Package 'EcoNetGen'

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Title Simulate and Sample from Ecological Interaction Networks

Description Randomly generate a wide range of interaction networks with specified size, average degree, modularity, and topological structure. Sample nodes and links from within simulated networks randomly, by degree, by module, or by abundance. Simulations and sampling routines are implemented in 'FORTRAN', providing efficient generation times even for large networks. Basic visualization methods also included. Algorithms implemented here are described in de Aguiar et al. (2017) <arXiv:1708.01242>.

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URL https://github.com/cboettig/EcoNetGen

BugReports https://github.com/cboettig/EcoNetGen/issues

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R topics documented:

`adj_plot` *Plot network adjacency matrix*

Description

Plot network adjacency matrix

Usage

```
adj_plot(graph)
```

Arguments

`graph`	an igraph object

Examples

```
set.seed(12345)
graph <- netgen()
adj_plot(graph)
```

`netgen` *netgen*

Description

Randomly generate a wide range of interaction networks

Usage

```
netgen(net_size = 50, ave_module_size = 10, min_module_size = 6,
  min_submod_size = 1, net_type = c("mixed", "random", "scalefree",
  "nested", "bi-partite nested", "bi-partite random",
  "tri-trophic bipartite nested-random",
  "tri-trophic bipartite nested-bipartite nested", "bn", "br", "tt-bn-r",
  "tt-bn-bn"), ave_degree = 5, rewire_prob_global = 0.2,
  rewire_prob_local = 0, mixing_probs = c(0.2, 0.2, 0.2, 0.2, 0.2, 0,
  0), verbose = FALSE)
```

Arguments

net_size	network size (number of nodes)
ave_module_size	average module size
min_module_size	cutoff for the minimum modules size
min_submod_size	cutoff for submodules, used only for bipartite and tripartite networks
net_type	network type, see details
ave_degree	average degree of connection
rewire_prob_global	probability any given edge should be rewired
rewire_prob_local	probability that edges within a module should be rewire locally (within the module)
mixing_probs	module probabilities for first 7 types, used for constructing mixed networks
verbose	logical, default TRUE. Should a message report summary statistics?

Details

network type is one of

- mixed
- random
- scalefree
- nested
- bi-partite nested (or short-hand "bn")
- bi-partite random (or short-hand "br")
- tri-trophic bipartite nested-random. (Can use short-hand "ttbnr")
- tri-trophic bipartite nested-bipartite nested (Can use short-hand "ttbnbn")

Valid Parameter Ranges

Please note that not all combinations of parameters will create valid networks. If an invalid combination is requested, `netgen()` will error with an informative message. A list of these constraints is provided below for reference.

1. `net_size >= ave_module_size`. If 'net_size = ave_module_size" the program generates a network with a single module.
2. `ave_module_size > min_module_size`
3. `ave_degree >= 1`. Preferably larger than 4, to ensure single component modules.
4. `rewire_prob_global = 0` produces completely uncoupled modules. To ensure a single component network use `rewire_prob_global > 0` and sufficiently large.
5. `rewire_prob_local = 0` produces idealized modules. Use `rewire_prob_local > 0` to add stochasticity to the modules.

6. For tripartite networks `min_module_size > min_submod_size`. This also implies `min_module_size >= 2`.
7. For scalefree networks (or mixed networks involving scalefree modules) `ave_degree < min_module_size`
8. For mixed networks `mixing_probs` need to sum to 1. If the sum is larger than one, only the first types, corresponding to `sum <=1`, will be sampled.

Value

an `igraph` object

Examples

```
library(EcoNetGen)

set.seed(12345)
net <- netgen()
adj_plot(net)
```

`netgen_v1` *netgen_v1*

Description

netgen function

Usage

```
netgen_v1(n_modav = c(50, 10), cutoffs = c(3, 0), net_type = 1,
  net_degree = 10, net_rewire = c(0.3, 0), mod_probs = c(0.2, 0.2,
  0.2, 0.2, 0.2, 0, 0), verbose = FALSE)
```

Arguments

`n_modav`	network size and average module size (integer vector, length 2)
`cutoffs`	module and submodule minimum sizes (integer vector, length 2). (submodules are used only for bipartite and tripartite networks)
`net_type`	integer indicating type, see details
`net_degree`	average degree of connection
`net_rewire`	global and local network rewiring probabilities
`mod_probs`	module probabilities for types 1 to 51, used for constructing mixed networks, net_type = 0
`verbose`	logical, default TRUE. Should a message report summary statistics?

Details

network type

- 0 = mixed
- 1 = random
- 2 = scalefree
- 3 = nested
- 41 = bi-partite nested
- 42 = bi-partite random
- 51 = tri-trophic bipartite nested-random "ttbnr"
- 52 = tri-trophic bipartite nested-bipartite nested "ttbnbn"

Value

an igraph object

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netsampler *Network Sampling Routine*

Description

Network Sampling Routine

Usage

```
netsampler(network_in, key_nodes_sampler = c("random", "lognormal",
  "Fisher log series", "exponential", "degree", "module"),
  neighbors_sampler = c("random", "exponential"), n_key_nodes = 10,
  n_neighbors = 0.5, hidden_modules = NULL, module_sizes = NULL,
  cluster_fn = igraph::cluster_edge_betweenness)
```

Arguments

network_in	input network (as igraph object)
key_nodes_sampler	sampling criteria for key nodes. See details.
neighbors_sampler	sampling criteria for neighbors. see details.
n_key_nodes	number of key nodes to sample.
n_neighbors	number of first neighbors or fraction of first neighbors. See details.
hidden_modules	list of the modules to exclude (max 10 modules; only the first numb_hidden are used)
module_sizes	integer vector giving the size of each module. see details.
cluster_fn	a clustering function, from igraph::cluster_*. Default is igraph::cluster_edge_betweeness. Only used to compute module sizes if not provided.

Details

Algorithm first samples n_key_nodes according the the requested `key_nodes_sampler` criterion. For each key node, the requested number or fraction of neighbors is then sampled according to the `neighbors_sampler` criterion. Optionally, a list of modules can be designated as "hidden" and will be excluded from sampling.

if `n_neighbors is greater than 1, assumes this is the number to sample. If` n_neighbors `is between 0 and 1,` to sample 100

Provide `module_sizes` list to improve performance. If not provided, this will will be calculated based on `igraph::cluster_edge_betweeness`. Be sure to provide a `module_sizes` vector whenever calling `netsampler` repeatedly on the same network to avoid unnecessary performance hit from recalculating modules every time. See examples.

Value

the original input network (as an igraph network object), with the attribute `label` added to the edges and vertices indicating if that edge or vertex was `sampled` or `unsampled`.

Examples

```
set.seed(12345)
net <- netgen()
sample <- netsampler(net)

## Precompute `module_sizes` for replicate sampling of the same network:
 library(igraph)
 modules <- cluster_edge_betweenness(as.undirected(net))
 module_sizes <- vapply(igraph::groups(modules), length, integer(1))
 sample <- netsampler(net, module_sizes = module_sizes)
```

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