

# Package ‘scenario’

February 17, 2016

**Type** Package

**Title** Construct Reduced Trees with Predefined Nodal Structures

**Version** 1.0

**Date** 2016-02-15

**URL** <https://github.com/swd-turner/scenario>

**Description** Uses the neural gas algorithm to construct a scenario tree for use in multi-stage stochastic programming. The primary input is a set of initial scenarios or realizations of a disturbance. The scenario tree nodal structure must be predefined using a scenario tree nodal partition matrix.

**License** GPL (>= 2)

**LazyData** yes

**Imports** graphics

**Suggests** knitr

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** CRAN

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buildtree	<i>Build a scenario tree with a predefined nodal structure.</i>
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### Description

Uses the neural gas method to build a scenario tree.

### Usage

```
buildtree(x, treeStruct, lambda_0 = 10, lambda_f = 0.01, e_0 = 0.5,
          e_f = 0.05, jMax = 40000, plot = TRUE)
```

### Arguments

x	Matrix of initial scenarios, realizations or ensemble members. Each column stores a scenario, with number of rows equal to number of time steps.
treeStruct	Matrix defining the nodal structure of the tree (see example). This is a scenario tree nodal partition matrix.
lambda_0	Upper neighbourhood range parameter. Default = 10.
lambda_f	Lower neighborhood range paramger. Default = 0.01.
e_0	Upper adaptation step parameter. Default = 0.5.
e_f	Lower adaptation step parameter. Default = 0.05.
jMax	Number of iterations. Default = 40000.
plot	logical. If TRUE (the default) the final tree is plotted.

### Value

Returns a list object containing the initial input scenarios, the input scenarios tree structure, the values of the final reduced scenario tree, and the tree branch probabilities at the end nodes.

### References

Xu, B., Zhong, P.A., Zambon, R.C., Zhao, Y., Yeh, W. (2015) Scenario tree reduction in stochastic programming with recourse for hydropower operations, *Water Resources Research*, 51, 6359-6380.

Dupacova, Jitka, Giorgio Consigli, and Stein W. Wallace. "Scenarios for multistage stochastic programs." *Annals of operations research* 100.1-4 (2000): 25-53.

### Examples

```
# Generate some 25 random realizations of length 4 and reduce to scenario tree.
scenarios <- matrix(rnorm(100),ncol=25)
treeStruct <- rbind(c(1, 1, 1, 1, 1),
                  c(2, 2, 7, 7, 11),
                  c(3, 5, 8, 8, 12),
                  c(4, 6, 9, 10, 13)
                  )
tree <- buildtree(scenarios, treeStruct, jMax = 1000)
```

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checktree	<i>Check the tree structure implied by a scenario tree nodal partition matrix.</i>
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**Description**

Returns a plot showing the nodal structure (not values) of a scenario tree defined using a scenario tree nodal partition matrix.

**Usage**

```
checktree(treeStruct)
```

**Arguments**

treeStruct      Matrix defining the nodal structure of the tree.

**Value**

Returns a plot of the scenario tree structure implied by the input nodal partition matrix.

**References**

Dupacova, Jitka, Giorgio Consigli, and Stein W. Wallace. "Scenarios for multistage stochastic programs." *Annals of operations research* 100.1-4 (2000): 25-53.

**Examples**

```
treeStruct <- rbind(c(1, 1, 1, 1, 1),
                   c(2, 2, 7, 7, 11),
                   c(3, 5, 8, 8, 12),
                   c(4, 6, 9, 10, 13)
                   )
checktree(treeStruct)
```

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scenario	<i>scenario: Construct reduced trees with a predefined nodal structures</i>
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**Description**

The `buildtree` function uses the neural gas method to generate a scenario tree of predefined nodal structure. The `checktree` function plots a scenario tree structure as defined by a nodal partition matrix.

## References

- Latorre, J.M., Cerisola, S. and Ramos, A. (2007) Clustering algorithms for scenario tree generation: Application to natural hydro flows, *European Journal of Operational Research*, 181, 1339-1353.
- Xu, B., Zhong, P.A., Zambon, R.C., Zhao, Y., Yeh, W. (2015) Scenario tree reduction in stochastic programming with recourse for hydropower operations, *Water Resources Research*, 51, 6359-6380.
- Dupacova, Jitka, Giorgio Consigli, and Stein W. Wallace. "Scenarios for multistage stochastic programs." *Annals of operations research* 100.1-4 (2000): 25-53.

## Examples

```
# TEST BY GENERATING SCENARIOS FROM KNOWN CENTROIDS AND THEN
# COMPARING FIT BETWEEN THE GENERATED TREE AND INTIAL CENTROIDS.

# 1. Generate scenarios with known centroids:

centroids <- cbind(c(0,2,3), c(0,2,1), c(0,-2,-3),c(0,-2,-1))
matplot(centroids, type="l", lwd = 3, col = "black", lty = 3)
scenarios <- matrix(rep(centroids,5), ncol=20) + matrix(rnorm(60,0,0.25),ncol=20)
matlines(scenarios, col = "grey")

# 2. Assign and check nodal structure for tree:

treeStruct <- rbind(c(1,1,1,1),
                  c(2,2,5,5),
                  c(3,4,6,7))
checktree(treeStruct)

# 3. Build scenario tree:

tree <- buildtree(scenarios, treeStruct, jMax = 1000)

#4. Compare original centroids

matlines(centroids,lwd = 3, col = "black", lty = 3)
# Improved convergence is achieved by increasing the number of iterations, jMax.
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