

# Package ‘CausalR’

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**Type** Package

**Title** Causal Reasoning on Biological Networks

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**Description** Causal Reasoning algorithms for biological networks, including predictions, scoring, p-value calculation and ranking

**Depends** R (>= 3.0), igraph

**Imports** igraph

**Suggests** knitr, RUnit, BiocGenerics

**VignetteBuilder** knitr

**biocViews** GraphAndNetwork, Network

**License** GPL (>= 2)

**NeedsCompilation** no

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---

AddIDsToVertices	<i>add IDs to vertices</i>
------------------	----------------------------

---

**Description**

Adds the IDs as a vertex property to the vertices in the network. Used when creating sub-networks where the new nodes will retain the IDs from their original network

**Usage**

AddIDsToVertices(network)

**Arguments**

network            the network to which the IDs are to be added

**Value**

network with IDs added

---

AddWeightsToEdges	<i>add weights to edges</i>
-------------------	-----------------------------

---

**Description**

Adds weight information to the edges of given network (1 for activation and -1 for inhibition)

**Usage**

AddWeightsToEdges(network, tableOfInteractions)

**Arguments**

network            an igraph constructed from the original .sif file  
tableOfInteractions            a column of the corresponding .sif file indicating the direction of activation/interaction

**Value**

an augmented network

AnalyseExperimentalData

*analyse experimental data*

---

### **Description**

Returns the number of up- and down-regulated genes in the experimental data

### **Usage**

```
AnalyseExperimentalData(experimentalData)
```

### **Arguments**

experimentalData

a dataframe containing a list of genes with corresponding direction of change (1 or -1)

### **Value**

up and down regulation statistics for the experimental data

---

AnalysePredictionsList

*analyse predictions list*

---

### **Description**

Taking the list of predictions from a particular hypothesis, counts the number of positive and negative predictions in the list and the number of 0's (from numPredictions).

### **Usage**

```
AnalysePredictionsList(predictionsList, numPredictions)
```

### **Arguments**

predictionsList

list of predictions

numPredictions number of predictions

### **Value**

prediction statistics

**Examples**

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
ccg <- CreateCCG(network)
predictions <- MakePredictions("NodeA", +1, ccg, 2)
AnalysePredictionsList(predictions,8)
```

---

CalculateEnrichmentPValue

*calculates an enrichment p-value*

---

**Description**

Calculate a enrichment p-value for a given hypothesis by comparing the corresponding predicted and observed gene changes

**Usage**

```
CalculateEnrichmentPValue(predictions, results)
```

**Arguments**

predictions	predictions of changes from the CCG for a particular hypothesis
results	gene changes observed in the experimental data

**Value**

an enrichment p-value

**Examples**

```
predictions <- matrix(c(1,2,3,1,1,-1), ncol = 2)
results<- matrix(c(1,2,3,4,1,1,-1,1), ncol = 2)
CalculateEnrichmentPValue(predictions, results)
```

---

CalculateSignificance *calculate overall significance p-value*

---

**Description**

Calculates the p-value of a score given the hypothesis score and the distribution table, using either the quartic or the (faster) cubic algorithm

**Usage**

```
CalculateSignificance(hypothesisScore, predictionListStats,
  experimentalResultStats, epsilon = 1e-05, useCubicAlgorithm = TRUE,
  use1bAlgorithm = TRUE)
```

**Arguments**

hypothesisScore	score for a particular hypothesis
predictionListStats	numbers of predicted up-regulated, predicted down-regulated and ambiguous predictions predicted by the algorithm
experimentalResultStats	numbers of up-regulated, down-regulated and not significantly changed transcripts in the experimental data
epsilon	threshold that is used when calculating the p-value using the cubic algorithm
useCubicAlgorithm	use the cubic algorithm, defaults to TRUE
use1bAlgorithm	use the 1b version of the algorithm, defaults to TRUE used to calculate the p-value

**Value**

the resulting p-value

**Examples**

```

CalculateSignificance(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=TRUE)
CalculateSignificanceUsingQuarticAlgorithm(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=FALSE)
CalculateSignificance(5, c(7,4,19), c(6,6,18), 1e-5)
CalculateSignificance(5, c(7,4,19), c(6,6,18), epsilon=1e-5, useCubicAlgorithm=TRUE)
CalculateSignificanceUsingCubicAlgorithm(5, c(7,4,19), c(6,6,18), 1e-5)

```

---

```

CalculateSignificanceUsingCubicAlgorithm
      calculate significance using the cubic algorithm

```

---

**Description**

Calculates the p-value of a score given the hypothesis score and the distribution table (calculated using the cubic algorithm)

**Usage**

```

CalculateSignificanceUsingCubicAlgorithm(hypothesisScore, predictionListStats,
      experimentalDataStats, epsilon)

```

**Arguments**

hypothesisScore	the score whose p-value we want to find.
predictionListStats	numbers of predicted up-regulated, predicted down-regulated and ambiguous predictions.
experimentalDataStats	numbers of up-regulated, down-regulated and not significantly changed transcripts in the experimental data.
epsilon	an epsilon threshold that is used when calculating the p-value using the cubic algorithm. Defaults to 1e-5.

**Value**

p-value

**References**

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

**Examples**

```
CalculateSignificance(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=TRUE)
CalculateSignificanceUsingQuarticAlgorithm(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=FALSE)
CalculateSignificance(5, c(7,4,19), c(6,6,18), 1e-5)
CalculateSignificance(5, c(7,4,19), c(6,6,18), epsilon=1e-5, useCubicAlgorithm=TRUE)
CalculateSignificanceUsingCubicAlgorithm(5, c(7,4,19), c(6,6,18), 1e-5)
```

---

CalculateSignificanceUsingCubicAlgorithm1b

*Calculate Significance Using Cubic Algorithm*

---

**Description**

Calculate the p-value of a score given the hypothesis score and the distribution table (calculated using the cubic algorithm 1b in Assessing statistical significance in causal graphs - Chindelevitch et al)

**Usage**

```
CalculateSignificanceUsingCubicAlgorithm1b(hypothesisScore, predictionListStats,
experimentalDataStats, epsilon)
```

**Arguments**

hypothesisScore	The score whose p-value we want to find.
predictionListStats	Number of predicted up-regulated, predicted down-regulated and ambiguous predictions.
experimentalDataStats	Number of up-regulated, down-regulated and not significantly changed transcripts in the experimental data.
epsilon	The threshold that is used when calculating the p-value using the cubic algorithm. (Defaults to 1e-5, only used for the cubic algorithm, ignored if useCubicAlgorithm is FALSE.)

**Value**

p value

**Examples**

```

CalculateSignificance(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=TRUE)
CalculateSignificanceUsingQuarticAlgorithm(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=FALSE)
CalculateSignificance(5, c(7,4,19), c(6,6,18), 1e-5)
CalculateSignificance(5, c(7,4,19), c(6,6,18), epsilon=1e-5, useCubicAlgorithm=TRUE)
CalculateSignificanceUsingCubicAlgorithm1b(5, c(7,4,19), c(6,6,18), 1e-5)

```

---

CalculateSignificanceUsingQuarticAlgorithm

*calculate significance using the quartic algorithm*

---

**Description**

Computes the significance of a given hypothesis. For a detailed description of the algorithm see Causal reasoning on biological networks: interpreting transcriptional changes - Chindelevitch et al., section 2. from which the methods and notation is taken.

**Usage**

```

CalculateSignificanceUsingQuarticAlgorithm(hypothesisScore, predictionListStats,
experimentalDataStats)

```



**Arguments**

- hypothesisScore  
the score for which a p-value is required
- predictionListStats  
a vector containing the values q+, q- and q0 (the number of positive/negative/non-significant or contradictory) predictions)
- experimentalDataStats  
a vector containing the values n+, n- and n0 (the number of positive/negative/non-significant (or contradictory) transcripts in the results) (or contradictory) transcripts in the results)

**Value**

the corresponding p-value

**References**

L Chindelevitch et al. Causal reasoning on biological networks: Interpreting transcriptional changes. *Bioinformatics*, 28(8):1114-21, 2012.

**Examples**

```
CalculateSignificance(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=TRUE)
CalculateSignificanceUsingQuarticAlgorithm(5, c(7,4,19), c(6,6,18))
CalculateSignificance(5, c(7,4,19), c(6,6,18), useCubicAlgorithm=FALSE)
CalculateSignificance(5, c(7,4,19), c(6,6,18), 1e-5)
CalculateSignificance(5, c(7,4,19), c(6,6,18), epsilon=1e-5, useCubicAlgorithm=TRUE)
CalculateSignificanceUsingCubicAlgorithm(5, c(7,4,19), c(6,6,18), 1e-5)
```

---

CalculateTotalWeightForAllContingencyTables

*calculate total weight for all contingency tables*

---

**Description**

Calculates the total weights or D-values for all possible contingency tables. This value can be used to calculate the p-value

**Usage**

```
CalculateTotalWeightForAllContingencyTables(experimentalDataStats,
returnlog = FALSE)
```

**Arguments**

`experimentalDataStats`  
 a vector containing the values  $n+$ ,  $n-$  and  $n0$ , the number of positive/negative/non-significant (or contradictory) transcripts in the results

`returnlog`      whether the result should be returned as a log. Default is FALSE.

**Value**

a D-value or weight

---

`CalculateWeightGivenValuesInThreeByThreeContingencyTable`  
*calculate weight given values in three-by-three contingency table*

---

**Description**

Given the values in the three by three contingency table and the values of the number of positive/negative/non-significant predictions ( $q+$ ,  $q-$ ,  $q0$ ) this function calculates the D-value (or weight).

**Usage**

```
CalculateWeightGivenValuesInThreeByThreeContingencyTable(threeByThreeContingencyTable,
logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

**Arguments**

`threeByThreeContingencyTable`  
 a 3x3 contingency table

`logOfFactorialOfPredictionListStats`  
 log of Factorial of prediction statistics

`returnlog`      should the result be returned as a log value. Default is FALSE.

**Value**

a D-value (or weight)

---

CheckPossibleValuesAreValid  
*check possible values are valid*

---

**Description**

Checks if the a given set of possible values for n++, n+-, n-+ and n- are agree with the predicted and experimental data

**Usage**

```
CheckPossibleValuesAreValid(predictionDataStats, experimentalDataStats,  
    possibleValues)
```

**Arguments**

predictionDataStats  
a vector of predicted results

experimentalDataStats  
a vector of observed experimental results

possibleValues a vector of possible values n++, n+-, n-+ and n-

**Value**

TRUE if and only if the given vector of possible values is valid

---

CheckRowAndColumnSumValuesAreValid  
*check row and column sum values are valid*

---

**Description**

Checkes to see if the values of r+, r-, c+ and c- which are stored in rowAndColumnSumValues define a valid contingency table

**Usage**

```
CheckRowAndColumnSumValuesAreValid(rowAndColumnSumValues, predictionListStats,  
    experimentalResultStats)
```

**Arguments**

`rowAndColumnSumValues`  
a 4x1 vector containing the row and column sum values (r+, r-, c+, c-) for a 2x2 contingency table

`predictionListStats`  
a vector containing the values q+, q- and q0

`experimentalResultStats`  
A vector containing the values n+, n- and n0

**Value**

TRUE if the table is valid; otherwise FALSE

---

CompareHypothesis      *compare hypothesis*

---

**Description**

Compare the predictions from a hypothesis with the experimental data returning an matrix with columns for node ID, predictions, experimental results and the corresponding scores.

**Usage**

```
CompareHypothesis(matrixOfPredictions, matrixOfExperimentalData, ccg = NULL,
  sourceNode = NULL)
```

**Arguments**

`matrixOfPredictions`  
a matrix of predictions

`matrixOfExperimentalData`  
a matrix of experimental data

`ccg`  
a CCG network (default=NULL)

`sourceNode`  
A starting node (default=NULL)

**Value**

a matrix containing predictions, observations and scores.

**Examples**

```
predictions <- matrix(c(1,2,3,+1,0,-1),ncol=2)
experimentalData <- matrix(c(1,2,4,+1,+1,-1),ncol=2)
ScoreHypothesis(predictions,experimentalData)
CompareHypothesis(predictions,experimentalData)
```

---

ComputeFinalDistribution  
*compute final distribution*

---

**Description**

Computes a final reference distribution of the score used to compute the final p-value.

**Usage**

```
ComputeFinalDistribution(resultsMatrix)
```

**Arguments**

resultsMatrix a matrix containing the scores and weights from which the distribution is to be calculated

**Value**

distributionMatrix a matrix containing the reference distribution for the score

---

ComputePValueFromDistributionTable  
*compute a p-value from the distribution table*

---

**Description**

Computes the p-value of the score of an hypothesis, based on a distribution table

**Usage**

```
ComputePValueFromDistributionTable(scoreOfHypothesis, distributionMatrix,  
totalWeights)
```

**Arguments**

scoreOfHypothesis  
a score of hypothesis  
distributionMatrix  
a distribution table presented as a matrix  
totalWeights a matrix of total weights

**Value**

a p-value

---

CreateCCG	<i>create a Computational Causal Graph (CCG)</i>
-----------	--

---

**Description**

Creates a computational causal graph from a network file.

**Usage**

```
CreateCCG(filename)
```

**Arguments**

filename            file name of the network file (in .sif file format)

**Value**

an igraph object containing the CCG.

**Note**

CreateCG and CreateCCG create causal and computational causal graphs respectively.

**References**

L Chindelevitch et al. Causal reasoning on biological networks: Interpreting transcriptional changes. *Bioinformatics*, 28(8):1114-21, 2012.

**Examples**

```
# get path to example .sif file
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
#create ccg
cgg = CreateCCG(network)
```

---

CreateCG	<i>create a Computational Graph (CG)</i>
----------	--

---

**Description**

Creates a CG network from a .sif file. Takes in a .sif file output from Cytoscape, and creates an 'igraph' representing the network. The edges will be annotated with the type of interaction and a weight (1 for activation and -1 for inhibition)

**Usage**

```
CreateCG(sifFile)
```

**Arguments**

`sifFile` the path of the .sif file that contains all the information about the network Load in .sif file

**Value**

a CG network

**Examples**

```
# get path to example .sif file
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
#create cg
cg = CreateCG(network)
```

---

CreateNetworkFromTable

*create network from table*

---

**Description**

Creates a network from an internal data table created from a .sif file: this function converts the data read in from the .sif file into an igraph in R.

**Usage**

```
CreateNetworkFromTable(dataTable)
```

**Arguments**

`dataTable` the data table containing the information read in from the .sif file representing the network.

**Value**

an igraph network

---

DetermineInteractionTypeOfPath  
*determine interaction type of path*

---

**Description**

Determines the sign of a given path. Given a path and through the network, this function will determine if the path results in activation or inhibition. Activation is indicated by 1, inhibition by -1

**Usage**

DetermineInteractionTypeOfPath(network, nodesInPath)

**Arguments**

network	an igraph representing the network
nodesInPath	an ordered list of the nodes visited on the path - note that these contain numbers which use R's internal reference to the edges

**Value**

a signed integer representing the paths sign

---

FindApproximateValuesThatWillMaximiseDValue  
*find approximate values that will maximise D value*

---

**Description**

Finds an approximate table values to maximise D. Given the values of q+, q-, q0, n+, n- and n0 this function will produce the approximate values of n++, n+-, n-+ and n-- that will maximise the D value. See Assessing statistical significance of casual graphs, page 6. The values are approximate since they need to be rounded, although the direction of rounding is not clear at this stage.

**Usage**

FindApproximateValuesThatWillMaximiseDValue(predictionListStats,  
experimentalDataStats)

**Arguments**

predictionListStats	a vector containing the values q+, q- and q0: numbers of positive, negative and non-significant/contradictory predictions
experimentalDataStats	a vector containing the values n+, n- and n0: numbers of positive, negative and non-significant/contradictory predictions



**Value**

a 2x2 contingency table which approximately maximises D

**References**

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

---

FindIdsOfConnectedNodesInSubgraph

*find Ids of connected nodes in subgraph*

---

**Description**

Adds the IDs of the connected nodes in a subgraph to an existing list. Given the IDs of connected nodes in the full network, this function will find the corresponding IDs in the subgraph

**Usage**

```
FindIdsOfConnectedNodesInSubgraph(idsOfConnectedNodes, subgraphOfConnectedNodes)
```

**Arguments**

idsOfConnectedNodes

a list of connected nodes in the full graph

subgraphOfConnectedNodes

a subgraph

**Value**

a list of connected nodes in the subgraph

---

FindMaximumDValue

*find maximum D value*

---

**Description**

computes the maximum possible D-value for given values  $q_+$ ,  $q_-$ ,  $q_0$  and  $n_+$ ,  $n_-$ ,  $n_0$ .

**Usage**

```
FindMaximumDValue(predictionListStats, experimentalDataStats,
  logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

**Arguments**

predictionListStats	a vector containing the predicted values $q+$ , $q-$ and $q0$ : numbers of positive, negative and non-significant/contradictory predictions
experimentalDataStats	A vector containing the observed values $n+$ , $n-$ and $n0$ : numbers of positive, negative and non-significant/contradictory observations
logOfFactorialOfPredictionListStats	a vector containing the log of the factorial value for each entry in predictionListStats
returnlog	should the result be returned as a log; default FALSE

**Value**

the maximum possible D value

---

GetAllPossibleRoundingCombinations

*get score for numbers of correct and incorrect predictions*

---

**Description**

Returns all possible rounding combinations of a 2x2 table. Given the values of  $n++$ ,  $n+-$ ,  $n-+$  and  $n--$  (stored in twoByTwoContingencyTable) this function will compute all possibilities of rounding each value up or down.

**Usage**

```
GetAllPossibleRoundingCombinations(twoByTwoContingencyTable)
```

**Arguments**

twoByTwoContingencyTable	Approximate values of $n++$ , $n+-$ , $n-+$ and $n--$ , these values are calculated to optimise the D-value (see page 6 of Assessing statistical significance of causal graphs)
--------------------------	---

**Value**

a matrix of rounding combinations

---

GetApproximateMaximumDValueFromThreeByTwoContingencyTable  
*returns approximate maximum D value or weight for a 3x2 superfamily*

---

### Description

Computes an approximate maximum D value (or weight) for a superfamily (3x2 table). The result is only approximate as only the first valid D value that is return. This has been done to speed up the overall algorithm.

### Usage

```
GetApproximateMaximumDValueFromThreeByTwoContingencyTable(threeByTwoContingencyTable,
predictionListStats, logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

### Arguments

threeByTwoContingencyTable  
 approximate values of n++, n+-, n-+, n-, n0+ and n0-, these values are calculated to optimise the D-value (see page 6 of Assessing statistical significance of causal graphs)

predictionListStats  
 a vector containing the values q+, q- and q0 (the number of positive/negative/non-significant (or contradictory) predictions)

logOfFactorialOfPredictionListStats  
 a vector containing the log of the factorial value for each entry in predictionListStats

returnlog  
 return the result as a log, default is FALSE

### Value

an approximate maximum D value or weight

---

GetApproximateMaximumDValueFromTwoByTwoContingencyTable  
*computes an approximate maximum D value or weight*

---

### Description

Computes an approximate maximum D value (or weight). The calculation is approximate since only the first valid D value that is round. This has been done to speed up the overall algorithm - to get the exact answer use GetMaximumDValueFromTwoByTwoContingencyTable.

**Usage**

```
GetApproximateMaximumDValueFromTwoByTwoContingencyTable(n_pp, n_pm, n_mp, n_mm,
  predictionListStats, experimentalDataStats,
  logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

**Arguments**

n\_pp            the count n++ from the prediction-observation contingency matrix

n\_pm            the count n+- from the prediction-observation contingency matrix

n\_mp            the count n-+ from the prediction-observation contingency matrix

n\_mm            the count n-- from the prediction-observation contingency matrix

predictionListStats  
                a vector containing the values q+, q- and q0: the number of positive, negative, non-significant/contradictory predictions

experimentalDataStats  
                a vector containing the values n+, n- and n0: the number of positive, negative, non-significant/contradictory observations

logOfFactorialOfPredictionListStats  
                a vector containing the log of the factorial value for each entry in predictionListStats

returnlog        return the result as a log, default is FALSE

**Value**

the maximum D value or weight

---

GetCombinationsOfCorrectandIncorrectPredictions  
*returns table of correct and incorrect predictions*

---

**Description**

Returns the numbers of correct and incorrect positive and negative predictions

**Usage**

```
GetCombinationsOfCorrectandIncorrectPredictions(predictionDataStats,
  experimentalDataStats)
```

**Arguments**

predictionDataStats  
                    prediction data statistics table

experimentalDataStats  
                    Experimental data statistics table

**Value**

a matrix the numbers of correct and incorrect positive and negative prediction

---

GetInteractionInformation

*returns interaction information from input data*

---

**Description**

Gets the interaction information from the input data

**Usage**

```
GetInteractionInformation(dataTable)
```

**Arguments**

dataTable      a data table containing the information read in from the .sif file representing the network.

**Value**

a vector of interaction information

---

GetMatrixOfCausalRelationships

*compute causal relationships matrix*

---

**Description**

Get a matrix of causal relationships from the network and the IDs of connected nodes

**Usage**

```
GetMatrixOfCausalRelationships(hypothesis, network,  
idsOfConnectedNodesFromSubgraph)
```

**Arguments**

hypothesis      a hypothesis node  
network          a CCG network  
idsOfConnectedNodesFromSubgraph  
                 a list of connected nodes in the subgraph of interest

**Value**

causal relationships matrix

---

 GetMaxDValueForAFamily

*get maximum D value for a family*


---

### Description

Computes the maximum D value for a particular family - denoted as  $D_{fam}$  on page 6 of Assessing Statistical Significance of Causal Graphs

### Usage

```
GetMaxDValueForAFamily(r_p, r_m, c_p, predictionListStats,
  experimentalDataStats, logOfFactorialOfPredictionListStats,
  returnlog = FALSE)
```

### Arguments

<code>r_p</code>	row sum r+
<code>r_m</code>	row sum r-
<code>c_p</code>	column sum c+
<code>predictionListStats</code>	approximate values of $n_{++}$ , $n_{+-}$ , $n_{-+}$ and $n_{--}$
<code>experimentalDataStats</code>	a vector containing the values $q_+$ , $q_-$ and $q_0$ : number of positive, negative, non-significant/contradictory predictions
<code>logOfFactorialOfPredictionListStats</code>	a vector containing the values $n_+$ , $n_-$ and $n_0$ : number of positive, negative, non-significant/contradictory observations
<code>returnlog</code>	return result as log, default value is FALSE

### Value

the maximum  $D_{fam}$  Value

### References

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

---

 GetMaxDValueForAThreeByTwoFamily

*get maximum D value for three-by-two a family*


---

### Description

Returns the maximum D value for a particular family as described as D\_fam on pages 6 and 7 of Assessing Statistical Significance of Causal Graphs in Assessing Statistical Significance of Causal Graphs

### Usage

```
GetMaxDValueForAThreeByTwoFamily(r_p, r_m, r_z, n_p, n_m, predictionListStats,
  logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

### Arguments

r_p	a r+ row sum from the prediction-observation matrix
r_m	a r- row sum from the prediction-observation matrix
r_z	a r0 row sum from the prediction-observation matrix
n_p	a number of predicted increases from the prediction-observation matrix
n_m	a number of predicted decreases from the prediction-observation matrix
predictionListStats	a vector contain the number of postive, negative and non-significant/contradictory predictions: q+, q- and q0.
logOfFactorialOfPredictionListStats	a vector containing the log of the factorial for each element in the prediction-ListStats object
returnlog	whether or not the maximum D value should be returned as a log (TRUE). Otherwise a non-logged value is returned.

### Value

Maximum D\_fam Value

### References

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

---

 GetMaximumDValueFromTwoByTwoContingencyTable

*get maximum D value from two-by-two contingency table*


---

### Description

Computes the maximum D value (or weight) given approximate values of  $n_{++}$ ,  $n_{+-}$ ,  $n_{-+}$  and  $n_{--}$ . These values are approximate and in general are non-integer values; they are found by using an approximation detailed in the paper *Assessing statistical significance in causal graphs* on page 6 i.e.  $n_{ab}$  is approximately equal to  $q_a * n_b / t$  where  $a$  and  $b$  are either  $+$ ,  $-$  or  $0$ . The value is an approximation since the direction in which the number should be rounded is not clear and hence this function runs through all possible combinations of rounding before concluding the maximum D-value.

### Usage

```
GetMaximumDValueFromTwoByTwoContingencyTable(twoByTwoContingencyTable,
  predictionListStats, experimentalDataStats,
  logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

### Arguments

`twoByTwoContingencyTable`  
 approximate values of  $n_{++}$ ,  $n_{+-}$ ,  $n_{-+}$  and  $n_{--}$ , these values are calculated to optimise the D-value

`predictionListStats`  
 a vector containing the values  $q_+$ ,  $q_-$  and  $q_0$  the number of positive/negative/non-significant (or contradictory) predictions)

`experimentalDataStats`  
 a vector containing the values  $n_+$ ,  $n_-$  and  $n_0$  (the number of positive/negative/non-significant (or contradictory) transcripts in the results)

`logOfFactorialOfPredictionListStats`  
 a vector containing the log of the factorial value for each entry in `predictionListStats`

`returnlog`      whether or not the value should be returned as a log (TRUE) or not (FALSE)

### Value

the maximal D-value

### References

L Chindelevitch et al. *Assessing statistical significance in causal graphs*. BMC Bioinformatics, 13(35), 2012.



---

GetNodeID	<i>get CCG node ID</i>
-----------	------------------------

---

**Description**

Returns the CCG node ID from a node name or a vector of node names and a given direction of regulation.

**Usage**

```
GetNodeID(network, nodename, direction = 1)
```

**Arguments**

network	a CCG object
nodename	the node name, or names, for which the ID is required
direction	the direction of regulation of the required node or nodes. Maybe +1 (default) or -1.

**Value**

a scalar or vector containing the node ID or IDs requested

---

GetNodeName	<i>get node name</i>
-------------	----------------------

---

**Description**

Returns the node name from one or more node IDs, or substitute node names for node IDs, given in first column of a matrix typically of predictions or experimental data

**Usage**

```
GetNodeName(network, nodeID, signed = FALSE)
```

**Arguments**

network	Built from igraph
nodeID	a node ID or a matrix containing node IDs in its first column
signed	whether or not the node name should be signed. Setting this value to TRUE gives a signed name indicating whether the gene is up or down regulated in the network

**Value**

a node name or a vector of node names depending if the input is an matrix.

**Examples**

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
cgg = CreateCCG(network)
nodeID <- 10
getNodeName(cgg, nodeID)
```

---

GetNumberOfPositiveAndNegativeEntries

*counts the number of positive and negative entries*

---

**Description**

Counts the number of entries in the in the second column of an input table that are +1 or -1.

**Usage**

```
GetNumberOfPositiveAndNegativeEntries(dataList)
```

**Arguments**

`dataList` an array or dataframe in which the second column is numeric

**Value**

a vector of two components, the first of which giving the number of +1 entries, the second the number of -1's.

**Examples**

```
expData<-read.table(system.file(package="CausalR", "extdata", "testData.txt"))
GetNumberOfPositiveAndNegativeEntries(expData)
```

---

GetRegulatedNodes      *get regulated nodes*

---

### Description

This function will compute the nodes regulated by the given hypothesis gene and write the results to a file

### Usage

```
GetRegulatedNodes(PPIInet, Expressiondata, delta, hypothesisGene = "",
  signOfHypothesis = 1, outputfile = "")
```

### Arguments

PPIInet	a protein-protein interaction network
Expressiondata	a table of observed gene expression data
delta	the number of edges to follow along the network. This should typically be between 1 and 5 dependent on network size/topology
hypothesisGene	the name of the hypothesis gene
signOfHypothesis	the sign of action expected from the hypothesis, +1 for up regulation, -1 for down
outputfile	the file to which the results should be written

### Value

Nodes regulated by hypothesis gene

---

GetRowAndColumnSumValues  
*get row and column sum values*

---

### Description

Returns the possible values of r+, r-, c+ and c- (the column and row sum values) following page 6 of Assessing statistical significance in causal graphs (Chindelevitch et. al)

### Usage

```
GetRowAndColumnSumValues(predictionListStats, experimentalResultStats)
```

**Arguments**

- predictionListStats  
a vector containing the number of positive, negative, or non-significant/contradictory predictions (q+, q- and q0)
- experimentalResultStats  
a vector containing the number of positive, negative, or non-significant/contradictory observations (n+, n- and n0)

**Value**

a matrix of row and sum values r+, r-, c+ and c-

**References**

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

---

GetScoreForNumbersOfCorrectandIncorrectPredictions

*returns the score for a given number of correct and incorrect predictions*

---

**Description**

Returns the score based on the values of n++, n+-, n-+ and n--

**Usage**

GetScoreForNumbersOfCorrectandIncorrectPredictions(matrixRow)

**Arguments**

- matrixRow a row of a matrix of correct and incorrect prediction scores

**Value**

the corresponding score for the given row

---

`GetScoresWeightsMatrix`*get scores weight matrix*

---

**Description**

Computes the score and weight for a network/set of experimental data based on the table containing possible values of n++, n+-, n-+ and n-.

**Usage**

```
GetScoresWeightsMatrix(matrixOfPossibleValues, predictionDataStats,  
    experimentalDataStats, logOfFactorialOfPredictionListStats)
```

**Arguments**

`matrixOfPossibleValues`

values of n++, n+-, n-+ and n- that need to be assessed

`predictionDataStats`

a table of predicions

`experimentalDataStats`

a table of observed experimental data

`logOfFactorialOfPredictionListStats`

a vector containing the log of the factorial value for each entry in predictionList-Stats

**Value**

a matrix containing scores and logs of the weights

---

`GetScoresWeightsMatrixByCubicAlg`*get scores weights matrix by the cubic algorithm*

---

**Description**

Implements the cubic algorithm as described on pages 6 and 7 of Assessing statistical significance in causal graphs, Chindelevitch et al. 2012

**Usage**

```
GetScoresWeightsMatrixByCubicAlg(predictionListStats, experimentalDataStats,  
    epsilon)
```

**Arguments**

predictionListStats  
a vector containing the values q+, q- and q0

experimentalDataStats  
a vector containing the values n+, n- and n0

epsilon  
the algorithms tolerance epsilon

**Value**

a matrix containing the ternary dot product distribution

**References**

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

---

GetSetOfDifferentiallyExpressedGenes  
*get set of differentially expressed genes*

---

**Description**

Gets the set of differentially expressed genes in the results, G+ as defined by in Causal reasoning on biological networks: Interpreting transcriptional changes, L Chindelevitch et al.

**Usage**

```
GetSetOfDifferentiallyExpressedGenes(results)
```

**Arguments**

results  
a table of results

**Value**

a matrix of differentially expressed genes

**References**

L Chindelevitch et al. Causal reasoning on biological networks: Interpreting transcriptional changes. Bioinformatics, 28(8):1114-21, 2012.

---

GetSetOfSignificantPredictions  
*get set of significant predictions*

---

**Description**

Gets the set of positive and negative predictions, the combination of the sets Sh+ and Sh- in Causal reasoning on biological networks: Interpreting transcriptional changes, L Chindelevitch et al.

**Usage**

GetSetOfSignificantPredictions(predictions)

**Arguments**

predictions      a table of predictions

**Value**

a matrix of positive and negative predictions

**References**

L Chindelevitch et al. Causal reasoning on biological networks: Interpreting transcriptional changes. *Bioinformatics*, 28(8):1114-21, 2012.

---

GetShortestPathsFromCCG  
*get shortest paths from CCG*

---

**Description**

Gets the node names in the shortest path from one node in a CCG to another

**Usage**

GetShortestPathsFromCCG(network, hypothesisnode, targetnode,  
 showbothdirs = FALSE, display = TRUE)

**Arguments**

network	built from iGraph
hypothesisnode	hypothesis node ID
targetnode	target node ID
showbothdirs	where multiple paths from a positive and negative node, FALSE returns only the shortest. Otherwise both are returned.
display	if true, echo the resulting paths to the screen

**Value**

a list of vectors containing the nodes of individual paths

**Examples**

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
cgg = CreateCCG(network)
hypothesisnode = 1
targetnode = 10
GetShortestPathsFromCCG (cgg, hypothesisnode, targetnode)
```

---

GetWeightForNumbersOfCorrectandIncorrectPredictions

*get weight for numbers of correct and incorrect predictions*

---

**Description**

Gets the weight based on the values of n++, n+-, n-+ and n--.

**Usage**

```
GetWeightForNumbersOfCorrectandIncorrectPredictions(n_pp, n_pm, n_mp, n_mm,
  predictionDataStats, experimentalDataStats,
  logOfFactorialOfPredictionListStats, returnlog = FALSE)
```

**Arguments**

n_pp	the contingency table entry n++
n_pm	the contingency table entry n+-
n_mp	the contingency table entry n-+
n_mm	the contingency table entry n--
predictionDataStats	prediction data statistics
experimentalDataStats	experimental data statistics
logOfFactorialOfPredictionListStats	log of factorial of prediction list stats
returnlog	true if the result should be returned as a log

**Value**

none



---

GetWeightsAboveHypothesisScoreAndTotalWeights  
*get weights above hypothesis score and total weights*

---

**Description**

Gets the score based on the values of n++, n+-, n-+ and n--. Used as part of a p-value calculation.

**Usage**

```
GetWeightsAboveHypothesisScoreAndTotalWeights(r_p, r_m, c_p,
predictionListStats, experimentalDataStats,
logOfFactorialOfPredictionListStats, hypothesisScore, logepsDMax, logDMax)
```

**Arguments**

r_p	the row sum r+
r_m	the row sum r-
c_p	the column sum c+
predictionListStats	statistics for the prediction list
experimentalDataStats	statistics for the experimental data
logOfFactorialOfPredictionListStats	log of factorial of prediction list stats
hypothesisScore	the hypothesis score to be considered
logepsDMax	Exponential of logD Maximum value
logDMax	A logD Maximum value

**Value**

score data

---

GetWeightsAboveHypothesisScoreForAThreeByTwoTable  
*updates weights for contingency table and produce values for p-value calculation*

---

**Description**

Finds the D-Values (weights) from any 3x2 contingency tables that have a score above and including the hypothesis score. It also calculates the total weight, and returns a 2x1 vector of the two values. The ratio of these values is the p-value.

**Usage**

```
GetWeightsAboveHypothesisScoreForAThreeByTwoTable(weights, r_p, r_m, r_z, n_p,
  n_m, predictionListStats, experimentalDataStats,
  logOfFactorialOfPredictionListStats, hypothesisScore, logepsDMax, logDMax)
```

**Arguments**

weights	Weights
r_p	the row sum r+
r_m	the row sum r-
r_z	the row sum r0
n_p	the column sum n+
n_m	the column sum n-
predictionListStats	a list of prediction statistics
experimentalDataStats	the observed experimental data
logOfFactorialOfPredictionListStats	log factorial's of prediction list stats
hypothesisScore	the hypothesis score to be considered
logepsDMax	log of epsilon logD Maximum value
logDMax	a logD Maximum value

**Value**

a vector containing the hypothesis score and the total weight

---

```
GetWeightsFromInteractionInformation
  get weights from interaction information
```

---

**Description**

Returns a matrix of weights (-1,0,+1) indicating the direction of regulation from the interaction information.

**Usage**

```
GetWeightsFromInteractionInformation(interactionInfo)
```

**Arguments**

interactionInfo	a central column of the .sif file, giving the type of edge interaction
-----------------	--

**Value**

a matrix of weights corresponding the the direction of regulation

---

MakePredictions	<i>make predictions</i>
-----------------	-------------------------

---

**Description**

Creates a matrix of predictions for a particular hypothesis. The output is an array containing the relationship between each node and the hypothesis. The hypothesis provided will be the vertex id of one of the nodes in the network (as an integer node ID or name, including + or - for up/down regulation in the case of a CCG). The signOfHypothesis variable should be a 1 or -1, indicating up/down regulation.

**Usage**

```
MakePredictions(hypothesisnode, signOfHypothesis, network, delta,  
nodesInExperimentalData = NULL)
```

**Arguments**

**hypothesisnode** the node in the causal graph from which predictions should be made. Can be either a (numerical) node ID or a (string) node name.

**signOfHypothesis** whether the hypothesis node is up- or down-regulated. Should be +1 or -1.

**network** a (Computational) Causal Graph, as an igraph.

**delta** the distance to search within the causal graph.

**nodesInExperimentalData** optional. Nodes to include in the output. Should be a list of node IDs.

**Value**

a matrix of predictions for the given particular hypothesis

**Examples**

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")  
ccg <- CreateCCG(network)  
predictions <- MakePredictions("NodeA", +1, ccg, 2)
```

---

MakePredictionsFromCCG

*make predictions from CCG*

---

### Description

Create a matrix of predictions for a particular hypothesis starting from a network with separate nodes for up- and down-regulation (+ve and -ve). The output is an array containing the relationship between each node and the hypothesis. The hypothesis provided will be the vertex id of one of the nodes in the network (as an integer or name including + or - for up/down regulation). The `signOfHypothesis` variable should be a 1 or -1, indicating up/down regulation. (It generally shouldn't be necessary to reverse the sign of a node when working from a CCG, but this facility is included for consistency with `MakePredictionsFromCG`)

### Usage

```
MakePredictionsFromCCG(hypothesisnode, signOfHypothesis, network, delta,  
  nodesInExperimentalData = NULL)
```

### Arguments

`hypothesisnode` a hypothesis node  
`signOfHypothesis`  
the direction of change of hypothesis node  
`network` a computational causal graph  
`delta` the number of edges across which the hypothesis should be followed  
`nodesInExperimentalData`  
the number of nodes in experimental data

### Value

an matrix containing the relationship between each node and the hypothesis

### Examples

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")  
ccg <- CreateCCG(network)  
MakePredictionsFromCCG("NodeA", +1, ccg, 2)
```

---

OrderHypotheses	<i>order hypotheses</i>
-----------------	-------------------------

---

**Description**

Ranks the hypotheses. Takes a matrix containing the scores for each node of the network, and ranks them placing the hypothesis with the most correct predictions is at the top

**Usage**

```
OrderHypotheses(scoresMatrix)
```

**Arguments**

`scoresMatrix` a matrix containing the scores for each node of the network

**Value**

a ranked table of hypotheses

---

PlotGraphWithNodeNames	<i>plot graph with node names</i>
------------------------	-----------------------------------

---

**Description**

Plots an igraph with the node names. Plots a igraph to the screen displaying the names of the nodes input rather than R's internal numbering.

**Usage**

```
PlotGraphWithNodeNames(igraph)
```

**Arguments**

`igraph` internal an igraph representation of an interaction network

**Value**

network visualisation

**Examples**

```
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
ccg <- CreateCCG(network)
PlotGraphWithNodeNames(ccg)
```

---

PopulateTheThreeByThreeContingencyTable  
*populate the three-by-three contingency table*

---

### Description

Populates 3x3 signed contingency table of expected versus observed changes. Given the values of n++, n+-, n-+ and n--, calculates n0+, n0-, n+0, n-0 and n00. Notation from Chindelevitch et al. Causal reasoning on biological networks Bioinformatics (2012) paper.

### Usage

```
PopulateTheThreeByThreeContingencyTable(n_pp, n_pm, n_mp, n_mm,
predictionDataStats, experimentalDataStats)
```

### Arguments

n_pp	n++ contingency table entry
n_pm	n+- contingency table entry
n_mp	n-+ contingency table entry
n_mm	n-- contingency table entry
predictionDataStats	a prediction data table.
experimentalDataStats	an experimental data table

### Value

Vector of calculated values for n0+, n0-, n+0, n-0 and n00 - See: Chindelevitch et al. Bioinformatics (2012).

---

PopulateTwoByTwoContingencyTable  
*Populate Two by Two Contingency Table*

---

### Description

Calculates a 2x2 contingency table. Given the value of n++ and the row and column sums (r+, r-, c+, c-), Calculates the remaining values in the 2x2 contingency table i.e. n+-, n-+, and n--. See Chindelevitch et al. BMC Bioinformatics (2012) paper 'Assessing Statistical significance of causal graphs' for clarification on notation.

### Usage

```
PopulateTwoByTwoContingencyTable(rowAndColumnSumValues, n_pp)
```

**Arguments**

rowAndColumnSumValues  
the row and column sums (r+, r-, c+, c-).

n\_pp  
the value of n++.

**Value**

the completed 2x2 contingency table: n++, n+-, n-+, n-

**References**

L Chindelevitch et al. Causal reasoning on biological networks: Interpreting transcriptional changes. *Bioinformatics*, 28(8):1114-21, 2012.

---

ProcessExperimentalData  
*process experimental data*

---

**Description**

Processes experimental data to get it into the correct form for scoring. The node names that are read in as strings acquire an internal id when the network is created. This function will replace the node name with its id.

**Usage**

```
ProcessExperimentalData(experimentalData, network)
```

**Arguments**

experimentalData  
input experimental data.

network  
an input interaction network.

**Value**

processed experimental data formatted ready for scoring

---

RankTheHypotheses      *rank the hypotheses*

---

## Description

Rank the hypotheses in the causal network

## Usage

```
RankTheHypotheses(network, experimentalData, delta, epsilon = 1e-05,
  useCubicAlgorithm = TRUE, use1bAlgorithm = TRUE, symmetricCCG = TRUE,
  listOfNodes = NULL, correctPredictionsThreshold = -Inf)
```

## Arguments

network	Computational Causal Graph, as an <code>igraph</code> .
experimentalData	The experimental data read in using <a href="#">ReadExperimentalData</a> . The results is an $n \times 2$ matrix; where the first column contains the node ids of the nodes in the network that the results refer to. The second column contains values indicating the direction of regulation in the results - (+)1 for up, -1 for down and 0 for insignificant amounts of regulation.
delta	Distance to search within the causal graph.
epsilon	The threshold that is used when calculating the p-value using the cubic algorithm (see "Assessing statistical significance in causal graphs").
useCubicAlgorithm	An indicator specifying which algorithm will be used to calculate the p-value. The default is set as <code>useCubicAlgorithm = TRUE</code> which uses the cubic algorithm. If this value is set as <code>FALSE</code> , the algorithm will use the much slower quartic algorithm which does compute the exact answer, as opposed to using approximations like the cubic algorithm.
use1bAlgorithm	An indicator specifying whether the 1a or 1b (default, faster) variant of the cubic algorithm described in Chindelevitch's paper will be used to calculate the p-value.
symmetricCCG	This flag specifies whether the CCG is assumed to be symmetric. The value is set as <code>TRUE</code> as a default. If this is the case the running time of the algorithm is reduced since the bottom half of the table can be filled in using the results of calculations performed earlier.
listOfNodes	A list of nodes specified by the user. The algorithm will only calculate and store the results for the nodes in the specified list. The default value is <code>NULL</code> ; here the algorithm will calculate and store results for all the nodes in the network.
correctPredictionsThreshold	A threshold on the number of correct predictions for a given hypothesis. If a hypothesis produces fewer correct predictions than <code>predictionsThreshold</code> then the algorithm will not calculate the two p-values. Instead "NA" will be displayed in



the final two columns of the corresponding row of the results table. As a default correctPredictionsThreshold is set as -Inf, so that the p-values are calculated for all specified hypotheses.

**Value**

A data frame containing the results of the algorithm.

**References**

L Chindelevitch et al. Assessing statistical significance in causal graphs. BMC Bioinformatics, 13(35), 2012.

**Examples**

```
#get path to example network file
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
#create ccg
ccg <- CreateCCG(network)
#get path to example experimental data
fileName<- system.file(package="CausalR", "extdata", "testData.txt")
#read in experimental data
expData<- ReadExperimentalData(fileName, ccg)
RankTheHypotheses(ccg, expData, 2)
```

---

ReadExperimentalData *read experimental data*

---

**Description**

Reads experimental data for the causal reasoning algorithm from a text file.

**Usage**

```
ReadExperimentalData(fileName, network, removeDuplicates)
```

**Arguments**

fileName	a file containing the experimental data (text file format)
network	a (Computational) Causal Graph, as an igraph.
removeDuplicates	Optional, defaults to true. Remove duplicated nodes the experimental file (i.e. where the result for a node is repeated, use the first value given only; the alternative is to return a result which contains multiple rows for this node).

**Value**

(n x 2) matrix of nodes and direction of regulation. The first column of the matrix contains the node IDs from the network, and the second contains the experimental values.

**Examples**

```
#get path to example network file
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
##create ccg
ccg <- CreateCCG(network)
#get path to example experimental data
fileName<- system.file(package="CausalR", "extdata", "testData.txt")
ReadExperimentalData(fileName, ccg)
```

---

ReadSifFileToTable     *read .sif to Table*

---

**Description**

Reads a .sif file into a table in R

**Usage**

```
ReadSifFileToTable(sifFile)
```

**Arguments**

sifFile            the sifFile to be read in

**Value**

a R table containing the data from the .sif file

---

RemoveIDsNotInExperimentalData  
                                   *remove IDs not in experimental data*

---

**Description**

Takes in a list of connected nodes and removes those not in the experimental data.

**Usage**

```
RemoveIDsNotInExperimentalData(connectedNodes, nodesInExperimentalData)
```

**Arguments**

connectedNodes    a list of connected nodes  
 nodesInExperimentalData  
                                   a list of nodes in the experimental data

**Value**

connectedNodesInExperimentalData a list of connected nodes with the redundant nodes removed

---

runRankHypothesis      *run rank the hypothesis*

---

**Description**

A top level function that used to run CausalR

**Usage**

```
runRankHypothesis(PPIInet, Expressiondata, delta, correctPredictionsThreshold)
```

**Arguments**

PPIInet              PPIInet is the PPI interaction file

Expressiondata    observed gene expression data

delta                the number of links to follow from any hypothesis no. Dedepending on network size/topology, this value typically ranges between 1 and 5

correctPredictionsThreshold

Minimal score for p-values calculation. Hypotheses with scores below this value will get NAs for p-value and enrichment p-value. The usual default is -inf within the RankTheHypotheses function, where it is employed.

**Value**

rankedHypothesis table of results produced by the algorithm

---

runSCANR              *run ScanR*

---

**Description**

This function will return nodes regulated by the given hypothesisGene

**Usage**

```
runSCANR(PPIInet, Expressiondata, NumberOfDeltaToScan = 5, topNumGenes = 150,  
correctPredictionsThreshold = 1)
```

**Arguments**

**PPInet**            PPInetwork  
**Expressiondata**   Expressiondata  
**NumberOfDeltaToScan**  
                          Iteratively scan for 1 to NumberOfDeltaToScan delta values  
**topNumGenes**      A value to select top genes to report (typically top 100 genes)  
**correctPredictionsThreshold**  
                          Minimal score for p-values calculation. Hypotheses with scores below this value will get NAs for p-value and enrichment p-value. The usual default is -inf within the RankTheHypotheses function, where it is employed.

**Value**

returns list of genes from each delta scan run

**Examples**

```

NumberOfDeltaToScan=2
topNumGenes=4
correctPredictionsThreshold=1
expData<- system.file(package="CausalR", "extdata", "testData.txt")
network <- system.file(package="CausalR", "extdata", "testNetwork.sif")
runSCANR(network, expData,NumberOfDeltaToScan,topNumGenes, correctPredictionsThreshold)

```

---

ScoreHypothesis            *score hypothesis*

---

**Description**

Score a single hypothesis, using the predictions from the network and the experimental data returning a vector of scoring statistics

**Usage**

```
ScoreHypothesis(matrixOfPredictions, matrixOfExperimentalData)
```

**Arguments**

**matrixOfPredictions**  
                          a matrix of predictions  
**matrixOfExperimentalData**  
                          a matrix of experimentaldata

**Value**

scoreBreakdown a vector giving, in order, the overall score, and the numbers of correct, incorrect and ambiguous predictions

**Examples**

```
predictions <- matrix(c(1,2,3,+1,0,-1),ncol=2)
experimentalData <- matrix(c(1,2,4,+1,+1,-1),ncol=2)
ScoreHypothesis(predictions,experimentalData)
CompareHypothesis(predictions,experimentalData)
```

---

ValidateFormatOfDataTable

*validate format of the experimental data table*

---

**Description**

Checks the format of the experimental data. This is expected to be two columns, the first containing the gene name and the second the direction of regulation, -1, 0 or 1. The function checks the number of columns and the values of the second column,

**Usage**

```
ValidateFormatOfDataTable(dataTable)
```

**Arguments**

dataTable      the data table to be tested

**Value**

true if the data table is valid

---

ValidateFormatOfTable *validate format of table*

---

**Description**

Checks the format of the loaded in data. In particular expects a table with threecolumns (in order) a initiating gene, an interaction ("Activates","Inhibits") and a responding gene and checks the number of rows and the values of the middle column.

**Usage**

```
ValidateFormatOfTable(dataTable)
```

**Arguments**

dataTable      the table to be tested

**Value**

true if the test is satisfied.

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