Package 'networkABC'

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Type Package

Title Network Reverse Engineering with Approximate Bayesian Computation

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Depends R (>= 3.0.0)

Imports RColorBrewer, network, sna

Suggests ggplot2, knitr, markdown, rmarkdown

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Description

We developed an inference tool based on approximate Bayesian computation to decipher network data and assess the strength of the inferred links between network's actors. It is a new multilevel approximate Bayesian computation (ABC) approach. At the first level, the method captures the global properties of the network, such as a scale-free structure and clustering coefficients, whereas the second level is targeted to capture local properties, including the probability of each couple of genes being linked. Up to now, Approximate Bayesian Computation (ABC) algorithms have been scarcely used in that setting and, due to the computational overhead, their application was limited to a small number of genes. On the contrary, our algorithm was made to cope with that issue and has low computational cost. It can be used, for instance, for elucidating gene regulatory network, which is an important step towards understanding the normal cell physiology and complex pathological phenotype. Reverse-engineering consists in using gene expressions over time or over different experimental conditions to discover the structure of the gene network in a targeted cellular process. The fact that gene expression data are usually noisy, highly correlated, and have high dimensionality explains the need for specific statistical methods to reverse engineer the underlying network.

NeedsCompilation yes

License GPL-3

Encoding UTF-8

Classification/MSC 62E17, 62F15, 62J07, 62P10, 92C42

LazyData true

VignetteBuilder knitr

URL https://fbertran.github.io/networkABC/,
https://github.com/fbertran/networkABC/

BugReports https://github.com/fbertran/networkABC/issues/

RoxygenNote 7.2.1

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abc *ABC algorithm for network reverse-engineering*

Description

ABC algorithm for network reverse-engineering

Usage

```
abc(
  data,
  clust_coeffs = c(0.33, 0.66, 1),
  tolerance = NA,
  number_hubs = NA,
  iterations = 10,
```

```
  number_networks = 1000,
  hub_probs = NA,
  neighbour_probs = NA,
  is_probs = 1
)
```

Arguments

data	: Any microarray data in the form of a matrix (rows are genes and columns are time points)
clust_coeffs	: one dimensional array of size clust_size of clustering coefficients (these clustering coefficient are tested in the ABc algorithm).
tolerance	: a real value based for the tolerance between the generated networks and the reference network
number_hubs	: number of hubs in the network
iterations	: number of times to repeat ABC algorithm
number_networks	: number of generated networks in each iteration of the ABC algorithm
hub_probs	: one-dimensional array of size number_genes for the each label to be in the role of a hub
neighbour_probs	: this is the matrix of neighbour probabilities of size number_nodes*number_nodes
is_probs	: this needs to be set either to one (if you specify hub_probs and neighbour_probs) or to zero (if neither probabilities are specified). Warning: you should specify both hub_probs and neighbour_probs if is_probs is one. If is_prob is zero these arrays should simply indicate an array of a specified size..

Examples

```
M<-matrix(rnorm(30),10,3)
result<-abc(data=M)
```

---

clusteringCoefficient *Calculate the clustering coefficient*

Description

Calculate the clustering coefficient for an adjacency matrix. By default, the local clustering coefficient is calculated. From the PCIT package after it was archived on the CRAN.

Usage

```
clusteringCoefficient(adj, FUN = "localClusteringCoefficient", ...)
```

Arguments

adj	An adjacency matrix. Calculating the clustering coefficient only makes sense if some connections are zero i.e. no connection.
FUN	The function for calculating the clustering coefficient.
...	Arguments to pass to FUN

Value

The clustering coefficient(s) for the adjacency matrix.

Author(s)

Nathan S. Watson-Haigh

See Also

localClusteringCoefficient

Examples

```
clusteringCoefficient(network_gen(50,.33)$network)
```

---

localClusteringCoefficient

Calculate the local clustering coefficient

Description

Calculate the local clustering coefficient for each node in an adjacency matrix. The clustering coefficient is defined as the proportion of existing connections from the total possible (Watts and Strogatz, 1998).

Usage

```
localClusteringCoefficient(adj)
```

Arguments

adj	An adjacency matrix. Calculating the clustering coefficient only makes sense if some connections are zero i.e. no connection.

Value

A vector of local clustering coefficients for each node/gene of the adjacency matrix.

Author(s)

Nathan S. Watson-Haigh

References

D.J. Watts and S.H. Strogatz. (1998) Collective dynamics of 'small-world' networks. Nature. 393(6684). 440-442.

See Also

clusteringCoefficient

Examples

```
localClusteringCoefficient(network_gen(50,.33)$network)
```

`netsimul` *Simulated network*

Description

Result of the use of the `network_gen` function.

Usage

```
netsimul
```

Format

A list of three objects :

number_genes The number of genes in the network

clust_coef The clustering coefficient

network The simulated network

`networkABC` *networkABC*

Description

An inference tool based on approximate Bayesian computations to decipher network data and assess the strength of their inferred links.

References

networkABC: An inference tool for networks based on approximate Bayesian computation, Myriam Maumy-Bertrand, Frédéric Bertrand, preprint.

network_gen *Random scale-free network generation. This function is used intensively in the abc function.*

Description

Generate random network topology

Usage

```
network_gen(number_genes, clust_coef)
```

Arguments

number_genes	A number
clust_coef	A number

Value

A list with the number of of genes, the targeted clustering coefficient and the resulting network

Examples

```
network_gen(10,1)
```

resabc *Result of an ABC inference*

Description

Result for the reverse engineering of a simulated Cascade network

Usage

```
resabc
```

Format

A list of 14 objects :

data : The microarray data used, rows are genes and columns are time points.)

ngenes : The number of genes.)

ntimes : The number of timepoints)

clust_size : the size of clusters

clust_coeffs : the clustering coefficient

tolerance : the tolerance between the generated networks and the reference network

number_hubs : number of hubs in the network

iterations : number of times to repeat ABC algorithm

number_networks : number of generated networks in each iteration of the ABC algorithm

hub_probs : one-dimensional array of size number_genes for the each label to be in the role of a hub

neighbour_probs : matrix of neighbour probabilities of size number_nodes*number_nodes

is_probs : is equal to 1 since hub_probs and neighbour_probs were specified

---

`showHp` *Plot for the hub probabilities*

Description

Plot for the hub probabilities ; there is one probability for each node in the network.

Usage

```
showHp(result)
```

Arguments

`result`	: The result of the abc algorithm.

Examples

```
data(resabc)
showHp(resabc)
```

`showNetwork` *Plot the final network.*

Description

Plot the final network.

Usage

```
showNetwork(res, min_prob)
```

Arguments

`res`	: The result of the abc algorithm.
`min_prob`	: numeric ; under this probabilitie value, the link between two genes is set to 0.

Examples

```
data(resabc)
showNetwork(resabc,.2)
```

---

showNp *Plot for the neighbourhood probabilities*

Description

Plot for the neighbourhood probabilities ; there is one probability for each pair of node in the network.

Usage

```
showNp(result)
```

Arguments

result	: The result of the abc algorithm.

Examples

```
data(resabc)
showNp(resabc)
```

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