "ERSSA")
data(combinations.partial, package = "ERSSA")
data(condition_table.partial, package = "ERSSA")

# run erssa_edger_parallel with heart condition as control
deg.partial = erssa_edger_parallel(count_table.filtered.partial,
combinations.partial, condition_table.partial,
control='heart', num_workers=1)
**Description**

`ggplot2_dotplot` function plots the number of differentially expressed (DE) genes in each test.

**Usage**

```r
ggplot2_dotplot(deg = NULL, path = ".", save_plot = TRUE)
```

**Arguments**

- `deg` : The list of DE genes generated by one of ERSSA::DE_*.R scripts.
- `path` : Path to which the plot will be saved. Default to current working directory.
- `save_plot` : Boolean. Whether to save plot to drive. Default to TRUE.

**Details**

The number of DE genes are plotted as dots grouped by the associated replicate level. At each replicate level, a boxplot is drawn to mainly show the first and third quartiles as well as the median. Additionally, a red line is drawn representing the mean at each replicate level. A horizontal dashed blue line represents the number of DE genes found with all samples.

**Value**

A list is returned containing:

- `gg_object`: the ggplot2 object, which can then be further customized.
- `deg_dataframe`: the tidy table version of DEG numbers for plotting.
- `full_num_DEG`: The number of DE genes with all samples included.

**Author(s)**

Zixuan Shao, <Zixuanshao.zach@gmail.com>

**References**


**Examples**

```r
# load edgeR deg object generated by erssa_edger using example dataset
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(deg.partial, package = "ERSSA")

gg_dot = ggplot2_dotplot(deg.partial)
```
Description

ggplot2_intersectPlot function generates and plots the list of differentially expressed (DE) genes that are found in all combinations at any particular replicate level. Often in small-scale RNA-seq experiments, the inclusion or exclusion of any particular sample can result in a very different list of DE genes. To reduce the influence of any particular sample in the entire dataset analysis, it may be desirable to identify the list of DE genes that are enriched regardless of any specific sample(s) inclusion. This approach may be most useful analyzing the list of common DE genes at the greatest possible replicate to take advantage of the robust feature as well as employing typically the longest list of DE genes.

Usage

ggplot2_intersectPlot(deg = NULL, path = ".", save_plot = TRUE)

Arguments

deg The list of DE genes generated by one of ERSSA::DE_*.*R scripts.
path Path to which the plot will be saved. Default to current working directory.
save_plot Boolean. Whether to save plot to drive. Default to TRUE.

Details

Similar to how increasing number of detected DE genes can be found with more biological replicates, the list of common DE genes is expected to increase with more replicates. This eventually levels off as majority of DE genes have been found.

Value

A list is returned containing:

- gg_object the ggplot2 object, which can then be further customized.
- intersect.dataframe the tidy table version used for plotting.
- deg.dataframe the tidy table version of DEG numbers for plotting mean.
- intersect_genes list of vectors containing DE genes with vector name indicating the associated replicate level.
- full_num_DEG The number of DE genes with all samples included.

Author(s)

Zixuan Shao, <Zixuanshao.zach@gmail.com>
References

Examples

```r
# load edgeR deg object generated by erssa_edger using example dataset
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(deg.partial, package = "ERSSA")

gg_intersect = ggplot2_intersectPlot(deg.partial)
```

---

**ggplot2_marginPlot**  
_Plot percent increase in detection of DE genes across replicate levels_

**Description**

`ggplot2_marginPlot` function plots the percent change in number of DE genes identified at each step-wise increase in replicate level.

**Usage**

```r
ggplot2_marginPlot(deg = NULL, stat = "median", path = ".", save_plot = TRUE)
```

**Arguments**

- `deg`  
The list of DE genes generated by one of ERSSA::DE_*.R scripts.
- `stat`  
The statistic used for plotting. Options include 'mean', 'median'. Default='median'.
- `path`  
The path to which the plot will be saved. Default to current working directory.
- `save_plot`  
Boolean. Whether to save plot to drive. Default to TRUE.

**Details**

The percent change is calculated as (margin*100 lower replicate level). The results are visualized as bar plots. Either mean or median can be used for the calculation.

**Value**

A list is returned containing:

- `gg_object` the ggplot2 object, which can then be further customized.
- `marg_diff.dataframe` the tidy table version of percent changes for plotting.

**Author(s)**

Zixuan Shao, <Zixuanshao.zach@gmail.com>
References


Examples

# load edgeR deg object generated by erssa_edger using example dataset
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(deg.partial, package = "ERSSA")

gg_margin = ggplot2_marginPlot(deg.partial)

Description

ggplot2_TPR_FPRPlot function uses the full dataset list of DE genes as the ground truth to calculate the True Positive Rate (TPR) and False Positive Rate (FPR) for each sample combinations tested. The TPR and FPR are then plotted with FPR on x-axis and TPR on y-axis similar to a ROC curve.

Usage

ggplot2_TPR_FPRPlot(
  deg = NULL,
  count_table.filtered = NULL,
  stat = "mean",
  path = ".",
  save_plot = TRUE
)

Arguments

deg The list of DE genes generated by one of ERSSA::DE_*.R scripts.
count_table.filtered The filtered count table with non- and low-expression genes removed. Used to identify the genes found to be non-DE.
stat The statistics used to summarize TPR and FPR at each replicate level. Options include 'mean' and 'median'. Default = 'mean'.
path Path to which the plot will be saved. Default to current working directory.
save_plot Boolean. Whether to save plot to drive. Default to TRUE.
Details

Using the list of DE genes generated from the full dataset as the ground truth should be done with caution. Since the true list of DE genes is not known, this is the best alternative. This plot enables the visualization of the sensitivity and (1-specificity) of the DE gene detection at the tested replicate levels. At a sufficient replicate level, a relatively high TPR can be reached with reasonable low FPR. Such a replicate level is sufficient for most studies as additional replicates produce little improvement in TPR.

Value

A list is returned containing:

- `gg_object` the ggplot2 object, which can then be further customized.
- `TPR_FPR.dataframe` the tidy table used for plotting.
- `list_TP_FP_genes` lists of TP and FP genes. Follow the format of `deg` object with each `comb_n` now as a list contain two vectors, one for each of TP and FP list of DE genes.

Author(s)

Zixuan Shao, <Zixuanshao.zach@gmail.com>

References


Examples

```r
# load edgeR deg object generated by erssa_edger using example dataset
# example dataset containing 1000 genes, 4 replicates and 5 comb. per rep.
# level
data(deg.partial, package = "ERSSA")
data(count_table.filtered.partial, package = "ERSSA")

gg_TPR_FPR = ggplot2_TPR_FPRPlot(deg.partial, count_table.filtered.partial)
```
Index

comb_gen, 2
combinations.partial, 2
condition_table.full, 4
condition_table.partial, 4
count_filter, 4
count_table.filtered.partial, 5
count_table.full, 5
count_table.partial, 6
deg.partial, 6
erssa, 7
erssa_deseq2, 10
erssa_deseq2_parallel, 12
erssa_edger, 14
erssa_edger_parallel, 15
ggplot2_dotplot, 18
ggplot2_intersectPlot, 19
ggplot2_marginPlot, 20
ggplot2_TPR_FPRPlot, 21