Package 'wowa'

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Type Package

Title Weighted Ordered Weighted Average

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Maintainer Gleb Beliakov <gleb@deakin.edu.au>

Author Gleb Beliakov [aut, cre],
Daniela Calderon [aut]

Description
Introduce weights into Ordered Weighted Averages and extend bivariate means based on n-ary tree construction. Please refer to the following:
G. Beliakov, H. Bustince, and T. Calvo (2016, ISBN: 978-3-319-24753-3),
G. Beliakov(2018) <doi:10.1002/int.21913>,
G. Beliakov, J.J. Dujmovic (2016) <doi:10.1016/j.ins.2015.10.040>,
J.J. Dujmovic and G. Beliakov (2017) <doi:10.1002/int.21828>.

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R topics documented:

`wowa` *WOWA package*

Description

Various weighted multivariate extensions of bivariate and OWA functions, including implicit, quantifier-based and binary tree based WOWA.

Usage

```
wowa()
```

Details

Lists the functions implemented in this package.

Value

`output` No return value, called for printing only.

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
wowa()
```

`wowa.ImplicitWOWA` *Impicit Weighted OWA Computation Function*

Description

Function for Calculating implicit Weighted OWA function

Usage

```
wowa.ImplicitWOWA(x, p, w, n)
```

Arguments

`x`	The vector of inputs
`p`	The weights of inputs x
`w`	The OWA weightings vector
`n`	Dimension of the vector x

Value

`output`	The value of the Impicit Weighted OWA

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
n <- 4
example <- wowa.ImplicitWOWA(c(0.3,0.4,0.8,0.2), c(0.3,0.25,0.3,0.15),
                c(0.4,0.35,0.2,0.05), n)
example
```

---

wowa.OWA *Ordered weigted average function*

Description

Function for computing the ordered weigted averages

Usage

```
wowa.OWA(n, x, w)
```

Arguments

n	Dimension of the vector x
x	The vector of inputs
w	The OWA weights

Value

output	The value of the ordered weighted average.

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

Examples

```
n <- 4
wowa.OWA(n, c(0.3,0.4,0.8,0.2), c(0.4,0.35,0.2,0.05))
```

wowa.WAM *WAM computation*

Description

Function for calculating the Weighted Arithmetic Mean

Usage

```
wowa.WAM(n, x, w)
```

Arguments

n	Dimension of the array x
x	The vector of inputs
w	The vector of weights

Value

output	The value of the WAM function

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

Examples

```
n <- 4
wowa.WAM(n, c(0.3,0.4,0.8,0.2), c(0.3,0.25,0.3,0.15) )
```

wowa.WAn *Extension of binary averaging*

Description

Function for calculating a binary tree multivariate extension of a binary averaging function

Usage

```
wowa.WAn(x, w, n, Fn, L)
```

Arguments

x	Vector of inputs
w	The weightings vector
n	Dimension of the array x (and w)
Fn	Bivariate symmetric mean that is extended to n arguments
L	The number of levels of the binary tree (see docs)

Value

output	The output is Weighted n-variate mean extending Fn

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
      Fn <- function( x, y) { # just a simple arithmetic mean,
# but can be more complex functions (eg heronian, Logaritmic means)
out <- (x+y)/2
return(out)
       }

   n <- 4
   example <- wowa.WAn(c(0.3,0.4,0.8,0.2),  c(0.4,0.3,0.2,0.1), n, Fn, 10)
   example
```

`wowa.weightedf` *Weighted extension of the OWA function*

Description

Function for extending order weigted averages and other multivariate symmetric functions

Usage

```
wowa.weightedf(x, p, w, n, Fn, L)
```

Arguments

`x`	The vector of inputs
`p`	The weights of inputs x
`w`	The OWA weightings vector
`n`	The dimension of the vector x
`Fn`	Base n-variate symmetric function defined in R
`L`	The number of levels of the n-ary tree (see docs)

Value

`output`	The output is the weighted ordered weigted average.

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
     Fn <- function(n, x, w) {
    out <- 0.0
  for(i in 1:n) out<- out+x[i]*w[i];
  #print(out)
         return(out)
      }
     n <- 4

       example <- wowa.weightedf(c(0.3,0.4,0.8,0.2), c(0.3,0.25,0.3,0.15),
                  c(0.4,0.35,0.2,0.05), n, Fn,  10)
example
```

`wowa.weightedOWAQuantifier` *WOWA value computation Function*

Description

Function for calculating the value of the quantifier-based WOWA function

Usage

```
wowa.weightedOWAQuantifier(x, p, w, n, spl)
```

Arguments

`x`	The vector of inputs
`p`	The weights of inputs x
`w`	The OWA weightings vector
`n`	The dimension of the array x
`spl`	A structure that keeps the spline knots and coefficients computed in weightedOWAQuantifierBuild function

Value

`output`	The output is quantifier-based WOWA value

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
n <- 4
pweights=c(0.3,0.25,0.3,0.15);
wweights=c(0.4,0.35,0.2,0.05);
tempspline <- wowa.weightedOWAQuantifierBuild(pweights,wweights , n)
wowa.weightedOWAQuantifier(c(0.3,0.4,0.8,0.2), pweights, wweights, n, tempspline)
```

---

wowa.weightedOWAQuantifierBuild

RIM quantifier of the Weighted OWA function

Description

Function for building the RIM quantifier of the Weighted OWA function

Usage

```
wowa.weightedOWAQuantifierBuild(p, w, n)
```

Arguments

p	The weights of inputs x
w	The OWA weightings vector
n	The dimension of the vectors p,w

Value

output	A structure which has fields: spl, which keeps the spline knots and coefficients for later use in weightedOWAQuantifier, and Tnum, the number of knots in the monotone spline

Author(s)

Gleb Beliakov, Daniela L. Calderon, Deakin University

References

[1]G. Beliakov, H. Bustince, and T. Calvo. A Practical Guide to Averaging Functions. Springer, Berlin, Heidelberg, 2016.

[2]G. Beliakov. A method of introducing weights into OWA operators and other symmetric functions. In V. Kreinovich, editor, Uncertainty Modeling. Dedicated to B. Kovalerchuk, pages 37-52. Springer, Cham, 2017.

[3]G. Beliakov. Comparing apples and oranges: The weighted OWA function, Int.J. Intelligent Systems, 33, 1089-1108, 2018.

[4]V. Torra. The weighted OWA operator. Int. J. Intelligent Systems, 12:153-166, 1997.

[5]G. Beliakov and J.J. Dujmovic , Extension of bivariate means to weighted means of several arguments by using binary trees, Information sciences, 331, 137-147, 2016.

[6] J.J. Dujmovic and G. Beliakov. Idempotent weighted aggregation based on binary aggregation trees. Int. J. Intelligent Systems 32, 31-50, 2017.

Examples

```
n <- 4
pweights=c(0.3,0.25,0.3,0.15);
wweights=c(0.4,0.35,0.2,0.05);
tspline <- wowa.weightedOWAQuantifierBuild(pweights,wweights , n)
wowa.weightedOWAQuantifier(c(0.3,0.4,0.8,0.2), pweights, wweights, n, tspline)
```

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