

Package ‘mirTarRnaSeq’

November 18, 2024

Type Package

Title mirTarRnaSeq

Version 1.14.0

Description mirTarRnaSeq R package can be used for interactive mRNA miRNA sequencing statistical analysis. This package utilizes expression or differential expression mRNA and miRNA sequencing results and performs interactive correlation and various GLMs (Regular GLM, Multivariate GLM, and Interaction GLMs) analysis between mRNA and miRNA experiments. These experiments can be time point experiments, and or condition experiments.

License MIT + file LICENSE

Encoding UTF-8

LazyData true

Depends R (>= 4.1.0), ggplot2

DeploySubPath mirTarRnaSeq

biocViews miRNA, Regression, Software, Sequencing, SmallRNA,
TimeCourse, DifferentialExpression

RoxygenNote 7.2.3

Suggests BiocStyle, knitr, rmarkdown, R.cache, SPONGE

VignetteBuilder knitr

Imports purrr, MASS, pscl, assertthat, caTools, dplyr, pheatmap,
reshape2, corrplot, grDevices, graphics, stats, utils,
data.table, R.utils, viridis

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

git_branch RELEASE_3_20

git_last_commit 6a9908f

git_last_commit_date 2024-10-29

Repository Bioconductor 3.20

Date/Publication 2024-11-17

Author Mercedeh Movassagh [aut, cre] (<<https://orcid.org/0000-0001-7690-0230>>),
Sarah Morton [aut],
Rafael Irizarry [aut],
Jeffrey Bailey [aut],
Joseph N Paulson [aut]

Maintainer Mercedeh Movassagh <mercedeh@ds.dfci.harvard.edu>

Contents

canonicalModel_	3
Combine	4
combiner	4
corMirnaRna	5
corMirnaRnaMiranda	5
corr_0	6
downloadMirandaFile	6
drawCorPlot	7
drawInterPlots	7
fdrSig	8
final_results	8
finInterResult	9
geneVari	9
geneVariant	10
getInputSpecies	10
glm_gaussian	11
glm_multi	11
glm_nb	12
glm_poisson	12
glm_zeroinfl	13
glm_zeroinfl_negbin	13
glm_zeroinfl_poisson	14
importMirandaFile	14
inter0	15
makeFormulaRightSide	15
miRanComp	16
miRanda	16
miRandaIntersect	16
mirandaIntersectInter	17
miRandaM	18
miranda_sponge_predict	18
miRNA	18
miRNA0_2	19
miRNA0_5	19
miRNA2_5	19
miRNA_fc	19
miRNA_fc2	19
mirRnaDensityCor	20
mirRnaDensityInter	20
mirRnaHeatmap	21
mirRnaHeatmapDiff	22
modelAIC	22
modelCoefficients	23
modelData	23
modelModelName	24
modelModelPvalue	24
modelsFilter	25
modelTermPvalues	25
mRNA	26
mRNA0_2	26

mRNA0_5	26
mRNA2_5	26
mRNA_fc	26
mRNA_fc2	27
one2manySponge	27
one2OneRnaMiRNA	28
outs	28
outs2	29
plotFit	29
plotResiduals	29
plotTerms	30
results	30
runAllMirnaModels	31
runModel	32
runModels	32
sampCorRnaMirna	33
sig_corrs	34
sig_InterR	34
some_model	34
threshSig	35
threshSigInter	35
twoTimePoint	36
twoTimePointSamp	36
tzTrans	37

Index 38

canonicalModel_	<i>Decifer a 'model parameter' and run appropriate glm_... function.</i>
-----------------	--------------------------------------------------------------------------

Description

Return canonical model from model type string, function of object. Returns a model as returned by `glm_gaussian()` and others, based on a string, function or model type object (i.e. "glm_gaussian", `glm_gaussian` or `glm_gaussian()`).

Usage

```
canonicalModel_(model)
```

Arguments

`model` string, function or object representing a model type.

Value

model type object

Combine	<i>This is data is the mRNA expression across samples and miRNA expression data which is to be investigated in one file. This data set is used in documentation examples.</i>
---------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the mRNA expression across samples and miRNA expression data which is to be investigated in one file. This data set is used in documentation examples.

combiner	<i>combiner combines the miRNA and mRNA files</i>
----------	---------------------------------------------------

Description

This function makes and intersection dataframe for mRNA and miRNA/s of interest to be tested.

Usage

```
combiner(mRNA, miRNA, miRNA_select)
```

Arguments

mRNA	Matrix or data.frame mRNA/RNA from transformed diff expression file (generated using TZtranz)
miRNA	Matrix or data frame miRNA from transformed diff file (generated using TZtranz)
miRNA_select	A vector of character's for miRNAs which the user is interested in investigating if glm is use 1 miRNA should be input. If multivariate several miRNAs should be imported, same goes for interaction determination for miRNAs. Note we do not recommend more than 3-4 miRNAs at a time for the latter cases.

Value

A dataframe which includes only mRNAs and miRNA intersection for the next estimation geneVari output.

Examples

```
miRNA_select <- c("ebv-mir-bart9-5p")
x <- combiner(mRNA, miRNA, miRNA_select)
```

corMirnaRna	<i>corMirnaRna correlation for miRNA and mRNA</i>
-------------	---------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns the correlation dataframe

Usage

```
corMirnaRna(mRNA, miRNA, method = "pearson")
```

Arguments

mRNA	mRNA file generated from foldchanges (FC) obj of the one2OneRnaMiRNA
miRNA	miRNA file generated from foldchanges (FC) obj of the one2OneRnaMiRNA
method	Default is "pearson" else use "kendall" or "spearman"

Value

Correlation data.frame

Examples

```
x <- corMirnaRna(mRNA_fc, miRNA_fc, method = "spearman")
```

corMirnaRnaMiranda	<i>corMirnaRnaMiranda correlation for miRNA and mRNA</i>
--------------------	----------------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns the correlation dataframe.

Usage

```
corMirnaRnaMiranda(mRNA, miRNA, CorVal, getInputSpeciesDF, method = "pearson")
```

Arguments

mRNA	mRNA file generated from foldchanges (FC) obj of the one2OneRnaMiRNA.
miRNA	miRNA file generated from foldchanges (FC) obj of the one2OneRnaMiRNA
CorVal	Correlation cut off.Example: If correlation -0.2 it would only return correlations with smaller than this value correlation for miRNA and mRNA at various time points.
getInputSpeciesDF	The dataframe generated from the getInputSpecies function.
method	Default is "pearson" else use "kendall" or "spearman".

Value

Correlation dataframe

Examples

```
x <- corMirnaRnaMiranda(mRNA_fc, miRNA_fc, Cor = -0.9, miRandaM)
```

corr_0

This is data is the mRNA FC and miRNA FC correlation data. This data set is used in documentation examples.

Description

This is data is the mRNA FC and miRNA FC correlation data. This data set is used in documentation examples.

downloadMirandaFile

downloadMirandaFile Read internal Miranda file

Description

Reads internal Miranda file from extdata and returns it as a data.frame

Usage

```
downloadMirandaFile(urlf)
```

Arguments

urlf URL of the specific chosen file

Value

data.frame containing downloaded miRanda file

Examples

```
x <- downloadMirandaFile(
  "https://zenodo.org/record/4615670/files/Mouse_miRanda.txt.gz"
)
```

drawCorPlot	<i>drawCorPlot correlation plots for mRNA and miRNA regression results</i>
-------------	----------------------------------------------------------------------------

Description

This function plots correlations for mRNA and miRNAs regression results (negative correlation for multi and individual interactions and positive and negative for interactions)

Usage

```
drawCorPlot(corMatrix, ...)
```

Arguments

corMatrix	Significant correlation matrix
...	parameters form the corrplot package

Value

miRNA mRNA target correlation plot

Examples

```
x <- drawCorPlot(corMatrix)
```

drawInterPlots	<i>drawInterPlots for finInterResult miRNA and mRNA Interrelation real data</i>
----------------	---------------------------------------------------------------------------------

Description

This function draws miRNA, mRNA density plots for miRNA and mRNA Interrelation while comparing in addition to overall FC_miRNA and FC_mRNA plots from the finInterResult dataframe function.

Usage

```
drawInterPlots(mrna, mirna, final_results)
```

Arguments

mrna	mRNA results of twoTimePoint function.
mirna	miRNA results of twoTimePoint function.
final_results	finInterResult miRNA and mRNA interrelation in two timepoints results in a dataframe.

Value

par plots

Examples

```
x <- drawInterPlots(mRNA_fc2, miRNA_fc2, final_results)
```

fdrSig	<i>fdrSig Returns FDR significant miRNA/mRNA predictions</i>
--------	--------------------------------------------------------------

Description

This function performs FDR correction on the p_values generated by the runModels function list.

Usage

```
fdrSig(RMObj, value = 0.05, method = "fdr")
```

Arguments

RMObj	The output of runModels
value	The FDR value default is 0.1
method	The p-value adjustment method default is fdr. It could be either of the following "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", or "fdr".

Value

A list of FDR corrected p vlaues, annova, and significance for each gene and the miRNA/s of interest

Examples

```
models <- runModels(Combine, geneVariant, "ebv-mir-bart9-5p")
x <- fdrSig(models, value = 0.1, method = "fdr")
```

final_results	<i>This is data is the mRNA FC and miRNA FC correlation/interaction data results after filtration. This data set is used in documentation examples.</i>
---------------	---------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the mRNA FC and miRNA FC correlation/interaction data results after filtration. This data set is used in documentation examples.

finInterResult	<i>finInterResult miRNA and mRNA interrelation in two-time points results in a dataframe.</i>
----------------	-----------------------------------------------------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns a sampled from orig file interrelation dataframe depending on user sampling selection.

Usage

```
finInterResult(results)
```

Arguments

results Results from mirandaIntersectInter

Value

miRNA mRNA interrelation dataframe

Examples

```
x <- finInterResult(results)
```

geneVari	<i>geneVari Makes a list of gene names to be used in the runModels function</i>
----------	---------------------------------------------------------------------------------

Description

This function defines the boudnaries of mRNA vs miRNAs of interest to be analysed by the runModels function

Usage

```
geneVari(Combined, miRNA_select)
```

Arguments

Combined the combined file for mRNA and selected miRNAs output of combiner function
miRNA_select The vector of selected miRNA/s

Value

A vector of characters with defined mRNA dimensions

Examples

```
x <- geneVari(Combine, "ebv-mir-bart9-5p")
```

geneVariant	<i>This is data is the mRNA expression across samples and miRNA expression data which is to be investigated giving directions on which data is miRNA and which is mRNA. This data set is used in documentation examples.</i>
-------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the mRNA expression across samples and miRNA expression data which is to be investigated giving directions on which data is miRNA and which is mRNA. This data set is used in documentation examples.

getInputSpecies	<i>Return Miranda data for a given species.</i>
-----------------	-------------------------------------------------

Description

Reads Miranda file for a given species and returns it as a data.frame, thresholded by percent identity. Header options are Score (threshold), Energy-Kcal/Mol(energy), Subject-IdentityPercent(targetIden), Query-IdentityPercent (mirnaIden)

Usage

```
getInputSpecies(
  selection,
  threshold = 60,
  energy = NULL,
  targetIden = NULL,
  mirnaIden = NULL
)
```

Arguments

selection	Species (species selection are either for mature miRNA species "Human1", "Mouse", "C.elegans", "Epstein_Barr", "Epstein_Barr_Human", "Drosophila", "Kaposi_Sarcoma", "KSHV_Human", "Cytomegalovirus", "CMV_Human")
threshold	miRanda score threshold default 60
energy	miRanda folding energy threshold default NULL
targetIden	miRanda target identity score default NULL
mirnaIden	miRanda mirna identity score default NULL

Value

data.frame with Miranda data.

Examples

```
x <- getInputSpecies("Epstein_Barr", threshold = 60) # Default is threshold 60
```

`glm_gaussian`*Model functions for GLM with Gaussian model.*

Description

Implements standardized functions to fit the glm with Gaussian family and to obtain coefficients, pvalues, etc.

Usage

```
glm_gaussian()
```

Value

structure containing functions `fit`, `coefficients`, `aic`, `data`, `pterm`, `pmodel`, and a character string "glm_gaussian" in `model`.

Examples

```
x <- glm_gaussian()
```

`glm_multi`*Model functions for GLM with negative binomial family.*

Description

Runs models 'glm_gaussian', 'glm_nb', 'glm_poisson', 'glm_zeroinfl(poisson)', 'glm_zeroinfl(negbin)' and returns mode with lowest AIC.

Usage

```
glm_multi(  
  models = c(glm_gaussian, glm_nb, glm_poisson, glm_zeroinfl_poisson,  
            glm_zeroinfl_negbin)  
)
```

Arguments

`models` Model type, one or more of `glm_gaussian`, `glm_nb`, `glm_poisson`, `glm_zeroinfl_poisson` or `glm_zeroinfl_negbin`

Value

structure containing functions `fit`, `coefficients`, `aic`, `data`, `pterm`, `pmodel`, and a character string "glm_multi" in `model`.

Examples

```
x <- glm_multi()
```

`glm_nb`*Model functions for GLM with negative binomial family.*

Description

Implements standardized functions to fit the negative binomial GLM and to obtain coefficients, pvalues, etc.

Usage

```
glm_nb()
```

Value

structure containing functions `fit`, `coefficients`, `aic`, `data`, `pterm`, `pmodel`, and a character string "glm_nb" in `model`.

Examples

```
x <- glm_nb()
```

`glm_poisson`*Model functions for GLM with Poisson model.*

Description

Implements standardized functions to fit the glm with Poisson family and to obtain coefficients, pvalues, etc.

Usage

```
glm_poisson()
```

Value

structure containing functions `fit`, `coefficients`, `aic`, `data`, `pterm`, `pmodel`, and a character string "glm_poisson" in `model`.

Examples

```
x <- glm_poisson()
```

glm_zeroinfl	<i>Model functions for zero inflated model using either Poisson or Negative Binomial distributions.</i>
--------------	---------------------------------------------------------------------------------------------------------

Description

Implements standardized functions to fit the zero inflated model with Poisson or Negative Binomial distribution, and to obtain coefficients, pvalues, etc.

Usage

```
glm_zeroinfl(dist = "poisson")
```

Arguments

dist either 'poisson' or 'negbin'

Value

structure containing functions fit, coefficients, aic, data, pterm, pmodel, and a character string "glm_zeroinfl" in model.

Examples

```
x <- glm_zeroinfl("negbin")
```

glm_zeroinfl_negbin	<i>alias for glm_zeroinfl("negbin")</i>
---------------------	-----------------------------------------

Description

alias for glm_zeroinfl("negbin")

Usage

```
glm_zeroinfl_negbin(...)
```

Arguments

... passed to glm_zeroinfl

Value

structure containing functions fit, coefficients, aic, data, pterm, pmodel, and a character string "glm_zeroinfl" in model.

Examples

```
x <- glm_zeroinfl_negbin()
```

`glm_zeroinfl_poisson` *alias for glm_zeroinfl("poisson")*

Description

alias for `glm_zeroinfl("poisson")`

Usage

```
glm_zeroinfl_poisson(...)
```

Arguments

... passed to `glm_zeroinfl`

Value

structure containing functions `fit`, `coefficients`, `aic`, `data`, `pterm`, `pmodel`, and a character string `"glm_zeroinfl"` in `model`.

Examples

```
x <- glm_zeroinfl_poisson()
```

`importMirandaFile` *importMirandaFile Read internal Miranda file*

Description

Reads internal Miranda file from `extdata` and returns it as a `data.frame`

Usage

```
importMirandaFile(fn)
```

Arguments

`fn` filename

Value

`data.frame` containing Miranda data

Examples

```
x <- importMirandaFile("Mouse_miRanda.txt")
```

inter0	<i>This is data is the mRNA FC and miRNA FC correlation/interaction original data. This data set is used in documentation examples.</i>
--------	-----------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the mRNA FC and miRNA FC correlation/interaction original data. This data set is used in documentation examples.

makeFormulaRightSide	<i>makeFormulaRightSide makes right hand side of formula for model variables: vector of indep. variables</i>
----------------------	--------------------------------------------------------------------------------------------------------------

Description

This function make right hand side of formula for model variables: vector of indep. variables (i.e. miRNAs) mode: 'multi' for simple, 'inter' for model with interactions returns a string in the form "~ a + b", or "~ a + b + a * b"

Usage

```
makeFormulaRightSide(variables, mode = "multi")
```

Arguments

variables	The vector created by miRNA_select
mode	One of "multi", "inter" or NULL

Value

data.frame containing Miranda data

Examples

```
x <- makeFormulaRightSide(variables, mode = "multi")
```

miRanComp	<i>miRanComp comparison of mRNAs present with miRanda file targets</i>
-----------	------------------------------------------------------------------------

Description

This function generates a dataframe consisting of mRNA or miRNAs present in miRanda generated file using the `miRTarRNASeq:::getInputSpecies()` function

Usage

```
miRanComp(miRNA, miRanda)
```

Arguments

miRNA	Matrix or data.frame miRNA/RNA file or transformed diff expression file (generated using TZtranz)
miRanda	A dataframe of miRanda file with miRNA\$V1 and miRNA targets miRNA\$V2

Value

An miRNA expression dataframe which includes only Genes/Targets present in miRanda file

Examples

```
x <- miRanComp(miRNA, miRanda)
```

miRanda	<i>This is data is the results file from EBV miRanda getInputSpecies function. This data set is used in documentation examples.</i>
---------	-------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the results file from EBV miRanda getInputSpecies function. This data set is used in documentation examples.

miRandaIntersect	<i>miRandaIntersect Looks for Intersection of Significant output results with miRanda Results from getInputSpeciesDF function</i>
------------------	-----------------------------------------------------------------------------------------------------------------------------------

Description

Compares and looks for intersection if significant output results with miRanda Results from `getInputSpeciesDF` and outputs a final filtered output for only those pairs of miRNA and mRNA which have actually been predicted to be targets in miRanda file function

Usage

```
miRandaIntersect(sig_corrs, corrS, mRNA, miRNA, getInputSpeciesDF)
```


Arguments

sig_corrs	correlation matrix, produced by threshSig.
corrS	vector of correlations/differences, from the sampCorRnaMirna function.
mRNA	mRNA FC matrix.
miRNA	miRNA FC matrix.
getInputSpeciesDF	miranda data, produced by getInputSpecies.

Value

An object containing data.frames of significant mRNA, miRNA and correlation matrix filtered by miRanda input.

Examples

```
x <- miRandaIntersect(sig_InterR, outs2, mRNA_fc, miRNA_fc, miRandaM)
```

mirandaIntersectInter *mirandaIntersectInter Looks for Intersection of Significant output results with miRanda Results from getInputSpeciesDF function*

Description

Compares and looks for intersection if significant output results with miRanda Results from getInputSpeciesDF and outputs a final filtered ourput for only those pairs of miRNA and mRNA which have actually been predicted to be targets in miRanda file function

Usage

```
mirandaIntersectInter(sig_corrs, corrS, mRNA, miRNA, getInputSpeciesDF)
```

Arguments

sig_corrs	correlation matrix, produced by threshSig
corrS	vector of Differences/Correlations, from the sampCorRnaMirna function.
mRNA	mRNA FC matrix.
miRNA	miRNA FC matrix.
getInputSpeciesDF	miranda data, produced by getInputSpecies.

Value

An object containing data.frames of significant mRNA, miRNA and correlation matrix filtered by miranda input.

Examples

```
x <- mirandaIntersectInter(sig_InterR, outs2, mRNA_fc2, miRNA_fc2, miRandaM)
```

miRandaM	<i>This is data is the results file from mouse miRanda getInputSpecies function. This data set is used in documentation examples.</i>
----------	---------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the results file from mouse miRanda getInputSpecies function. This data set is used in documentation examples.

miranda_sponge_predict	<i>Transform miRanda data for relevant mRNA and miRNA to matrix form compatible with sponge</i>
------------------------	-------------------------------------------------------------------------------------------------

Description

Transforms miRanda data into adjacency matrix, with 1 indicating presence of a relationship between a mRNA and miRNA, and 0 otherwise. miRanda input is filtered by miRNA and mRNA present in 'mirna_exp' and 'diff_expr' row names, respectively.

Usage

```
miranda_sponge_predict(mirna_exp, diff_exp, miranda_data)
```

Arguments

mirna_exp	miRNA expression data.frame with miRNA for rows and samples for columns
diff_exp	mRNA expression data.frame with mRNA for rows and samples for columns
miranda_data	miRanda data.frame with the first two columns having miRNA and mRNA names

Value

matrix adjacency matrix with column names miRNA and row names mRNA

miRNA	<i>This is data is the miRNA expression file. This data set is used in documentation examples.</i>
-------	----------------------------------------------------------------------------------------------------

Description

This is data is the miRNA expression file. This data set is used in documentation examples.

miRNA0_2

This is data is the miRNA0_2 FC for 0-2 time point. This data set is used in documentation examples.

Description

This is data is the miRNA0_2 FC for 0-2 time point. This data set is used in documentation examples.

miRNA0_5

This is data is the miRNA0_5 FC for 0-5 time point. This data set is used in documentation examples.

Description

This is data is the miRNA0_5 FC for 0-5 time point. This data set is used in documentation examples.

miRNA2_5

This is data is the miRNA2_5 FC for 2-5 time point. This data set is used in documentation examples.

Description

This is data is the miRNA2_5 FC for 2-5 time point. This data set is used in documentation examples.

miRNA_fc

This is data is the combined miRNA FC for all time points. This data set is used in documentation examples.

Description

This is data is the combined miRNA FC for all time points. This data set is used in documentation examples.

miRNA_fc2

This data is the miRNA fold change data set for difference or interrelation section. This data set is used in documentation examples.

Description

This data is the miRNA fold change data set for difference or interrelation section. This data set is used in documentation examples.

mirRnaDensityCor	<i>mirRnaDensityCor for miRTarRNASeq miRNA and mRNA correlation real data versus sampled data</i>
------------------	---------------------------------------------------------------------------------------------------

Description

This function draws density plots for miRNA and mRNA correlation while comparing real data vs sampled data. It mainly illustrates the where the lower relationships lie.

Usage

```
mirRnaDensityCor(corr0, corrS, pvalue = 0.05)
```

Arguments

corr0	data.frame results of corMirnaRna function.
corrS	data.frame results from the sampCorRnaMirna function.
pvalue	The p value threshold to be used on the data density plot default is 0.05.

Value

Density plot

Examples

```
x <- mirRnaDensityCor(corr_0, outs, pvalue = 0.05)
```

mirRnaDensityInter	<i>mirRnaDensityInter for mirTarRNASeq miRNA and mRNA Interrelation real data versus sampled data</i>
--------------------	-------------------------------------------------------------------------------------------------------

Description

This function draws density plots for miRNA and mRNA Interrelation while comparing real data vs sampled data. It mainly illustrates the where the lower relationships lie.

Usage

```
mirRnaDensityInter(Inter0, OUTS, pvalue = 0.05)
```

Arguments

Inter0	data.frame results of twoTimePoint function.
OUTS	data.frame results from the twoTimePointSamp function.
pvalue	The p value threshold to be used on the data density plot default is 0.05.

Value

Density plot

Examples

```
x <- mirRnaDensityInter(Inter0, OUTS, pvalue = 0.05)
```

mirRnaHeatmap	<i>mirRnaHeatmap</i> pheatmap for miRTarRNASeq miRNA and mRNA correlation
---------------	---------------------------------------------------------------------------

Description

This function draws pheatmaps for miRNA and mRNA correlation while using default and pheatmap for all other parameters

Usage

```
mirRnaHeatmap(
  finalF,
  ...,
  upper_bound = 0,
  main = "Default mRNA miRNA heatmap",
  color = c(viridis::inferno(50), "grey90"),
  fontsize = 7
)
```

Arguments

finalF	data.frame results of corMirnaRnaMiranda or corMirnaRna function
...	arguments passed onto pheatmap
upper_bound	is the upper_bound of the correlation pheatmap scale default is zero user can set to values based on output of correlation result (value)
main	is the title of the pheatmap
color	default inferno(50) from the library viridis R base, R colorbrewer and viridis compatible
fontsize	default is 7 user adjustable

Value

pheatmap Obj

Examples

```
x <- mirRnaHeatmap(corr_0)
```

mirRnaHeatmapDiff	<i>mirRnaHeatmapDiff</i> heatmap for miRTarRNASeq miRNA and mRNA correlation
-------------------	------------------------------------------------------------------------------

Description

This function draws heatmaps (pheatmaps) for miRNA and mRNA correlation while using default and heatmap for all other parameters

Usage

```
mirRnaHeatmapDiff(
  finalF,
  ...,
  upper_bound = 0,
  main = "Default mRNA miRNA heatmap",
  color = c("grey90", viridis::inferno(50)),
  fontsize = 7
)
```

Arguments

finalF	data.frame results of corMirnaRnaMiranda or corMirnaRna function
...	arguments passed onto pheatmap
upper_bound	is the upper_bound of the correlation pheatmap scale default is zero user can set to values based on output of correlation result (value)
main	is the title of the pheatmap
color	default inferno(50) from the library viridis R base, R colorbrewer and viridis compatible
fontsize	default is 7 user adjustable

Value

pheatmap Obj

Examples

```
x <- mirRnaHeatmapDiff(results$corrs, upper_bound = -0.1, color = rainbow(50), fontsize = 10)
```

modelAIC	<i>Obtain model AIC</i>
----------	-------------------------

Description

Obtain model AIC

Usage

```
modelAIC(x)
```

Arguments

x fitted model

Value

AIC for model

Examples

```
modelAIC(some_model)
```

modelCoefficients *Obtain coefficients*

Description

Obtain coefficients

Usage

```
modelCoefficients(x)
```

Arguments

x fitted model

Value

fitted model coefficients

Examples

```
modelCoefficients(some_model)
```

modelData *Obtain model input data*

Description

Obtain model input data

Usage

```
modelData(x)
```

Arguments

x fitted model

Value

Input data for the fitted model

Examples

```
x <- modelData(some_model)
```

modelModelName	<i>Obtain model name</i>
----------------	--------------------------

Description

Obtain model name

Usage

```
modelModelName(x)
```

Arguments

x	fitted model
---	--------------

Value

model name

Examples

```
modelModelName(some_model)
```

modelModelPvalue	<i>Obtain model p-value</i>
------------------	-----------------------------

Description

Obtain model p-value

Usage

```
modelModelPvalue(x)
```

Arguments

x	fitted model
---	--------------

Value

Pvalue for the model

Examples

```
modelModelPvalue(some_model)
```

modelsFilter	<i>modelsFilter</i> Filter a list of models based on logical expression
--------------	-------------------------------------------------------------------------

Description

This function can be used to filter a list of models (such as returned by `runModelsZInf()`) based on a logical expression.

Usage

```
modelsFilter(models, expr, quiet = FALSE)
```

Arguments

<code>models</code>	list of models and related elements, such as returned by <code>runModelsZInf()</code>
<code>expr</code>	expression that yields a logical vector (evaluated in the environment of model)
<code>quiet</code>	suppress warnings

Value

models but with all elements filtered by logical expression `expr`. Elements for which filter could not be applied (e.g. length mismatch between element and condition) are set to NA.

Examples

```
x <- modelsFilter(models, pvalues < 0.05)
x <- modelsFilter(models, is_significant)
x <- modelsFilter(models, is_significant == FALSE)
```

modelTermPvalues	<i>Obtain p-values for terms in model formula</i>
------------------	---------------------------------------------------

Description

Obtain p-values for terms in model formula

Usage

```
modelTermPvalues(x)
```

Arguments

<code>x</code>	fitted model
----------------	--------------

Value

Pvalue for the terms in the fitted model

Examples

```
modelTermPvalues(some_model)
```

mRNA

This is data is the mRNA expression file. This data set is used in documentation examples.

Description

This is data is the mRNA expression file. This data set is used in documentation examples.

mRNA0_2

This is data is the mRNA0_2 FC for 0-2 time point. This data set is used in documentation examples.

Description

This is data is the mRNA0_2 FC for 0-2 time point. This data set is used in documentation examples.

mRNA0_5

This is data is the mRNA0_5 FC for 0-5 time point. This data set is used in documentation examples.

Description

This is data is the mRNA0_5 FC for 0-5 time point. This data set is used in documentation examples.

mRNA2_5

This is data is the mRNA2_5 FC for 2-5 time point. This data set is used in documentation examples.

Description

This is data is the mRNA2_5 FC for 2-5 time point. This data set is used in documentation examples.

mRNA_fc

This is data is the combined mRNA FC for all time points. This data set is used in documentation examples.

Description

This is data is the combined mRNA FC for all time points. This data set is used in documentation examples.

mRNA_fc2	<i>This data is the mRNA fold change data set for difference or interrelation section. This data set is used in documentation examples.</i>
----------	---------------------------------------------------------------------------------------------------------------------------------------------

Description

This data is the mRNA fold change data set for difference or interrelation section. This data set is used in documentation examples.

one2manySponge	<i>Sparse Partial Correlations On mRNA/miRNA Expression We make mirTarRnaSeq compatible to SPONGE package in order to estimate sparse matrix correlation (using elastic net) for prediction potential miRNA-mRNA interaction. Note this function/method is suggested for miRNA/mRNA interactions in many samples with a notable variance of mRNA/miRNA expression. This model also only reports negative sparse partial correlation predictions.</i>
----------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

Sparse Partial Correlations On mRNA/miRNA Expression We make mirTarRnaSeq compatible to SPONGE package in order to estimate sparse matrix correlation (using elastic net) for prediction potential miRNA-mRNA interaction. Note this function/method is suggested for miRNA/mRNA interactions in many samples with a notable variance of mRNA/miRNA expression. This model also only reports negative sparse partial correlation predictions.

Usage

```
one2manySponge(mirna_exp, diff_exp, miranda_sponge_predict, non_null = TRUE)
```

Arguments

mirna_exp	miRNA expression data.frame with miRNA for rows and samples for columns
diff_exp	mRNA expression data.frame with mRNA for rows and samples for columns
miranda_sponge_predict	miRanda sponge compatible matrix produced by miranda_sponge_predict function
non_null	The default for this parameter is TRUE, hence it returns only non-null estimated if FALSE it would return all NULL and TRUE estimates.

Value

matrix adjacency matrix with column names miRNA and row names mRNA

one2OneRnaMiRNA	<i>one2OneRnaMiRNA correlation for miRNA and mRNA using differential expression fold change and if/when available p-value</i>
-----------------	-------------------------------------------------------------------------------------------------------------------------------

Description

This function inputs accept a list of dataframes and returns an obj with two dataframes called FC and p-value. FC with rownames == genes and columns are FC1, 2, 3, ... (with fold-changes) - P-value with rownames == genes and columns are P1, 2, 3, ... (with p-values) both data.frames have the same order dimensions.

Usage

```
one2OneRnaMiRNA(
  files,
  gene_colname = "Gene",
  fc_colname = "FC",
  pval_colname = "pvalue",
  pthreshold = NULL
)
```

Arguments

files	a list of dataframes either miRNAs or mRNAs from various time points.
gene_colname	Default is a vector character of length 1 "Gene" user can alter if they choose This column contains the gene names.
fc_colname	Default "FC" is coloumn name for fold changes user can alter if they choose.
pval_colname	Default is "pvalue" column name for p-values (in input).
pthreshold	P-value threshold.

Value

Correlation dataframe

Examples

```
x <- one2OneRnaMiRNA(files)
```

outs	<i>This is data is the output file resulted from time point/conditions background correlation model. This data set is used in documentation examples.</i>
------	-----------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the output file resulted from time point/conditions background correlation model. This data set is used in documentation examples.

outs2	<i>This is data is the output file resulted from time point/conditions background difference/interrelation model. This data set is used in documentation examples.</i>
-------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the output file resulted from time point/conditions background difference/interrelation model. This data set is used in documentation examples.

plotFit	<i>Plot model</i>
---------	-------------------

Description

Plot 2D description

Usage

```
plotFit(model)
```

Arguments

model	linear model
-------	--------------

Value

does not return value

Examples

```
plotFit(lm(x ~ y, data = data.frame(x = runif(10), y = runif(10))))
```

plotResiduals	<i>Plot residuals</i>
---------------	-----------------------

Description

Plot residuals description

Usage

```
plotResiduals(model)
```

Arguments

model	linear model
-------	--------------

Value

does not return value

Examples

```
plotResiduals(lm(x ~ y, data = data.frame(x = runif(10), y = runif(10))))
```

plotTerms	<i>plotTerms</i>
-----------	------------------

Description

Plot terms description

Usage

```
plotTerms(model)
```

Arguments

model linear model

Value

does not return value

Examples

```
plotTerms(lm(x ~ y, data = data.frame(x = runif(10), y = runif(10))))
```

results	<i>This is data is the output file resulted from time point or conditions or correlation or interrelation model. This data set is used in documentation examples.</i>
---------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the output file resulted from time point or conditions or correlation or interrelation model. This data set is used in documentation examples.

runAllMirnaModels *runAllMirnaModels runModel for all miRNAs*

Description

This function runs the "runModel" function for all miRNAs and mRNA combinations of two and returns a list with significant genes and FDR models

Usage

```
runAllMirnaModels(
  mirnas,
  DiffExp mRNA,
  DiffExp miRNA,
  miranda_data,
  prob = 0.75,
  fdr_cutoff = 0.1,
  method = "fdr",
  cutoff = 0.05,
  all_coeff = FALSE,
  mode = NULL,
  family = glm_poisson(),
  scale = 1
)
```

Arguments

mirnas	vector of unique miRNAs under investigation.
DiffExp mRNA	differentially/expressed mRNAs expression file.
DiffExp miRNA	differentially/expressed miRNAs expression file.
miranda_data	getInputSpecies output file (use low filters).
prob	user defined ratio for miRanda distribution for miRanda score selection default is 0.75.
fdr_cutoff	cutoff for FDR selection default is 0.1.
method	finInterResult miRNA and mRNA interrelation in two time points results in a dataframe.
cutoff	P-value cutoff of the model.
all_coeff	if true only models with all negative coefficients will be selected if false at least one negative coefficient should be in the model; default is TRUE.
mode	model mode, default is Null, can be changed to "multi" and "inter".
family	Default is glm_poisson(), for zero inflated negative binomial NB option use glm_zeroinfl(dist="negbin").
scale	if normalized data (FPKM,RPKM,TPM,CPM), scale to 10 etc., however the higher you go on #scale the less accuracy your p-value estimate will be.

Value

List of run models

Examples

```

mirnas <- c("ebv-mir-bart9-5p", "ebv-mir-bart6-3p")
x <- runAllMirnaModels(mirnas, mRNA, miRNA, miRanda,
  prob = 0.90, fdr_cutoff = 0.1, method = "fdr",
  all_coeff = TRUE, mode = "multi",
  family = glm_poisson(), scale = 100
)

```

runModel	<i>Run a model of a specific kind</i>
----------	---------------------------------------

Description

Run a model of a specific kind

Usage

```
runModel(x, data, ..., model = glm_gaussian())
```

Arguments

x	model formula
data	data.frame to run the model on
...	passed on to fit()
model	model type

Value

fitted model

runModels	<i>runModels runs miRNA mrna model model for various miRNA-mRNA data distributions</i>
-----------	----------------------------------------------------------------------------------------

Description

This function defines the boundaries of mRNA vs miRNAs of interest to be analysed by the run-Models function

Usage

```

runModels(
  combination,
  select_mRNA,
  select_miRNA,
  mode = NULL,
  family = glm_poisson(),
  scale = 1,
  cutoff = 0.05,
  all_coeff = NULL
)

```


Arguments

combination	the combined file for mRNA and selected miRNAs output of combiner function
select_mRNA	the output of gene_variant function.
select_miRNA	The vector of miRNA/s to be investigated.
mode	the mode of analysis if more than one miRNA is being investigated multivariate "multi" or co-variate/interaction analysis "inter" is being used
family	gaussian or poisson
scale	factor to scale input data (for genes) by, prior to rounding and model fitting. (scale must be greater than zero).
cutoff	p-value cut off to call significance
all_coeff	if true only models with all negative coefficients will be selected if false at least one

Value

A list of p-values, annova, and significance for each gene and the miRNA/s of interest

Examples

```
x <- runModels(Combine, geneVariant, "ebv-mir-bart9-5p")
```

sampCorRnaMirna	<i>sampCorRnaMirna sampling for correlation for miRNA and mRNA</i>
-----------------	--------------------------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns a sampled from original file correlation dataframe depending on user sampling selection.

Usage

```
sampCorRnaMirna(
  mRNA,
  miRNA,
  method = "pearson",
  Shrouds = 100,
  Srounds = 1000
)
```

Arguments

mRNA	mRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.
miRNA	miRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.
method	Default is "pearson" else use "kendall" or "spearman".
Shrouds	number of shuffling over the FC data, default is 100.
Srounds	number of sampling from the shuffled data, default is 1000.

Value

Correlation data frame

Examples

```
x <- sampCorRnaMirna(mRNA_fc, miRNA_fc, method = "pearson", Shrouds = 10, Srouds = 10)
```

sig_corrs	<i>This is data is the output file resulted from time point or conditions experiment for correlation model after filtering and threshold modification. This data set is used in documentation examples.</i>
-----------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the output file resulted from time point or conditions experiment for correlation model after filtering and threshold modification. This data set is used in documentation examples.

sig_InterR	<i>This is data is the output file resulted from time point or conditions experiment for interrelation model after filtering and threshold modification. This data set is used in documentation examples.</i>
------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the output file resulted from time point or conditions experiment for interrelation model after filtering and threshold modification. This data set is used in documentation examples.

some_model	<i>This is data is the results file from regression analysis and its estimates. This data set is used in documentation examples.</i>
------------	--------------------------------------------------------------------------------------------------------------------------------------

Description

This is data is the results file from regression analysis and its estimates. This data set is used in documentation examples.

threshSig	<i>threshSig Using shuffling threshold finds appropriate significant miRNA-mRNA correlation</i>
-----------	-------------------------------------------------------------------------------------------------

Description

This function uses the sampCorRnaMirna shuffled output to determine an appropriate threshold for significant mRNA and miRNA relationship of the dataset and shows all those with significant relationships.

Usage

```
threshSig(corr0, corrS, pvalue = 0.05)
```

Arguments

corr0	data.frame results of corMirnaRna function.
corrS	vector of correlations, from the sampCorRnaMirna function.
pvalue	The p value threshold to be used on the sampled data.

Value

A dataframe of Significant mRNA and miRNA

Examples

```
x <- mirRnaHeatmap(outs, corr_0)
```

threshSigInter	<i>threshSigInter Using shuffling threshold finds appropriate significant miRNA-mRNA correlation</i>
----------------	------------------------------------------------------------------------------------------------------

Description

This function uses the sampCorRnaMirna shuffled output to determine an appropriate threshold for significant mRNA and miRNA relationship of the dataset and shows all those with significant relationships.

Usage

```
threshSigInter(corr0, corrS, pvalue = 0.05)
```

Arguments

corr0	data.frame results of corMirnaRna function.
corrS	vector of correlations, from the sampCorRnaMirna function.
pvalue	The p value threshold to be used on the sampled data.

Value

A dataframe of Significant mRNA and miRNA

Examples

```
x <- threshSigInter(corr_0, outs, pvalue = 0.05)
```

twoTimePoint	<i>twoTimePoint miRNA and mRNA interrelation in two timepoints</i>
--------------	--------------------------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns a sampled from original file interrelation dataframe depending on user sampling selection.

Usage

```
twoTimePoint(mRNA, miRNA)
```

Arguments

mRNA	mRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.
miRNA	miRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.

Value

miRNA mRNA interrelation dataframe

Examples

```
x <- twoTimePoint(mRNA_fc2, miRNA_fc2)
```

twoTimePointSamp	<i>twoTimePointSamp miRNA and mRNA interrelation in two timepoints sampling</i>
------------------	---------------------------------------------------------------------------------

Description

This function uses the output of one2OneRnaMiRNA and returns a sampled from orig file interrelation dataframe depending on user sampling selection.

Usage

```
twoTimePointSamp(mRNA, miRNA, Shrouds = 100, Srouds = 1000)
```

Arguments

mRNA	mRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.
miRNA	miRNA file generated from fold changes (FC) obj of the one2OneRnaMiRNA.
Shrounds	number of shuffling over the FC data, default is 100.
Srounds	number of sampling from the shuffled data, default is 1000.

Value

miRNA mRNA interrelation dataframe

Examples

```
x <- twoTimePointSamp(mRNA, miRNA, Shrounds = 10, Srounds = 10)
```

tzTrans	<i>tzTransTranspose and z-score transformation</i>
---------	----------------------------------------------------

Description

Transposes and z-score transforms a matrix or data.frame.

Usage

```
tzTrans(x)
```

Arguments

x	matrix of miRNA or mRNA or the data frame to be transformed
---	-------------------------------------------------------------

Value

transposed and transformed version of x as a matrix.

Examples

```
x <- tzTrans(miRNA)
```

Index

- * **2d**,
 - plotFit, 29
- * **Correlation**
 - corMirnaRna, 5
 - corMirnaRnaMiranda, 5
- * **Density**
 - mirRnaDensityCor, 20
 - mirRnaDensityInter, 20
- * **Intersection**
 - miRanComp, 16
- * **Results**
 - finInterResult, 9
- * **R**
 - drawCorPlot, 7
 - modelsFilter, 25
- * **SPONGE**
 - miranda_sponge_predict, 18
- * **Significance**,
 - threshSigInter, 35
- * **Significance**,
 - miRandaIntersect, 16
 - threshSig, 35
- * **Sponge**,
 - one2manySponge, 27
- * **Threshold**,
 - miRandaIntersect, 16
- * **Threshold**
 - corMirnaRna, 5
 - corMirnaRnaMiranda, 5
 - mirandaIntersectInter, 17
 - threshSig, 35
 - threshSigInter, 35
- * **all_miRNAs**
 - runAllMirnaModels, 31
- * **ceRNA**,
 - miranda_sponge_predict, 18
- * **ceRNA**
 - one2manySponge, 27
- * **color**,
 - mirRnaHeatmap, 21
 - mirRnaHeatmapDiff, 22
- * **correction**
 - fdrSig, 8
- * **correlation**,
 - miranda_sponge_predict, 18
 - one2manySponge, 27
 - sampCorRnaMirna, 33
 - twoTimePointSamp, 36
- * **correlation**
 - drawCorPlot, 7
 - mirRnaHeatmap, 21
 - mirRnaHeatmapDiff, 22
 - one2OneRnaMirna, 28
- * **dataframe**
 - finInterResult, 9
- * **data**
 - Combine, 4
 - corr_0, 6
 - final_results, 8
 - geneVariant, 10
 - inter0, 15
 - miRanda, 16
 - miRandaM, 18
 - miRNA, 18
 - miRNA0_2, 19
 - miRNA0_5, 19
 - miRNA2_5, 19
 - miRNA_fc, 19
 - miRNA_fc2, 19
 - mRNA, 26
 - mRNA0_2, 26
 - mRNA0_5, 26
 - mRNA2_5, 26
 - mRNA_fc, 26
 - mRNA_fc2, 27
 - outs, 28
 - outs2, 29
 - results, 30
 - sig_corrs, 34
 - sig_InterR, 34
 - some_model, 34
- * **dimensions**
 - geneVari, 9
- * **expression**
 - miRanComp, 16
- * **filter**

- modelsFilter, 25
- * **glm**
 - runModels, 32
- * **heatmap,**
 - mirRnaHeatmap, 21
 - mirRnaHeatmapDiff, 22
- * **interaction**
 - runModels, 32
- * **interrelation**
 - twoTimePoint, 36
- * **intersect**
 - miRandaIntersect, 16
 - mirandaIntersectInter, 17
- * **mRNA**
 - twoTimePoint, 36
- * **miRNA_mRNA_Intersection**
 - combiner, 4
- * **miRNA**
 - twoTimePoint, 36
- * **miRanda,**
 - corMirnaRna, 5
 - corMirnaRnaMiranda, 5
 - miranda_sponge_predict, 18
- * **miRanda**
 - corMirnaRna, 5
 - corMirnaRnaMiranda, 5
 - miRanComp, 16
 - mirandaIntersectInter, 17
- * **mirTarRnaSeq,**
 - one2manySponge, 27
- * **miranda,**
 - getInputSpecies, 10
- * **mirandaIntersectInter**
 - mirandaIntersectInter, 17
- * **models**
 - modelsFilter, 25
- * **model**
 - plotFit, 29
 - plotResiduals, 29
 - plotTerms, 30
- * **multivariate**
 - runModels, 32
- * **p_adjust,**
 - fdrSig, 8
- * **partial**
 - miranda_sponge_predict, 18
 - one2manySponge, 27
- * **pheatmap,**
 - mirRnaHeatmap, 21
 - mirRnaHeatmapDiff, 22
- * **plot,correlation_plot**
 - mirRnaHeatmap, 21
- mirRnaHeatmapDiff, 22
- * **plot,**
 - plotFit, 29
 - plotResiduals, 29
 - plotTerms, 30
- * **plot**
 - drawCorPlot, 7
 - drawInterPlots, 7
 - mirRnaDensityCor, 20
 - mirRnaDensityInter, 20
- * **residuals,**
 - plotResiduals, 29
 - plotTerms, 30
- * **runAllMirnaModels**
 - runAllMirnaModels, 31
- * **runModels**
 - runModels, 32
- * **sampling,**
 - sampCorRnaMirna, 33
 - twoTimePointSamp, 36
- * **scale,**
 - tzTrans, 37
- * **shuffling**
 - sampCorRnaMirna, 33
 - twoTimePointSamp, 36
- * **sparse**
 - miranda_sponge_predict, 18
 - one2manySponge, 27
- * **species**
 - getInputSpecies, 10
- * **transform,**
 - tzTrans, 37
- * **transpose**
 - tzTrans, 37
- * **univariate**
 - runModels, 32
- * **with**
 - corMirnaRna, 5
 - corMirnaRnaMiranda, 5
- * **zscore,**
 - tzTrans, 37
- canonicalModel_, 3
- Combine, 4
- combiner, 4
- corMirnaRna, 5
- corMirnaRnaMiranda, 5
- corr_0, 6
- downloadMirandaFile, 6
- drawCorPlot, 7
- drawInterPlots, 7

fdrSig, 8
final_results, 8
finInterResult, 9

geneVari, 9
geneVariant, 10
getInputSpecies, 10
glm_gaussian, 11
glm_multi, 11
glm_nb, 12
glm_poisson, 12
glm_zeroinfl, 13
glm_zeroinfl_negbin, 13
glm_zeroinfl_poisson, 14

importMirandaFile, 14
inter0, 15

makeFormulaRightSide, 15
miRanComp, 16
miRanda, 16
miranda_sponge_predict, 18
miRandaIntersect, 16
mirandaIntersectInter, 17
miRandaM, 18
miRNA, 18
miRNA0_2, 19
miRNA0_5, 19
miRNA2_5, 19
miRNA_fc, 19
miRNA_fc2, 19
mirRnaDensityCor, 20
mirRnaDensityInter, 20
mirRnaHeatmap, 21
mirRnaHeatmapDiff, 22
modelAIC, 22
modelCoefficients, 23
modelData, 23
modelModelName, 24
modelModelPvalue, 24
modelsFilter, 25
modelTermPvalues, 25
mRNA, 26
mRNA0_2, 26
mRNA0_5, 26
mRNA2_5, 26
mRNA_fc, 26
mRNA_fc2, 27

one2manySponge, 27
one2OneRnaMiRNA, 28
outs, 28
outs2, 29

plotFit, 29
plotResiduals, 29
plotTerms, 30

results, 30
runAllMirnaModels, 31
runModel, 32
runModels, 32

sampCorRnaMirna, 33
sig_corrs, 34
sig_InterR, 34
some_model, 34

threshSig, 35
threshSigInter, 35
twoTimePoint, 36
twoTimePointSamp, 36
tzTrans, 37