

Package ‘HOasso’

May 7, 2026

Type Package

Title Higher Order Assortativity for Complex Networks

Version 1.0.1

Date 2023-09-07

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Description Allows to evaluate Higher Order Assortativity of complex networks defined through objects of class 'igraph' from the package of the same name. The package returns a result also for directed and weighted graphs. References, Arcagni, A., Grassi, R., Stefani, S., & Torriero, A. (2017) <doi:10.1016/j.ejor.2017.04.028> Arcagni, A., Grassi, R., Stefani, S., & Torriero, A. (2021) <doi:10.1016/j.jbusres.2019.10.008> Arcagni, A., Cerqueti, R., & Grassi, R. (2023) <doi:10.48550/arXiv.2304.01737>.

Depends igraph, Rdpack

RdMacros Rdpack

License GPL (>= 2)

Encoding UTF-8

NeedsCompilation no

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Repository CRAN

Date/Publication 2023-09-07 08:40:10 UTC

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HOasso

*Evaluates Higer Order Assortativity of complex networks***Description**

The function evaluates Higer Order Assortativity of complex networks represented by objects of class `igraph` from the package of the same name.

Usage

```
HOasso(
  g,
  h = 1,
  weighted = is.weighted(g),
  x = c("sout", "dout", "lout", "sin", "din", "lin"),
  y = c("sin", "din", "lin", "sout", "dout", "lout")
)

## S3 method for class 'assortativity'
plot(x,
     type = "h",
     ylim = c(-1, 1),
     xlab = "Orders",
     ylab = "Assortativity",
     ...
)

## S3 method for class 'assortativity'
print(x, ...)
```

Arguments

<code>g</code>	an object of class <code>igraph</code> with two columns, listing the dominances, by rows.
<code>h</code>	an integer value, the function will evaluates the assortativity from the order 1 to the order <code>h</code> .
<code>weighted</code>	logical, if to use the weighted matrix to create the trasnition probabilities.
<code>x</code>	In case of the <code>HOasso</code> function the first centrality measure, out-strength by default, see details. An object of class <code>assortativity</code> in case of the <code>print</code> and <code>plot</code> functions
<code>y</code>	The second centrality measure, in-strength by default, see details.
<code>type</code>	Type of plot, histogram-like vertical lines by default.
<code>xlab</code>	A label for the x axis, <code>Orders</code> by default.
<code>ylab</code>	A label for the x axis, <code>Assortativity</code> by default.
<code>ylim</code>	The y limits of the plot, the assortativity index can assume only values between -1 and 1.
<code>...</code>	Other arguments of the <code>plot.default</code> or the <code>print.default</code> functions.

Details

Arguments `x` and `y` are character objects and can assume values "sout", "dout", "lout", "sin", "din", "lin" representing the out-strength, out-degree, out-log-strength, in-strength, in-degree, and in-log-strength respectively.

In case of undirected graphs in- and out- centrality measures are equal. In case of unweighted graphs the strength is equal to the degree.

The function returns an object of class `assortativity` subclass of a numeric vector.

`plot.assortativity` is identical to `plot.default` but with different defaults in order to get a plot coherent with the assortativity index.

`print.assortativity` is a method to show the assortativity values and the order side by side.

Value

A vector `h` long containing the assortativity measures from the order 1 to the order `h`.

References

Arcagni A, Grassi R, Stefani S, Torriero A (2017). "Higher order assortativity in complex networks." *European Journal of Operational Research*, **262**(2), 708–719. doi:10.1016/j.ejor.2017.04.028.

Arcagni A, Grassi R, Stefani S, Torriero A (2021). "Extending assortativity: An application to weighted social networks." *Journal of Business Research*, **129**, 774–783. doi:10.1016/j.jbusres.2019.10.008.

Arcagni A, Cerqueti R, Grassi R (2023). "Higher order assortativity for directed weighted networks and Markov chains." *arXiv preprint arXiv:2304.01737*. doi:10.48550/arXiv.2304.01737.

Examples

```
g <- graph_from_data_frame(data.frame(
  from = c("i", "j", "j", "k", "l"),
  to   = c("k", "k", "l", "l", "i"),
  weight = c(10, 5, 2, 3, 2)
))
E(g)$label <- E(g)$weight
a <- HOasso(g, h = 10)
print(a)
plot(a, lwd = 3, panel.first = abline(h = 0, lty = 2))
```

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