Package ‘steepness’

February 20, 2015

Version 0.2-2
Date 2014-29-09
Title Testing Steepness of Dominance Hierarchies
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Depends R (>= 3.1.0)
Description steepness is a package that computes steepness as a property of dominance hierarchies. Steepness is defined as the absolute slope of the straight line fitted to the normalized David’s scores. The normalized David’s scores can be obtained on the basis of dyadic dominance indices corrected for chance or by means of proportions of wins. Given an observed sociomatrix, it computes hierarchy’s steepness and estimates statistical significance by means of a randomization test.
License GPL (>= 2)
NeedsCompilation yes
Repository CRAN
Date/Publication 2014-10-01 07:28:10

R topics documented:

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Description

Steepness is a package that computes steepness as a property of dominance hierarchies. Steepness is defined as the absolute slope of the straight line fitted to the normalized David’s scores. The normalized David’s scores can be obtained on the basis of dyadic dominance indices corrected for chance or from the matrix of win proportions. Given an observed sociomatrix, it computes hierarchy’s steepness and estimates statistical significance by means of a randomization test (see de Vries, Stevens and Vervaecke, 2006).

Details

Package: steepness
Version: 0.2-2
Date: 2014-29-09
Depends: >= 3.1.0
License: GPL version 2 or newer

Index:

- getDij: Dyadic dominance index corrected for chance
- getDS: David’s scores
- getNormDS: Normalized David’s scores
- getOrderedMatrix: Ordered matrix according to NormDS values
- getPij: Matrix of proportions of wins
- getStp: Hierarchy’s steepness measure
- getwl: Several win and loss measures at individual level
- steeptest: Statistical significance for steepness statistic

Author(s)

David Leiva <dleivaur@ub.edu> & Han de Vries <J.deVries1@uu.nl>.
Maintainer: David Leiva <dleivaur@ub.edu>

References


See Also

For more information see: getDij, getDS, getNormDS, getOrderedMatrix, getPij, getStp, getwl, steeptest.
getDij

Dyadic dominance index corrected for chance -Dij-

Description
Function to obtain matrix of dyadic dominance indices corrected for chance from the observed sociomatrix.

Usage
getDij(X, names=NULL)

Arguments
X
Empirical sociomatrix containing wins-losses frequencies in dyadic encounters.

names
Character vector with the names of individuals. This vector is NULL by default

Details
getDij is only applied for square matrices in which the set of \( n \) actors is also the set of \( n \) partners. The matrices must also be numeric.

Value
Dij
Matrix of observed dyadic dominance indices corrected for chance.

Author(s)
David Leiva <dleiva@ub.edu> & Han de Vries <J.devries@uu.nl>.

References

See Also
steeptest.

Examples

# Example taken from Vervaecke et al. (2007):
X <- matrix(c(0, 58, 50, 61, 32, 37, 29, 29, 25, 8, 0, 22, 22, 9, 27, 20, 10, 48, 3, 3, 0, 19, 29, 12, 13, 19, 25, 5, 25, 9, 0, 33, 38, 35, 32, 57, 4, 7, 9, 1, 0, 28, 26, 16, 23, 4, 3, 0, 6, 0, 7, 6, 12,)}
getDS

Description

Function to obtain David’s scores from the observed sociomatrix.

Usage

getDS(X, names=NULL, method=c("Dij","Pij"))

Arguments

X

Empirical sociomatrix containing wins-losses frequencies in dyadic encounters. The matrix must be square and numeric.

names

Character vector with the names of individuals. This vector is NULL by default

method

A character string indicating which dyadic dominance measure is to be used for the computation of David’s scores. One of "Dij" or "Pij", can be abbreviated.

Details

getDS is obtained by means of the following expression: $DS = w1 + w2 - l1 - l2$ where $w1$ is the sum of $i$’s Dij or Pij values (depending on the method specification); $w2$ is the weighted sum of $i$’s dyadic dominance indices corrected for chance or the weighted sum of $i$’s win proportions; $l1$ is the sum of $i$’s Dji or Pji values and $l2$ is the sum of $i$’s dyadic lose indices corrected for chance or the weighted sum of $i$’s lose proportions.

Value

DS

David’s scores based on dyadic dominance indices corrected for chance or on win proportions.

Author(s)

David Leiva <dleiva@ub.edu> & Han de Vries <J.deVries1@uu.nl>.
References


See Also

`getDij`, `getPij`, `getwl`.

Examples

```r
# Example taken from Vervaecke et al. (2007):
X <- matrix(c(0, 58, 50, 61, 32, 37, 29, 39, 25, 8, 0, 22, 22, 9, 27, 20, 10, 48,
            3, 3, 0, 19, 29, 12, 13, 19, 8, 5, 8, 9, 0, 33, 38, 35, 32, 57,
            4, 7, 9, 1, 28, 26, 16, 23, 4, 3, 0, 0, 6, 0, 7, 6, 12,
            2, 0, 4, 1, 4, 0, 5, 3, 0, 2, 1, 1, 5, 8, 3, 0, 18, 3, 1, 3, 0, 0, 4, 1, 2, 0),
            nrow=9, byrow=TRUE)

individuals <- c("V", "VS", "B", "FJ", "PR", "VB", "TOR", "MU", "ZV")

res <- getDS(X, names=individuals, method="Dij")
print(res, digits=3)
```

```r
## getNormDS
Normalized David’s scores -NormDS-

### Description

Function to obtain normalized David’s scores from the observed sociomatrix.

### Usage

```r
getNormDS(X, names=NULL, method=c("Dij", "Pij"))
```

### Arguments

- **X**  
  Empirical sociomatrix containing wins-losses frequencies in dyadic encounters. The matrix must be square and numeric.

- **names**  
  Character vector with the names of individuals. This vector is NULL by default.

- **method**  
  A character string indicating which dyadic dominance measure is to be used for the computation of David’s scores. One of "Dij" or "Pij", can be abbreviated.
getNormDS

Details

getNormDS is obtained by means of the following expression: \[ \text{Norm}DS = \frac{DS + N(N - 1)/2}{N} \]

Value

\text{Norm}DS \quad \text{Normalized David’s scores based on dyadic dominance indices corrected for chance or based on the win proportions, depending on the method specified.}

Author(s)

David Leiva & Han de Vries.

References


See Also

getDij, getPij, getDS.

Examples

```r
# Example taken from Vervaecke et al. (2007):
X <- matrix(c(0,58,50,61,32,37,29,39,25,8,0,22,22,9,27,20,10,48,
            3,3,0,19,29,12,13,19,8,5,8,9,0,33,38,35,32,57,
            4,7,9,1,0,28,26,16,23,4,3,0,6,0,7,6,12,
            2,0,4,1,4,0,5,3,0,2,1,1,5,8,3,0,10,3,1,3,0,0,4,1,2,0),
            nrow=9,byrow=TRUE)
individuals <- c("V","VS","B","FJ","PR","VB","TOR","MJ","ZV")
res <- getNormDS(X,names=individuals,method="Dij")
print(res,digits=3)
```
getOrderedMatrix  

Ordered matrix according to NormDS values

Description

Function to order the observed matrix of dyadic dominance encounters according to the individuals’ NormDS values.

Usage

getOrderedMatrix(X, names=NULL, method=c("Dij","Pij"))

Arguments

- **X**: Empirical sociomatrix containing wins-losses frequencies in dyadic encounters.
- **names**: Character vector with the names of individuals. This vector is NULL by default.
- **method**: A character string indicating which dyadic dominance measure is to be used for the computation of David’s scores. One of "Dij" or "Pij", can be abbreviated.

Details

getOrderedMatrix is only applied for square matrices in which the set of \(n\) actors is also the set of \(n\) partners. The matrices must also be numeric.

Value

- **ordered.matrix**: Matrix of observed dyadic dominance encounters ordered according to the individuals’ NormDS values.
- **ordered.names**: Vector of individuals’ names ordered according to their NormDS values.
- **order.seq**: Sequence used in the order of the matrix of dyadic encounters and the vector of names.

Author(s)

David Leiva <dleivaur@ub.edu> & Han de Vries <J.deVries1@uu.nl>.

References


See Also

getNormDS.
getPij

**Matrix of win proportions -$Pij$-**

**Description**

Function to obtain matrix of win proportions from the observed sociomatrix.

**Usage**

```r
getPij(X, names=NULL)
```

**Arguments**

- **X**: Empirical sociomatrix containing wins-losses frequencies in dyadic encounters.
- **names**: Character vector with the names of individuals. This vector is NULL by default.

**Details**

`getPij` is only applied for square matrices in which the set of $n$ actors is also the set of $n$ partners. The matrices must also be numeric.

**Value**

- **$Pij$**: Matrix of observed win proportions.

**Author(s)**

David Leiva <dleivaur@ub.edu> & Han de Vries <j.devries1@uu.nl>.

---

**Examples**

```r
### example taken from Vervaekte et al. (2007):

X <- matrix(c(0,58,50,61,32,37,29,39,25,8,0,22,22,9,27,20,10,48,
  3,3,0,19,29,12,13,19,8,5,8,9,0,33,38,35,32,57,
  4,7,9,1,0,28,26,16,23,4,3,0,0,6,0,7,6,12,
  2,0,4,1,4,4,0,5,3,0,2,1,1,5,8,3,0,10,3,1,3,0,0,4,1,2,0),
  nrow=9,byrow=TRUE)

individuals <- c("V","VS","B","FJ","PR","VB","TOR","MU","ZV")

res <- getOrderedMatrix(X,individuals,method="Dij")$ordered.matrix

print(res,digits=3)
```
getStp

References


See Also

steeptest.

Examples

##############################################################################
### example taken from vervaecke et alN HRPP7)Z ###
##############################################################################

X <- matrix(c(0,58,50,61,32,37,29,39,25,8,0,22,22,9,27,20,10,48,
              3,3,0,19,29,12,13,19,8,5,8,9,0,33,38,35,32,57,
              4,7,9,1,0,28,26,16,23,4,3,0,6,0,7,6,12,
              2,0,4,1,4,0,5,3,0,2,1,1,5,8,3,0,10,3,1,3,0,0,4,1,2,0),
nrow=9,byrow=TRUE)

individuals <- c("V","VS","B","FJ","PR","VB","TOR","MU","ZV")

res <- getPij(X,individuals)
print(res,digits=3)

getStp

Steepness measure of dominance hierarchies -Stp-

Description

Function to obtain hierarchy’s steepness measure from the observed sociomatrix.

Usage

getStp(X, method=c("Dij","Pij"))

Arguments

X

Empirical sociomatrix containing wins-losses frequencies in dyadic encounters. The matrix must be square and numeric.

method

A character string indicating which dyadic dominance measure is to be used for the computation of David’s scores. One of "Dij" or "Pij", can be abbreviated.
getStp is the absolute value of the slope of the best-fitted line between the normalized David’s scores and the rank dominance in a decreasing order. The regression is obtained by Ordinary Least Squares method.

Value

getStp Steepness measure based on dyadic dominance indices corrected for chance or based on the matrix of win proportions, depending on the method specified.

Author(s)

David Leiva <dleivaur@ub.edu> & Han de Vries <j.deVries1@uu.nl>.

References


See Also

getDij, getPij, getNormDS.

Examples

```r
##############################################################################
### example taken from vervaecke et al. (2007):                       ###
###----------------------------------------------------------------------------
X <- matrix(c(0,58,50,61,32,37,29,39,25,8,0,22,22,9,27,20,10,48,
4,3,3,0,19,29,12,13,19,8,5,8,9,0,33,38,35,32,57,
4,7,9,1,0,28,26,16,23,4,3,0,0,6,0,7,6,12,
2,0,4,1,4,0,5,3,0,2,1,1,5,8,3,0,10,3,1,3,0,0,4,1,2,0),
rownames=9, byrow=TRUE)

individuals <- c("V","VS","B","FJ","PR","VB","TOR","MJ","ZV")

print(getStp(X,method="Dij"),digits=3)
```

---

**getwl**

*Win-loss measures at individual level*

**Description**

Function to obtain win and loss measures at individual level from the observed sociomatrix.
getwl

Usage

getwl(X, names=NULL, method=c("Dij","Pij"))

Arguments

  X          Empirical sociomatrix containing wins-losses frequencies in dyadic encounters. The matrix must be square and numeric.
  names      Character vector with the names of individuals. This vector is NULL by default
  method     A character string indicating which dyadic dominance measure is to be used for the computation of David's scores. One of "Dij" or "Pij", can be abbreviated.

Details

By means of the empirical sociomatrix of wins and losses this function computes several win-loss measures at individual level. Specifically, it computes \( w \), \( weighted.w \), \( l \) and \( weighted.l \). \( w \) is the sum of individuals’ dyadic dominances \( D_{ij} \) or the sum of proportions of wins \( P_{ij} \) by rows, depending on the specification of the method. \( weighted.w \) measures is the sum of individuals’ \( D_{ij} \) or \( P_{ij} \) values weighted by the \( w \) values of their interactants. \( l \) is the sum of individuals’ dyadic dominance indices \( D_{ij} \) or the sum of individuals’ proportions of wins \( P_{ij} \) by columns. And finally, \( weighted.l \) is the columns sum of individuals’ \( D_{ij} \) or \( P_{ij} \) values weighted by the \( l \) values of their interactants. These measures are used when computing David's scores.

Value

The result is a data frame with the following components:

  w          Sum of dyadic dominance indices \( D_{ij} \) or proportions of wins \( P_{ij} \) by rows.
  weighted.w Weighted sum of dyadic dominance indices \( D_{ij} \) or proportions of wins \( P_{ij} \).
  l          Sum of dyadic dominance indices \( D_{ij} \) or proportions of wins \( P_{ij} \) by columns.
  weighted.l Weighted sum of dyadic dominance indices \( D_{ij} \) or proportions of wins \( P_{ij} \).

Author(s)

David Leiva <dleivaur@ub.edu> & Han de Vries <J.devries1@uu.nl>.

References


See Also

getDij, getPij, getDS.
Examples

```r
##############################################################################
### example taken from Vervaecke et al. (2007):                          ###
##############################################################################

X <- matrix(c(0, 58, 50, 61, 32, 37, 29, 39, 25, 8, 0, 22, 22, 9, 27, 20, 10, 48,
              3, 3, 0, 19, 29, 12, 13, 19, 8, 5, 8, 9, 0, 33, 38, 35, 32, 57,
              4, 7, 9, 1, 0, 28, 26, 16, 23, 4, 3, 0, 0, 6, 0, 7, 6, 12,
              2, 0, 4, 1, 4, 4, 0, 5, 3, 0, 2, 1, 1, 5, 8, 3, 0, 10, 3, 1, 3, 0, 0, 4, 1, 2, 0),
              nrow=9, byrow=TRUE)


res <- getwl(X, names=individuals, method="Dij")

print(res, digits=3)
```

---

**steeptest**

*Statistical significance for steepness of dominance hierarchies statistic*

**Description**

Estimates statistical significance for steepness measure on the basis of dyadic dominance indices corrected for chance $D_{ij}$ or based on proportions of wins $P_{ij}$.

**Usage**

```
steeptest(X, rep, names=NULL, method=c("Dij","Pij"), order=TRUE)
```

**Arguments**

- **X**
  - Empirical sociomatrix containing wins-losses frequencies in dyadic encounters. The matrix must be square and numeric.

- **rep**
  - Number of simulations for carrying out the randomization test.

- **names**
  - Character vector with individuals’ names.

- **method**
  - A character string indicating which dyadic dominance measure is to be used for the computation of David’s scores. One of "Dij" or "Pij", can be abbreviated.

- **order**
  - Logical, if TRUE, results for Dij, DS and NormDS are ordered according to the individuals’ NormDS values. TRUE by default.
Details

steeptest estimates statistical significance for steepness measures based on dyadic dominance index corrected for chance $Dij$ or based on the matrix of win proportions $Pij$, depending on the method specified. This procedure simulates a number of sociomatrises under a uniform distribution by means of callings to C routine steep, then computes steepness based on $Dij$ or $Pij$. Specifically, it computes normalized David’s scores, see getNormDS for more details. Then it computes the steepness measure based on these indices, see getStp. After rep simulations the sampling distribution for the statistic ($Stp$) is estimated. Then statistical significance is computed as follows when results are shown by means of summary method: 

$$p = \frac{NS + 1}{NOS + 1}$$

Where $NS$ is computed as:

1. The number of times that simulated values are greater than or equal to the empirical value, if right-tailed p value is calculated.
2. And the number of times that simulated values are lower than or equal to the empirical value, if left-tailed p value is calculated.

And NOS represents the number of simulated values.

Value

steeptest returns an object of class steeptest containing the following components:

- call: Function call.
- names: Character vector with individuals’ names.
- method: A character string indicating which dyadic dominance measure is used for the computation of David’s scores.
- rep: Number of simulations for carrying out the randomization test.
- matdom: If method is set to be $Dij$ the function returns the matrix of observed dyadic dominance indices corrected for chance. If method is $Pij$ the matrix of proportions of wins is returned as a part of the output.
- DS: David’s scores based on $Dij$ or $Pij$, depending on the specification of the method.
- NormDS: Normalized David’s scores based on dyadic dominance indices corrected for chance or on proportions of wins in dyadic encounters.
- Stp: Steepness value based on Normalized David’s scores.
- interc: Intercept of the fitted line based on Normalized David’s scores.
- Stpsim: The function provides results of the randomization procedure for the steepness measure based on NormDS.

Author(s)

David Leiva <dleivaur@ub.edu> & Han de Vries <j.deVries1@uu.nl>.

References


See Also

getDij, getPij, getNormDS

Examples

##############################################################################
### example taken from Vervaecke et al. (2007):                    ###
### Example taken from Vervaecke et al. (2007):                    ###
X <- matrix(c(0,58,50,61,32,37,29,39,25,8,0,22,22,9,27,20,10,48,  
3,3,0,19,29,12,13,19,8,5,8,9,0,33,38,35,32,57,  
4,7,9,1,0,28,26,16,23,4,3,0,0,6,0,7,6,12,  
2,0,4,1,4,4,0,5,3,0,2,1,1,5,8,3,0,10,3,1,3,0,0,4,1,2,0),  
nrow=9,byrow=TRUE)

individuals <- c("V","VS","B","FJ","PR","VB","TOR","MU","ZV")

STP <- steeptest(X, rep=9999, names=individuals, method="Dij", order=TRUE)  
summary(STP)  
plot(STP)
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