Package ‘crossmeta’

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**Title**  Cross Platform Meta-Analysis of Microarray Data

**Version**  1.28.0

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**Description**  Implements cross-platform and cross-species meta-analyses of Affymetrix, Illumina, and Agilent microarray data. This package automatizes common tasks such as downloading, normalizing, and annotating raw GEO data. The user then selects control and treatment samples in order to perform differential expression analyses for all comparisons. After analysing each contrast separately, the user can select tissue sources for each contrast and specify any tissue sources that should be grouped for the subsequent meta-analyses.

**Depends**  R (>= 4.0)

**SystemRequirements**  libxml2; libxml2-dev (deb), libxml2-devel (rpm)
libcurl: libcurl4-openssl-dev (deb), libcurl-devel (rpm)
openssl: libssl-dev (deb), openssl-devel (rpm), libssl_dev (csw), openssl@1.1 (brew)

**License**  MIT + file LICENSE

**Encoding**  UTF-8

**LazyData**  TRUE

**RoxygenNote**  7.1.2

**VignetteBuilder**  knitr

**URL**  https://github.com/alexvpickering/crossmeta

**BugReports**  https://github.com/alexvpickering/crossmeta/issues

**Suggests**  knitr, rmarkdown, lydata, org.Hs.eg.db, testthat

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2.1.1), stringr (>= 1.2.0), sva (>= 3.22.0), shiny (>= 1.0.0),
shinyjs (>= 2.0.0), shinyBS (>= 0.61), shinyWidgets (>= 0.5.3),
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**addContrastInput**

```
Description

Add contrast input

Usage

addContrastInput(id)
```
add_adjusted

*Add expression data adjusted for pairs/surrogate variables*

**Description**

Add expression data adjusted for pairs/surrogate variables

**Usage**

```r
add_adjusted(eset, svobj = list(sv = NULL), numsv = 0)
```

**Arguments**

- `eset` : ExpressionSet
- `svobj` : surrogate variable object
- `numsv` : Number of surrogate variables to adjust for

**Value**

eset with adjusted element added

add_sources

*Add sample source information for meta-analysis.*

**Description**

User selects a tissue source for each contrast and indicates any sources that should be paired. This step is required if you would like to perform source-specific effect-size/pathway meta-analyses.

**Usage**

```r
add_sources(diff_exprs, data_dir = getwd(), postfix = NULL)
```

**Arguments**

- `diff_exprs` : Previous result of `diff_expr`, which can be reloaded using `load_diff`.
- `data_dir` : String specifying directory of GSE folders.
- `postfix` : Optional string to append to saved results. Useful if need to run multiple meta-analyses on the same series but with different contrasts.
add_vsd

Details

The **Sources** tab is used to add a source for each contrast. To do so: click the relevant contrast rows, search for a source in the *Sample source* dropdown box, and then click the *Add* button.

The **Pairs** tab is used to indicate sources that should be paired (treated as the same source for subsequent effect-size and pathway meta-analyses). To do so: select at least two sources from the *Paired sources* dropdown box, and then click the *Add* button.

For each GSE, analysis results with added sources/pairs are saved in the corresponding GSE folder (in `data_dir`) that was created by `get_raw`.

Value

Same as `diff_expr` with added slots for each GSE in `diff_exprs`:

- **sources**
  Named vector specifying selected sample source for each contrast. Vector names identify the contrast.

- **pairs**
  List of character vectors indicating tissue sources that should be treated as the same source for subsequent effect-size and pathway meta-analyses.

Examples

```r
library(lydata)

# load result of previous call to diff_expr:
data_dir <- system.file("extdata", package = "lydata")
gse_names <- c("GSE9601", "GSE34817")
anals <- load_diff(gse_names, data_dir)

# run shiny GUI to add tissue sources
# anals <- add_sources(anals, data_dir)
```

---

### add_vsd

**Add VST normalized assay data element to expression set**

**Description**

For microarray datasets duplicates `exprs` slot into `vsd` slot.

**Usage**

```r
add_vsd(eset, rna_seq = TRUE)
```

**Arguments**

- **eset**
  ExpressionSet with group column in `pData(eset)`

- **rna_seq**
  Is this an RNA-seq `eset`? Default is `TRUE`. 
Value

eset with 'vsd' assayDataElement added.

---

bulkAnnot

*Logic for downloading and uploading bulk annotation*

---

**Description**

Logic for downloading and uploading bulk annotation

**Usage**

bulkAnnot(input, output, session, dataset_name, pdata)

---

bulkAnnotInput

*UI for Bulk Data annotation upload/download*

---

**Description**

UI for Bulk Data annotation upload/download

**Usage**

bulkAnnotInput(id)

---

bulkForm

*Logic for Bulk Data form*

---

**Description**

Logic for Bulk Data form

**Usage**

bulkForm(input, output, session, pdata, prev)
bulkFormInput

Input form for Bulk Data page

Description
Input form for Bulk Data page

Usage
bulkFormInput(id)

bulkPage
Logic for Select Contrasts Interface

Description
Logic for Select Contrasts Interface

Usage
bulkPage(input, output, session, eset, gse_name, prev)

Arguments
input, output, session
shiny module boilerplate
eset
ExpressionSet
gse_name
GEO accession for the series.
prev
Previous result of diff_expr. Used to allow rechecking previous selections.

bulkPageUI
UI for Select Contrasts Interface

Description
UI for Select Contrasts Interface

Usage
bulkPageUI(id)

Arguments
id
The id string to be namespaced.
bulkTable

**Description**
Logic for pdata table

**Usage**
bulkTable(input, output, session, eset, prev, up_annot)

bulkTableOutput

**Description**
Tables for datasets page

**Usage**
bulkTableOutput(id)

ch2_subset

**Description**
Two-channel esets use intraspotCorrelation and lmscFit so can’t use duplicateCorrelation. If not using one channel in contrasts (e.g. because all reference RNA) and have paired design, better to treat as single channel so that can use duplicateCorrelation.

**Usage**
ch2_subset(eset, prev_anal)

**Arguments**
- eset Annotated ExpressionSet. Created by load_raw.
- prev_anal One item (for eset) from previous result of diff_expr.

**Value**
ExpressionSet. If two-channel, paired and one channel not used will subset to used channel.
**clean_y**

Adjusts expression data for surrogate variables.

### Description

Factors out effect of surrogate variables discovered during surrogate variable analysis.

### Usage

```r
clean_y(y, mod, mod.clean)
```

### Arguments

- **y**
  Expression data of eset.
- **mod**
  Full model matrix supplied to `sva`.
- **mod.clean**
  Model matrix with factors to clean.

### Value

Expression data with effects of svs removed.

---

**delContrastsInput**

Delete contrasts input

### Description

Delete contrasts input

### Usage

```r
delContrastsInput(id)
```
# diff_expr

**Differential expression analysis of esets.**

## Description

After selecting control and test samples for each contrast, surrogate variable analysis ([sva](#)) and differential expression analysis is performed.

## Usage

```r
diff_expr(
  esets,
  data_dir = getwd(),
  annot = "SYMBOL",
  prev_anals = list(NULL),
  svanal = TRUE,
  recheck = FALSE,
  postfix = NULL,
  port = 3838
)
```

## Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>esets</code></td>
<td>List of annotated esets. Created by <a href="#">load_raw</a>.</td>
</tr>
<tr>
<td><code>data_dir</code></td>
<td>String specifying directory of GSE folders.</td>
</tr>
<tr>
<td><code>annot</code></td>
<td>String, column name in fData common to all esets. For duplicated values in this column, the row with the highest interquartile range across selected samples will be kept. If meta-analysis will follow, appropriate values are &quot;SYMBOL&quot; (default - for gene level analysis) or, if all esets are from the same platform, &quot;PROBE&quot; (for probe level analysis).</td>
</tr>
<tr>
<td><code>prev_anals</code></td>
<td>Previous result of <code>diff_expr</code>, which can be reloaded using <a href="#">load_diff</a>. If present, previous selections, names, and pairs will be reused.</td>
</tr>
<tr>
<td><code>svanal</code></td>
<td>Use surrogate variable analysis? Default is <code>TRUE</code>.</td>
</tr>
<tr>
<td><code>recheck</code></td>
<td>Would you like to recheck previous group/contrast annotations? Requires <code>prev_anals</code>. Default is <code>FALSE</code>.</td>
</tr>
<tr>
<td><code>postfix</code></td>
<td>Optional string to append to saved results. Useful if need to run multiple meta-analyses on the same series but with different contrasts.</td>
</tr>
<tr>
<td><code>port</code></td>
<td>See <a href="#">runApp</a>.</td>
</tr>
</tbody>
</table>

## Details

Click the Download icon and fill in the **Group name** column and optionally the **Pairs** column. Then save and upload the filled in metadata csv. After doing so, select a test and control group to compare and click the + icon to add the contrast. Repeat previous step to add additional contrasts.
After control and test samples have been added for all contrasts that you wish to include, click the *Done* button. Repeat for all GSEs.

Paired samples (e.g. the same subject before and after treatment) can be specified by filling out the *Pairs column* before uploading the metadata.

For each GSE, analysis results are saved in the corresponding GSE folder in `data_dir` that was created by `get_raw`. If analyses needs to be repeated, previous results can be reloaded with `load_diff` and supplied to the `prev_anals` parameter. In this case, previous selections, names, and pairs will be reused.

**Value**

List of named lists, one for each GSE. Each named list contains:

- **pdata**: data.frame with phenotype data for selected samples. Columns *treatment* (‘ctrl’ or ‘test’), *group*, and *pair* are added based on user selections.
- **top_tables**: List with results of `topTable` call (one per contrast). These results account for the effects of nuisance variables discovered by surrogate variable analysis.
- **ebayes_sv**: Results of call to `eBayes` with surrogate variables included in the model matrix.
- **annot**: Value of `annot` variable.

**Examples**

```r
library(lydata)

# location of raw data
data_dir <- system.file("extdata", package = "lydata")

# gather GSE names
gse_names <- c("GSE9601", "GSE15069", "GSE50841", "GSE34817", "GSE29689")

# load first eset
esets <- load_raw(gse_names[1], data_dir)

# run analysis (opens GUI)
# anals_old <- diff_expr(esets, data_dir)

# re-run analysis on first eset
prev <- load_diff(gse_names[1], data_dir)
anals <- diff_expr(esets[1], data_dir, prev_anals = prev)
```

---

**es_meta**

Effect size combination meta analysis.

**Description**

Performs effect-size meta-analyses across all studies and separately for each tissue source.
Usage

```r
es_meta(diff_exprs, cutoff = 0.3, by_source = FALSE)
```

Arguments

diff_exprs: Previous result of `diff_expr`, which can be reloaded using `load_diff`.
cutoff: Minimum fraction of contrasts that must have measured each gene. Between 0 and 1.
by_source: Should separate meta-analyses be performed for each tissue source added with `add_sources`?

Details

Builds on `zScores` function from GeneMeta by allowing for genes that were not measured in all studies. This implementation also uses moderated unbiased effect sizes calculated by `effectsize` from metaMA and determines false discovery rates using `fdrtool`.

Value

A list of named lists, one for each tissue source. Each list contains two named data.frames. The first, `filt`, has all the columns below for genes present in cutoff or more fraction of contrasts. The second, `raw`, has only `dprime` and `vardprime` columns, but for all genes (NAs for genes not measured by a given contrast).

- `dprime`: Unbiased effect sizes (one column per contrast).
- `vardprime`: Variances of unbiased effect sizes (one column per contrast).
- `mu`: Overall mean effect sizes.
- `var`: Variances of overall mean effect sizes.
- `z`: Overall z score = \( \mu / \sqrt{\text{var}} \).
- `fdr`: False discovery rates calculated from column `z` using `fdrtool`.
- `pval`: p-values calculated from column `z` using `fdrtool`.

Examples

```r
library(lydata)

# location of data
data_dir <- system.file("extdata", package = "lydata")

# gather GSE names
gse_names <- c("GSE9601", "GSE15069", "GSE50841", "GSE34817", "GSE29689")

# load previous analysis
anals <- load_diff(gse_names, data_dir)

# add tissue sources to perform separate meta-analyses for each source (optional)
# anals <- add_sources(anals, data_dir)
```
# perform meta-analysis
es <- es_meta(anals, by_source = TRUE)

**exprs.MA**

*Extract Log-Expression Matrix from MAList*

**Description**

Converts M and A-values to log-expression values. The output matrix will have two columns for each array, in the order all red then all green. Adapted from `plotDensities.MAList` instead of `exprs.MA` so that order is same as `phenoData.ch2`.

**Usage**

`exprs.MA(MA)`

**Arguments**

`MA` an MAList object.

**Value**

A numeric matrix with twice the columns of the input.

**filter_genes**

*Filter genes in RNA-seq ExpressionSet*

**Description**

Uses `filterByExpr` to filter based on 'counts' assay or 'exprs' assay if 'counts' isn't available (for ARCHS4 data).

**Usage**

`filter_genes(eset)`

**Arguments**

`eset` ExpressionSet with 'counts' assayDataElement and group column in pData

**Value**

`filtered eset`
See Also

filterByExpr

Examples

# example ExpressionSet
eset <- makeExampleCountsEset()
eset <- filter_genes(eset)

fit_ebayes  
Fit ebayes model

Description

Fit ebayes model

Usage

fit_ebayes(
  lm_fit,
  contrasts,
  robust = TRUE,
  trend = FALSE,
  allow.no.resid = FALSE
)

Arguments

lm_fit  
Result of call to run_limma

contrasts  
Character vector of contrasts to fit.

robust  
logical, should the estimation of df.prior and var.prior be robustified against outlier sample variances?

trend  
logical, should an intensity-dependent trend be allowed for the prior variance? If FALSE then the prior variance is constant. Alternatively, trend can be a row-wise numeric vector, which will be used as the covariate for the prior variance.

allow.no.resid  
Allow no residual degrees of freedom? if TRUE and the fit contrast matrix has no residual degrees of freedom, eBayes fit is skipped and the result of contrasts.fit is returned.

Value

result of eBayes
**fit_lm**

*Run limma analysis.*

**Description**

Runs limma differential expression analysis on all contrasts selected by `add_contrast`. Analysis performed with and without surrogate variables discovered by `diff_setup`. Also prints MDS plot and saves results.

**Usage**

```r
fit_lm(eset, svobj = list(sv = NULL), numsv = 0, rna_seq = TRUE)
```

**Arguments**

- `eset` Annotated eset created by `load_raw`. Replicate features and non-selected samples removed by `iqr_replicates`.
- `svobj` Surrogate variable analysis results. Returned from `run_sva`.
- `numsv` Number of surrogate variables to model.
- `rna_seq` Is this an RNA-seq eset? Default is `TRUE`.

**Value**

List with slots: * `fit` Result of `lmFit`. * `mod` model matrix used for fit.

---

**fix_illum_headers**

*Attempts to fix Illumina raw data header*

**Description**

Reads raw data files and tries to fix them up so that they can be loaded by `read.ilmn`.

**Usage**

```r
fix_illum_headers(elist_paths, eset = NULL)
```

**Arguments**

- `elist_paths` Path to Illumina raw data files. Usually contain patterns: non_normalized.txt, raw.txt, or _supplementary_.txt
- `eset` ExpressionSet from `getGEO`.

**Value**

Character vector for annotation argument to `read.ilmn`. Fixed raw data files are saved with filename ending in _fixed.txt
format_d1_annot  Format downloaded annotation

Description
Format downloaded annotation

Usage
format_d1_annot(annot)

format_up_annot  Format uploaded annotation

Description
Format uploaded annotation

Usage
format_up_annot(up, ref)

get_ch2_mod  Get design matrix for two-channel array

Description
Get design matrix for two-channel array

Usage
get_ch2_mod(eset)

Arguments
eset  ExpressionSet with colnames that end in "_red" and "_green" indicating channel and eset$group indicating group membership.

Value
model matrix for use by intraspotCorrelation and ImscFit
### get_group_levels

*Get group levels for bulk data plots*

**Description**

Get group levels for bulk data plots

**Usage**

```r
get_group_levels(pdata)
```

**Arguments**

- `pdata` Data.frame of phenotype data

### get_palette

*Get a Pallete to Distinguish Groups*

**Description**

Get a Pallete to Distinguish Groups

**Usage**

```r
get_palette(levs, dark = FALSE, with_all = FALSE)
```

**Arguments**

- `levs` Character vector of levels to get colour pallete for.

**Value**

Character vector with colour codes of length(levs).
get_raw

Download and unpack microarray supplementary files from GEO.

Description

Downloads and unpacks microarray supplementary files from GEO. Files are stored in the supplied data directory under the GSE name.

Usage

get_raw(gse_names, data_dir = getwd())

Arguments

gse_names Character vector of GSE names to download.
data_dir String specifying directory for GSE folders.

Value

NULL (for download/unpack only).

See Also

load_raw.

Examples

get_raw("GSE41845")

get_sva_mods

Get model matrices for surrogate variable analysis

Description

Used by add_adjusted to create model matrix with surrogate variables.

Usage

get_sva_mods(pdata)

Arguments

pdata data.frame of phenotype data with column 'group' and 'pair' (optional).

Value

List with model matrix(mod) and null model matrix (mod0) used for sva.
get_top_table

get_top_table

Description

Get top table

Usage

get_top_table(
  lm_fit,
  groups = c("test", "ctrl"),
  with.es = TRUE,
  robust = FALSE,
  trend = FALSE,
  allow.no.resid = FALSE
)

Arguments

lm_fit Result of run_limma

groups Test and Control group as strings.

with.es Add 'dprime' and 'vardprime' from effectsize? Default is TRUE.

robust logical, should the estimation of df.prior and var.prior be robustified against outlier sample variances?

trend logical, should an intensity-dependent trend be allowed for the prior variance? If FALSE then the prior variance is constant. Alternatively, trend can be a row-wise numeric vector, which will be used as the covariate for the prior variance.

allow.no.resid Allow no residual degrees of freedom? if TRUE and the fit contrast matrix has no residual degrees of freedom, eBayes fit is skipped and the result of contrasts.fit is returned.

Value

result of toptable
get_vsd  
*Get variance stabilized data for exploratory data analysis*

**Description**
Get variance stabilized data for exploratory data analysis

**Usage**
get_vsd(eset)

**Arguments**
eset  
ExpressionSet loaded with load_raw.

**Value**
matrix with variance stabilized expression data.

---

gs.names  
*Map between KEGG pathway numbers and names.*

**Description**
Used to map human KEGG pathway numbers to names. Updated Feb 2017.

**Usage**
data(gs.names)

**Format**
An object of class character of length 310.

**Value**
A named character vector of human KEGG pathway names. Names of vector are KEGG pathway numbers.
gslist

KEGG human pathway genes.

Description

Usage
data(gslist)

Format
An object of class list of length 310.

Value
A named list with entrez ids of genes for human KEGG pathways. List names are KEGG pathway numbers.

ilmn.nnum

Count numeric columns in raw Illumina data files

Description
Excludes probe ID cols

Usage
ilmn.nnum(elist_paths)

Arguments
elist_paths Paths to raw illumina data files

Value
Number of numeric columns in elist_paths excluding probe ID columns.
iqr_replicates  

*Removes features with replicated annotation.*

**Description**

For rows with duplicated annot, highested IQR retained.

**Usage**

```r
iqr_replicates(eset, annot = "SYMBOL", rm.dup = FALSE)
```

**Arguments**

- `eset`  
  Annotated eset created by `load_raw`.
- `annot`  
  Feature to use to remove replicates.
- `rm.dup`  
  Remove duplicates (same measure, multiple ids)? Used for Pathway analysis so that doesn’t treat probes that map to multiple genes as distinct measures.

**Value**

Expression set with unique features at probe or gene level.

---

is_invertible  

*Checks uploaded bulk pdata to make sure the study design is invertible*

**Description**

Check uploaded bulk pdata to make sure the study design is invertible

**Usage**

```r
is_invertible(pdata)
```
**load_agil_plat**  
*Load Agilent raw data*

**Description**

Load Agilent raw data

**Usage**

`load_agil_plat(eset, gse_name, gse_dir, ensql)`

**Arguments**

- `eset`  
  ExpressionSet from `getGEO`.
- `gse_name`  
  Accession name for `eset`.
- `gse_dir`  
  Direction with Agilent raw data.
- `ensql`  
  For development. Path to sqlite file with ENTREZID and SYMBOL columns created in data-raw/entrezdt.

**Value**

ExpressionSet

---

**load_diff**  
*Load previous differential expression analyses.*

**Description**

Loads previous differential expression analyses.

**Usage**

`load_diff(gse_names, data_dir = getwd(), annot = "SYMBOL", postfix = NULL)`

**Arguments**

- `gse_names`  
  Character vector specifying GSE names to be loaded.
- `data_dir`  
  String specifying directory of GSE folders.
- `annot`  
  Level of previous analysis (e.g. "SYMBOL" or "PROBE").
- `postfix`  
  Optional string to append to saved results. Useful if need to run multiple meta-analyses on the same series but with different contrasts.

**Value**

Result of previous call to `diff_expr`.
Examples

```r
library(lydata)

data_dir <- system.file("extdata", package = "lydata")
gse_names <- c("GSE9601", "GSE34817")
prev <- load_diff(gse_names, data_dir)
```

### load_illum_plat

**Illumina loader utility for load_plat.**

**Description**

Used by `load_plat` to load an eset.

**Usage**

```r
load_illum_plat(eset, gse_name, gse_dir, ensql)
```

**Arguments**

- `eset`  
  Expression set obtained by `getGEO`.
- `gse_name`  
  String specifying GSE name.
- `gse_dir`  
  String specifying path to GSE folder.

**Value**

Annotated eset.

**See Also**

`load_plat`.

---

### load_plat

**Load and pre-process raw Affymetrix, Illumina, and Agilent microarrays.**

**Description**

Load raw files previously downloaded with `get_raw`. Used by `load_raw`.

**Usage**

```r
load_plat(gse_name, data_dir, gpl_dir, ensql)
```
**load_raw**

**Arguments**

- **gse_name**: GSE names.
- **data_dir**: String specifying directory with GSE folder.
- **gpl_dir**: String specifying parent directory to search for previously downloaded GPL.soft files.
- **ensql**: For development. Path to sqlite file with ENTREZID and SYMBOL columns created in data-raw/entrezdt.

**Details**

Data is normalized, SYMBOL and PROBE annotation are added to fData slot.

**Value**

List of annotated esets, one for each platform in gse_name.

**See Also**

- `get_raw` to obtain raw data.

---

**Description**

Loads and annotates raw data previously downloaded with `get_raw`. Supported platforms include Affymetrix, Agilent, and Illumina.

**Usage**

```r
load_raw(
  gse_names,
  data_dir = getwd(),
  gpl_dir = "..",
  overwrite = FALSE,
  ensql = NULL
)
```

**Arguments**

- **gse_names**: Character vector of GSE names.
- **data_dir**: String specifying directory with GSE folders.
- **gpl_dir**: String specifying parent directory to search for previously downloaded GPL.soft files.
- **overwrite**: Do you want to overwrite saved esets from previous load_raw?
- **ensql**: For development. Path to sqlite file with ENTREZID and SYMBOL columns created in data-raw/entrezdt.
makeExampleCountsEset

Value

List of annotated esets.

Examples

library(lydata)
data_dir <- system.file("extdata", package = "lydata")
eset <- load_raw("GSE9601", data_dir = data_dir)

makeExampleCountsEset Make example ExpressionSet

Description

adapted from DESeq2::makeExampleDESeqDataSet

Usage

makeExampleCountsEset(
  n = 1000,
  m = 12,
  betaSD = 0,
  interceptMean = 4,
  interceptSD = 2,
  dispMeanRel = function(x) 4/x + 0.1,
  sizeFactors = rep(1, m)
)

Arguments

n number of rows
m number of columns
betaSD the standard deviation for non-intercept betas, i.e. beta ~ N(0,betaSD)
interceptMean the mean of the intercept betas (log2 scale)
interceptSD the standard deviation of the intercept betas (log2 scale)
dispMeanRel a function specifying the relationship of the dispersions on 2^trueIntercept
sizeFactors multiplicative factors for each sample

Examples

eset <- makeExampleCountsEset()
**match_prev_eset**

*Reuse contrast selections from previous analysis.*

**Description**

Transfers user-supplied selections from previous call of `diff_expr`.

**Usage**

```r
match_prev_eset(eset, prev_anal)
```

**Arguments**

- `eset`  
  Annotated eset. Created by `load_raw`.
- `prev_anal`  
  One item (for eset) from previous result of `diff_expr`. If present, previous selections and names will be reused.

**Value**

Expression set with samples and pData as in `prev_anal`.

**See Also**

- `diff_expr`

---

**open_raw_illum**

*Open raw Illumina microarray files.*

**Description**

Helper function to open raw Illumina microarray files in order to check that they are formatted correctly. For details on correct format, please see 'Checking Raw Illumina Data' in vignette.

**Usage**

```r
open_raw_illum(gse_names, data_dir = getwd())
```

**Arguments**

- `gse_names`  
  Character vector of Illumina GSE names to open.
- `data_dir`  
  String specifying directory with GSE folders.

**Value**

Character vector of successfully formated Illumina GSE names.
Examples

```r
library(lydata)

# Illumina GSE names
illum_names <- c("GSE50841", "GSE34817", "GSE29689")

# location of raw data
data_dir <- system.file("extdata", package = "lydata")

# open raw data files with default text editor
# open_raw_illum(illum_names)
```

---

**phenoData.ch2** *Construct AnnotatedDataFrame from Two-Channel ExpressionSet*

**Description**

Construct AnnotatedDataFrame from Two-Channel ExpressionSet

**Usage**

```r
phenoData.ch2(eset)
```

**Arguments**

- `eset` ExpressionSet with `pData` for two-channel Agilent array.

**Value**

AnnotatedDataFrame with twice as many rows as `eset`, one for each channel of each array in order all red then all green.

---

**prefix_illum_headers** *Run prefix on Illumina raw data files*

**Description**

Run prefix on Illumina raw data files

**Usage**

```r
prefix_illum_headers(elist_paths)
```

**Arguments**

- `elist_paths` Paths to raw Illumina data files
**query_ref**

Get correlation between query and reference signatures.

**Value**

Paths to fixed versions of `elist_paths`

**Description**

Determines the pearson correlation between the query and each reference signature.

**Usage**

```
query_ref(query, ref, sorted = TRUE, ngenes = 200)
```

**Arguments**

- `query` Named numeric vector of differential expression values for query genes. Usually `meta` slot of `get_dprimes` result.
- `ref` A matrix of differential expression to query against (rows are genes, columns are samples).
- `sorted` Would you like the results sorted by decreasing similarity? Default is TRUE.
- `ngenes` The number of top differentially-regulated (up and down) query genes to use.

**Value**

Vector of pearson correlations between query and reference signatures.

---

**remove_autonamed**

Remove columns that are autonamed by data.table

**Description**

Auto-named columns start with 'V' followed by the column number.

**Usage**

```
remove_autonamed(ex)
```

**Arguments**

- `ex` data.frame loaded with `fread`

**Value**

ex with auto-named columns removed.
run_limma

Linear model fitting of eset with limma.

Description

After selecting control and test samples for a contrast, surrogate variable analysis (sva) and linear model fitting with lmFit is performed.

Usage

run_limma(
  eset,
  annot = "SYMBOL",
  svobj = list(sv = NULL),
  numsv = 0,
  filter = TRUE
)

Arguments

eset Annotated eset created by load_raw.
annot String, column name in fData. For duplicated values in this column, the row with the highest interquartile range across selected samples will be kept. Appropriate values are "SYMBOL" (default - for gene level analysis) or "ENTREZID_HS" (for probe level analysis).
svobj Surrogate variable analysis results. Returned from run_sva.
numsv Number of surrogate variables to model.
filter For RNA-seq. Should genes with low counts be filtered? dseqr shiny app performs this step separately. Should be TRUE (default) if used outside of dseqr shiny app.

Details

If analyses need to be repeated, previous results can be reloaded with readRDS and supplied to the prev_anal parameter. In this case, previous selections will be reused.

Value

List with:

fit result of lmFit.
mod model.matrix used for fit
run_limma_setup  

Setup ExpressionSet for running limma analysis

Description

Setup ExpressionSet for running limma analysis

Usage

run_limma_setup(eset, prev)

Arguments

eset  
ExpressionSet
prev  
previous result of call to diff_expr

Value

eset ready for run_limma

run_lmfit  
Perform lmFit analysis from limma.

Description

If paired samples, runs duplicateCorrelation to estimate intra-patient variance.

Usage

run_lmfit(eset, mod, rna_seq = TRUE)

Arguments

eset  
Annotated eset created by load_raw. Non-selected samples and duplicate features removed by add_contrasts and iqr_replicates.
mod  
Model matrix generated by diff_setup. With or without surrogate variables.
rna_seq  
Is this an RNA-seq eset? Default is TRUE.

Value

result from call to limma lmFit.
run_select_contrasts  Shiny gadget to upload groups and select contrasts

Description

Shiny gadget to upload groups and select contrasts

Usage

run_select_contrasts(
eset,
gse_name,
prev = NULL,
app_dir = system.file("select_contrasts", package = "crossmeta", mustWork = TRUE),
port = 3838
)

Arguments

eset  ExpressionSet
gse_name  GEO accession for the series.
prev  Previous result of diff_expr. Used to allow rechecking previous selections.
app_dir  Directory to shiny app. For local development use 'inst/select_contrasts'. Default is in 'select_contrasts' sub directory of crossmeta package.
port  See runApp().

Value

result of setup_prev. Used to specify sample groups and contrasts for differential expression analysis.

run_sva  Run surrogate variable analysis

Description

Run surrogate variable analysis

Usage

run_sva(mods, eset, svanal = TRUE)
setup_prev

Arguments

<table>
<thead>
<tr>
<th>mods</th>
<th>result of get_sva_mods</th>
</tr>
</thead>
<tbody>
<tr>
<td>eset</td>
<td>ExpressionSet</td>
</tr>
<tr>
<td>svana</td>
<td>Should surrogate variable analysis be run? If FALSE, returns dummy result.</td>
</tr>
</tbody>
</table>

Description

Function is useful when number of samples makes manual selection with \texttt{diff_expr} error prone and time-consuming. This is often true for large clinical data sets.

Usage

\texttt{setup_prev(eset, contrasts)}

Arguments

- \texttt{eset} List containing one expression set with pData \texttt{`group`} and \texttt{`pair`} (optional) columns. Name of \texttt{eset} should be the GSE name.
- \texttt{contrasts} Character vector specifying contrasts to analyse. Each contrast must take the form \texttt{"B-A"} where both \texttt{"B"} and \texttt{"A"} are present in \texttt{eset pData \texttt{`group'}} column. \texttt{"B"} is the treatment group and \texttt{"A"} is the control group.

Value

List containing necessary information for \texttt{prev_anal} parameter of \texttt{diff_expr}.

Examples

\begin{verbatim}
library(lydata)
library(Biobase)

# location of raw data
data_dir <- system.file("extdata", package = "lydata")

# load eset
gse_name <- c("GSE34817")
eset <- load_raw(gse_name, data_dir)

# inspect pData of eset
# View(pData(eset$GSE34817))  # if using RStudio
head(pData(eset$GSE34817))  # otherwise

# get group info from pData (differs based on eset)
group <- pData(eset$GSE34817)$characteristics_ch1.1
\end{verbatim}
# make group names concise and valid
group <- gsub("treatment: ", ",", group)
group <- make.names(group)

# add group to eset pData
pData(eset$GSE34817)$group <- group

# setup selections
sel <- setup_prev(eset, contrasts = "LY-DMSO")

# run differential expression analysis
anal <- diff_expr(eset, data_dir, prev_anal = sel)

code

symbol_annot

Add hgnc symbol to expression set.

Description

Function first maps entrez gene ids to homologous human entrez gene ids and then to hgnc symbols.

Usage

symbol_annot(eset, gse_name = "", ensql = NULL)

Arguments

eset Expression set to annotate.
gse_name GSE name for eset.
ensql For development. Path to sqlite file with ENTREZID and SYMBOL columns created in data-raw/entrezdt.

Details

Initial entrez gene ids are obtained from bioconductor annotation data packages or from feature data of supplied expression set. Homologous human entrez ids are obtained from homologene and then mapped to hgnc symbols using org.Hs.eg.db. Expression set is expanded if 1:many mappings occur.

Value

Expression set with hgnc symbols ("SYMBOL") and row names ("PROBE") added to fData slot.

See Also

load_raw.
Examples

```r
library(lydata)

# location of raw data
data_dir <- system.file("extdata", package = "lydata")

# load eset
eset <- load_raw("GSE9601", data_dir)[[1]]

# annotate eset (need if load_raw failed to annotate)
eset <- symbol_annot(eset)
```

### to_eset

**Convert limma object to ExpressionSet**

**Description**

Convert limma object to ExpressionSet

**Usage**

```r
to_eset(object, eset)
```

**Arguments**

- `object`: an EList of MAList object containing expression data.
- `eset`: ExpressionSet from `getGEO`. Used for annotation.

**Value**

ExpressionSet using expression data from `object` and annotation from `eset`.

### to_ma

**Convert expression values to MAList**

**Description**

Convert expression values to MAList

**Usage**

```r
to_ma(y)
```

**Arguments**

- `y`: Expression values from two-channel agilent array in order all red then all green.
Value

MAList

Examples

A <- matrix(rnorm(100), ncol = 5)
M <- matrix(rnorm(100), ncol = 5)
MA <- new('MAList', list(M=M, A=A))
colnames(MA) <- letters[1:5]

y <- exprs.MA(MA)
MA2 <- crossmeta:::to_ma(y)
all.equal(MA, MA2)

validate_up_annot  Validate uploaded bulk annotation

Description

Validate uploaded bulk annotation

Usage

validate_up_annot(up, ref)

which_max_iqr  Get row indices of maximum IQR within annotation groups

Description

Groups by group_by and determines row with maximum IQR.

Usage

which_max_iqr(eset, group_by, x = exprs(eset))

Arguments

eset              ExpressionSet
group_by          Column in fData(eset) to group by
x                  matrix of expression values to use for IQR

Value

Integer vector of row numbers representing rows with the maximum IQR after grouping by group_by
**Description**

For converting Illumina _Supplementary_* .xls files to .txt for load_illum_plat.

**Usage**

```
xls_to_txt(xls_paths)
```

**Arguments**

- `xls_paths`  
  Paths to .xls files
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