Package 'AHPWR'

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Type Package

Title Compute Analytic Hierarchy Process

Version 0.1.2

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Description
Compute a tree level hierarchy, judgment matrix, consistency index and ratio, priority vectors, hierarchic synthesis and rank. Based on the book entitled ``Models, Methods, Concepts and Applications of the Analytic Hierarchy Process" by Saaty and Vargas (2012, ISBN 978-1-4614-3597-6).

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Imports dplyr, readxl, tidyr, ggplot2, igraph, formattable, magrittr, tibble, rlang, openxlsx

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NeedsCompilation no

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Contents

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ahp *Calculates the AHP*

Description

Calculates AHP in a list of paired arrays or in a properly formatted excel worksheet stipend.

Usage

```
ahp(base, mapeamento, nomes_alternativas)
```

Arguments

`base`	List of paired arrays or excel path containing the properly formatted paired arrays.
`mapeamento`	Vector containing the number of subscriptions of each criteria, from left to right. mapeamento = rep(0,n) n = number of criteria and no subcriteria; mapeamento = c(1,2) for one subcriteria in criteria 1 anda two subcriteria in criteria 2. If in doubt, see the tutorial vignette.
`nomes_alternativas`	Vector containing the names of the alternatives in your hierarchy, if not filled returns a vector of LETTERS.

Value

Table containing the relationships of criteria, subscriptions (If any) and Alternatives Using the AHP system.

Author(s)

Lyncoln Oliveira and Luciane Ferreira Alcoforado

Examples

```
x=paste0(letters[3],1:5)
y=c(5,2,7,3,2)
m1=matrix_ahp(x,y)
x=paste0(letters[1],1:3)
y=c(4.4,5.2,3)
m2=matrix_ahp(x,y)
y=c(2,4,3)
m3=matrix_ahp(x,y)
y=c(4.9,5,3.3)
m4=matrix_ahp(x,y)
y=c(4.4,4.2,4.3)
m5=matrix_ahp(x,y)
y=c(5.4,5.2,5.7)
m6=matrix_ahp(x,y)
base=list(m1, m2, m3, m4, m5, m6)
mapeamento = rep(0,5)
nomes_alternativas = paste0(letters[1],1:3)
ahp(base,mapeamento, nomes_alternativas)

#with subcriteria and 3 criteria and 2 alternatives
mapeamento = c(2,0,0) #2 subcriteria in criteria 1 and 0 subcriteria to others
x=paste0(letters[3],1:3) #3 criteria
y=c(5,2,7)
m1=matrix_ahp(x,y) #compare criteria
x=paste0(letters[4],1:2)
y=c(4,6)
m2=matrix_ahp(x,y) # 2 compare 2 subcriteria of criteria 1
x=paste0(letters[1],1:2)
y=c(2,4)
m3=matrix_ahp(x,y) #alternatives for subcriteria 1
y=c(4.9,5)
m4=matrix_ahp(x,y) #alternatives for subcriteria 2
y=c(4.4,4.2)
m5=matrix_ahp(x,y) #alternatives for criteria 2
y=c(5.4,5.2)
m6=matrix_ahp(x,y) ##alternatives for criteria 3
base=list(m1, m2, m3, m4, m5, m6)

nomes_alternativas = paste0(letters[1],1:2)
ahp(base,mapeamento, nomes_alternativas)

#Other mapeamento: criteria 2 with 2 subcriteria

mapeamento = c(0,2,0)
nomes_alternativas = paste0(letters[1],1:2)
ahp(base,mapeamento, nomes_alternativas)
```

---

ahp_geral *Calculates the AHP General*

Description

Calculates AHP in a list of paired arrays or in a properly formatted excel worksheet stipend.

Usage

```
ahp_geral(objeto, mapeamento = "PADRAO", nomes_alternativas = "PADRAO")
```

Arguments

objeto	List of paired arrays or excel path containing the properly formatted paired arrays.
mapeamento	Vector containing the number of subscriptions of each criteria, from left to right. If not filled the pattern and fill with 0. If in doubt, see the tutorial vignette.
nomes_alternativas	Vector containing the names of the alternatives in your hierarchy, if not filled returns a vector of LETTERS\[1\:qtdAlternatives\]

Value

Table containing the relationships of criteria, subscriptions (If any) and Alternatives Using the AHP system.

Author(s)

Lyncoln Oliveira

Examples

```
m1=matrix(c(1, 1/5, 3, 1/5, 1/3,5, 1, 5, 3, 3,
1/3, 1/5, 1, 1/3, 1/3,5, 1/3, 3, 1, 1,3, 1/3,
3, 1, 1),ncol=5,byrow=TRUE)
m2=matrix(c(1, 1/3, 1/6, 3, 1, 1/2,6, 2, 1),nrow=3, byrow=TRUE)
m3=matrix(c(1, 1/2, 1/2,2, 1, 2, 2, 1/2, 1),nrow=3, byrow=TRUE)
m4=matrix(c(1, 1, 2,1, 1, 1, 1/2, 1, 1),nrow=3, byrow=TRUE)
m5=matrix(c(1, 2, 3,1/2, 1, 2, 1/3, 1/2, 1),nrow=3, byrow=TRUE)
m6=matrix(c(1, 5, 3,1/5, 1, 1/3, 1/3, 3, 1),nrow=3, byrow=TRUE)
base=list(m1,m2,m3,m4,m5,m6)
mapeamento=rep(0,5)
nomes_alternativas="PADRAO"
ahp_geral(base,mapeamento, nomes_alternativas)
```

ahp_s *Calculates the AHP for criteria and subcriteria*

Description

Calculates AHP in a list of paired arrays or in a properly formatted excel worksheet stipend.

Usage

```
ahp_s(base, map)
```

Arguments

base	List of paired arrays or excel path containing the properly formatted paired arrays.
map	Vector containing the number of subscriptions of each criteria, from left to right. map = rep(0,n) n = number of criteria and no subcriteria; mapeamento = c(1,2) for one subcriteria in criteria 1 and two subcriteria in criteria 2. If in doubt, see the tutorial vignette.

Value

Table containing the relationships of criteria, subscriptions (If any) and Alternatives Using the AHP system.

Author(s)

Luciane Ferreira Alcoforado

Examples

```
x=paste0(letters[3],1:5)
y=c(5,2,7,3,2)
m1=matrix_ahp(x,y)
x=paste0(letters[1],1:3)
y=c(4.4,5.2,3)
m2=matrix_ahp(x,y)
y=c(2,4,3)
m3=matrix_ahp(x,y)
y=c(4.9,5,3.3)
m4=matrix_ahp(x,y)
y=c(4.4,4.2,4.3)
m5=matrix_ahp(x,y)
y=c(5.4,5.2,5.7)
m6=matrix_ahp(x,y)
base=list(m1, m2, m3, m4, m5, m6)
map = rep(0,5)
ahp_s(base,map)
```

```
#with two subcriteria in criteria 1 and 2 alternatives
map = c(2,0,0)
x=paste0(letters[3],1:3) #3 criteria
y=c(5,2,7)
m1=matrix_ahp(x,y) # matrix compare three criteria
x=paste0("SC1",1:2)
y=c(4,6)
m2=matrix_ahp(x,y) # 2 matrix compare two subcriteria of criteria 1
x=paste0(letters[1],1:2)
y=c(2,4)
m3=matrix_ahp(x,y) #alternatives for subcriteria 1
y=c(4.9,5)
m4=matrix_ahp(x,y) #alternatives for subcriteria 2
y=c(4.4,4.2)
m5=matrix_ahp(x,y) #alternatives for criteria 2
y=c(5.4,5.2)
m6=matrix_ahp(x,y) ##alternatives for criteria 3
base=list(m1, m2, m3, m4, m5, m6)


ahp_s(base,map)

#Other mapeamento: criteria 2 with 2 subcriteria and 3 alternatives


map = c(2,2)
x=paste0(letters[3],1:2) #2 criteria
y=c(5,7)
m1=matrix_ahp(x,y) # matrix compare two criteria
x=paste0("SC1",1:2)
y=c(4,6)
m2=matrix_ahp(x,y) # matrix compare two subcriteria of criteria 1
x=paste0(letters[1],1:3)
y=c(2,4,5)
m3=matrix_ahp(x,y) #alternatives for subcriteria 1 - criteria 1
y=c(4.9,5, 2)
m4=matrix_ahp(x,y) #alternatives for subcriteria 2 - criteria 1
y=c(4.4,8)
x=paste0("SC2",1:2)
m5=matrix_ahp(x,y) #matrix compare two subcriteria of criteria 2
y=c(5.4,5.2, 1)
x=paste0(letters[1],1:3)
m6=matrix_ahp(x,y) #alternatives for subcriteria 1 - criteria 2
y=c(9,5.2, 3)
m7=matrix_ahp(x,y) #alternatives for subcriteria 2 - criteria 2
base=list(m1, m2, m3, m4, m5, m6, m7)

ahp_s(base,map)
```

---

autoVetor *Calculates the eigen vector of matrix*

Description

Calculates the eigen vector of matrix

Usage

```
autoVetor(matriz)
```

Arguments

matriz	a paired matrix

Value

Returns a normalized eigenvector

Author(s)

Lyncoln Oliveira

Examples

```
m=diag(16)+2-2*diag(16)
m
autoVetor(m)
```

---

calcula_prioridades *Calculates the priority vector of a paired matrix*

Description

Calculates the priority vector of a paired array based on a list

Usage

```
calcula_prioridades(lista)
```

Arguments

lista	a paired matrix list

Value

Returns a list containing priority vectors for each matrix in the read list

Author(s)

Lyncoln Oliveira

CI *calculates saaty's consistency index*

Description

Function to calculate the saaty's consistency index

Usage

```
CI(m)
```

Arguments

m	is a matrice of pairwise comparison

Value

Returns saaty's consistency index

Author(s)

Luciane Ferreira Alcoforado

Examples

```
x=c("c1", "c2", "c3", "c4")
y=c(3, 9, 2, 8)
m=matrix_ahp(x,y)
CI(m)

x=c("a1", "a2", "a3", "a4", "a5")
y=c(1, 9, 1.5, 8, 6)
m=matrix_ahp(x,y)
CI(m)

m=diag(16)+2-2*diag(16)
m
CI(m)
CR(m)
```

CR *calculates saaty's consistency ratio*

Description

Function to calculate the saaty's consistency ratio

Usage

```
CR(m)
```

Arguments

m	is a matrice of pairwise comparison

Value

Returns saaty's consistency ratio in [0,1]

Author(s)

Luciane Ferreira Alcoforado

Examples

```
x=c("c1", "c2", "c3", "c4")
y=c(3, 9, 2, 8)
m=matrix_ahp(x,y)
CR(m)

x=c("a1", "a2", "a3", "a4", "a5")
y=c(1, 9, 1.5, 8, 6)
m=matrix_ahp(x,y)
CR(m)

m=diag(16)+2-2*diag(16)
m
CI(m)
CR(m)
```

`flow_chart` *creates a hierarchical structure*

Description

Function to build the Diagram of hierarchies

Function to build the Diagram of hierarchies

Usage

```
flow_chart(names, c, a)

flow_chart(names, c, a)
```

Arguments

`names`	is a vector with names for goal, criteria and choices in this exact sequence
`c`	is a integer number of criteria, c>=2
`a`	is a integer number of choices, a>=2

Value

Returns Diagram of hierarchies

Returns Diagram of hierarchies

Author(s)

Luciane Ferreira Alcoforado

Examples

```
p=flow_chart(names=NULL, a=2, c=2)
p

p=flow_chart(names=NULL, a=2, c=3)
p+ggplot2::theme_void()

flow_chart(names=c("G", "cost", "time", "hour", "home", "beach"),c=3, a=2)

p=flow_chart(names=NULL, a=2, c=2)
p

p=flow_chart(names=NULL, a=2, c=3)
p+ggplot2::theme_void()

flow_chart(names=c("G", "cost", "time", "hour", "home", "beach"),c=3, a=2)
```

`formata_tabela` *Format an AHP table created by the general ahp() function*

Description

Format an AHP table created by the general ahp() function

Usage

```
formata_tabela(tabela, cores = "PADRAO")
```

Arguments

`tabela`	AHP table created by the general ahp() function
`cores`	Color pattern to format the table. If "PADRAO" returns the color pattern (green, blue, green or blue); if "GRAY" returns the default gray color; if "WHITE" returns the table without colors

Value

Returns a table formatted with background colors responsive to element priority amounts

Author(s)

Lyncoln Oliveira

`formata_tabela2` *Format an AHP table created by the general ahp() function*

Description

Format an AHP table created by the general ahp() function

Usage

```
formata_tabela2(tabela, cores = "PADRAO")
```

Arguments

`tabela`	AHP table created by the general ahp() function
`cores`	Color pattern to format the table. If "PADRAO" returns the color pattern (green, blue, green or blue); if "GRAY" returns the default gray color; if "WHITE" returns the table without colors

Value

Retorna uma tabela formatada com cores defundo responsivas as quantidades de prioridade dos elementos

Author(s)

Lyncoln Oliveira

`ler` *Read an excel file containing the paired matrices*

Description

Function to read an excel file containing the paired matrices and turn all spreadsheets into a list of matrices in R.

Usage

```
ler(caminho)
```

Arguments

`caminho`	Address to an excel file that contains the worksheets.

Value

Returns a list containing the matrices from the excel file.

Author(s)

Lyncoln Oliveira

Examples

```
# Criando um arquivo de exemplo para o teste
library(openxlsx)
tmp <- tempfile(fileext = ".xlsx")
m <- matrix(c(1, 2, 0.5, 1), nrow = 2)
openxlsx::write.xlsx(list(Sheet1 = m), file = tmp)

# Testando a função
lista = ler(tmp)
lista
```

`matrix_ahp` *creates a dataframe containing the judments holistic*

Description

Function to build the judment matrix

Function to build the judgment matrix based on a vector of weights.

Usage

```
matrix_ahp(x, y)

matrix_ahp(x, y)
```

Arguments

x	A vector of names (criteria or choices).
y	A vector of weights on the Saaty scale, typically in [1, 9].

Value

Returns a judment matrice.

Returns a square judgment matrix (n x n).

Author(s)

Luciane Ferreira Alcoforado

Examples

```
x=c("c1", "c2", "c3", "c4")
y=c(3, 9, 2, 8)
matrix_ahp(x,y)

x=c("a1", "a2", "a3", "a4", "a5")
y=c(1, 9, 1.5, 8, 6)
matrix_ahp(x,y)
x <- c("c1", "c2", "c3", "c4")
y <- c(3, 9, 2, 8)
matrix_ahp(x, y)
```

matriz_julgamento *Create paired matrix and can test saaty consistency rate*

Description

Function that Create paired matrix and can test saaty consistency rate

Usage

```
matriz_julgamento(n_comp, CR = TRUE, n_matrix = 1)
```

Arguments

n_comp	Number of elements to be evaluated
CR	If TRUE also returns the consistency rate of saaty, if FALSE returns only matrix
n_matrix	Number of matrix to be created

Value

Returns a list with 2 positions. First position contains the paired matrices and the second position their consistency rates

Author(s)

Lyncoln Oliveira

normaliza *generates vectors of weights for criteria and alternatives*

Description

Function that generates vectors of weights for criteria and alternatives

Usage

```
normaliza(lista)
```

Arguments

lista	is a list with judment matrices

Value

Returns auxiliary list

Author(s)

Lyncoln Oliveira

Examples

```
lista = list(M1=diag(3), M2=diag(3)+4-4*diag(3))
normaliza(lista)
```

---

ranque *Calculates the ranking of alternatives*

Description

Calculates ranking of alternatives for a list of judment matrix

Usage

```
ranque(tabela)
```

Arguments

tabela	table building by ahp_s or ahp_geral

Value

Table containing the ranking of alternatives

Author(s)

Lyncoln Oliveira

Examples

```
x=paste0(letters[3],1:5)
y=c(5,2,7,3,2)
m1=matrix_ahp(x,y)
x=paste0(letters[1],1:3)
y=c(4.4,5.2,3)
m2=matrix_ahp(x,y)
y=c(2,4,3)
m3=matrix_ahp(x,y)
y=c(4.9,5,3.3)
m4=matrix_ahp(x,y)
y=c(4.4,4.2,4.3)
m5=matrix_ahp(x,y)
y=c(5.4,5.2,5.7)
m6=matrix_ahp(x,y)
base=list(m1, m2, m3, m4, m5, m6)
```

```
mapeamento = rep(0,5)
nomes_alternativas = paste0(letters[1],1:3)
tabela = ahp(base,mapeamento, nomes_alternativas)
ranque(tabela)

#with subcriteria and 3 criteria and 2 alternatives
mapeamento = c(2,0,0) #2 subcriteria in criteria 1 and 0 subcriteria to others
x=paste0(letters[3],1:3) #3 criteria
y=c(5,2,7)
m1=matrix_ahp(x,y) #compare criteria
x=paste0(letters[4],1:2)
y=c(4,6)
m2=matrix_ahp(x,y) # 2 compare 2 subcriteria of criteria 1
x=paste0(letters[1],1:2)
y=c(2,4)
m3=matrix_ahp(x,y) #alternatives for subcriteria 1
y=c(4.9,5)
m4=matrix_ahp(x,y) #alternatives for subcriteria 2
y=c(4.4,4.2)
m5=matrix_ahp(x,y) #alternatives for criteria 2
y=c(5.4,5.2)
m6=matrix_ahp(x,y) ##alternatives for criteria 3
base=list(m1, m2, m3, m4, m5, m6)

nomes_alternativas = paste0(letters[1],1:2)
tabela = ahp(base,mapeamento, nomes_alternativas)
ranque(tabela)
```

`tabela_holistica` *organizes a table with comparison matrix data*

Description

Function to organizes a table with comparison matrix data

Usage

```
tabela_holistica(pesos)
```

Arguments

`pesos`	vector with holistic weights for comparison or comparison matrix data

Value

Returns a table with assigned holistic weights, comparison matrix, priority vector and consistency ratio

Author(s)

Luciane Ferreira Alcoforado & Orlando Longo

Examples

```
pesos = c(3, 7, 9, 2)
names(pesos) = paste0("C",1:4)
tabela_holistica(pesos)

m = matrix_ahp(y=c(3,4,3,2.5), x=paste0("A",1:4))
tabela_holistica(pesos=m)
```

---

transforma_tabela *Transforms table with numbers into percentage with 2 decimal places*

Description

Function to Transforms table with numbers into percentage with 2 decimal places

Usage

```
transforma_tabela(tabela)
```

Arguments

tabela	table to transforms

Value

Returns a transform table with percentage

Author(s)

Lyncoln Oliveira

Examples

```
tabela=data.frame(x=c(0.5, 0.25), y=c(0.55, 0.93))
transforma_tabela(tabela)
```

xlsx_ahp *build file with judgment matrices*

Description

Function to build file with judgment matrices

Usage

```
xlsx_ahp(m, file, sheet, append = FALSE)
```

Arguments

m	is a matrix of pairwise comparison
file	is the path to the output file.
sheet	is a character string with the sheet name.
append	is a logical value indicating if m should be appended to an existing file.

Value

Returns a xlsx document

Author(s)

Luciane Ferreira Alcoforado

Examples

```
# Criando um arquivo temporário para o exemplo funcionar sem erro
library(openxlsx)
m1 <- matrix(c(1, 2, 0.5, 1), nrow = 2)
tmp <- tempfile(fileext = ".xlsx")
write.xlsx(list(Sheet1 = m1), file = tmp)

# Agora testando a função ler com o arquivo que acabamos de criar
lista = ler(tmp)
lista
```

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