Package 'ipsfs'

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Type Package

Title Intuitionistic, Pythagorean, and Spherical Fuzzy Similarity Measure

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Description Advanced fuzzy logic based techniques are implemented to compute the similarity among different objects or items. Typically, application areas consist of transforming raw data into the corresponding advanced fuzzy logic representation and determining the similarity between two objects using advanced fuzzy similarity techniques in various fields of research, such as text classification, pattern recognition, software projects, decision-making, medical diagnosis, and market prediction. Functions are designed to compute the membership, non-membership, hesitant-membership, indeterminacy-membership, and refusal-membership for the input matrices. Furthermore, it also includes a large number of advanced fuzzy logic based similarity measure functions to compute the Intuitionistic fuzzy similarity (IFS), Pythagorean fuzzy similarity (PFS), and Spherical fuzzy similarity (SFS) between two objects or items based on their fuzzy relationships. It also includes working examples for each function with sample data sets.

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R topics documented:

`hmemIFS` *Intuitionistic hesitancy membership function*

Description

Intuitionistic hesitancy membership values with membership and non-membership values as input

Usage

```
hmemIFS(m, nm)
```

Arguments

`m`	IFS membership values computed using either triangular or trapezoidal or guassian membership function
`nm`	IFS non-membership values computed using either Sugeno and Terano's or Yager's non-membership function

Value

IFS hesistancy values

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nm<-nonmemS(m,lam)
hmemIFS(m,nm)
#       [,1]       [,2]       [,3]
#[1,]0.09921264 0.05810582 0.03270001
#[2,]0.09915966 0.03100937 0.05966479
#[3,]0.04565299 0.09939456 0.04565299
#[4,]0.04565299 0.09939456 0.04565299
```

---

hmemPFS *Pythagorean hesitancy membership function*

Description

Pythagorean hesitancy membership values with membership and non-membership values as input

Usage

```
hmemPFS(m, nm)
```

Arguments

m	PFS membership values computed using either triangular or trapezoidal or guassian membership function
nm	PFS non-membership values computed using either Sugeno and Terano's or Yager's non-membership function

Value

PFS hesistancy values

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nm<-nonmemS(m,lam)
hmemPFS(m,nm)
#       [,1]      [,2]      [,3]
#[1,] 0.7651357 0.5875871 0.4417361
#[2,] 0.7649349 0.4302263 0.5953393
#[3,] 0.5213768 0.7658251 0.5213768
#[4,] 0.5213768 0.7658251 0.5213768
```

imemSFS *Spherical indeterminacy membership function*

Description

Spherical indeterminacy membership values with membership and non-membership values as input

Usage

```
imemSFS(m, nm)
```

Arguments

m	SFS membership values computed using either triangular or trapezoidal or guassian membership function
nm	SFS non-membership values computed using either Sugeno and Terano's or Yager's non-membership function

Value

SFS indeterminacy membership values

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nm<-nonmemS(m,lam)
imemSFS(m,nm)
#        [,1]       [,2]       [,3]
#[1,] 0.09921264 0.05810582 0.03270001
#[2,] 0.09915966 0.03100937 0.05966479
#[3,] 0.04565299 0.09939456 0.04565299
#[4,] 0.04565299 0.09939456 0.04565299
```

leftfootfinding *Left foot values*

Description

Left foot value for triangular or trapezoidal membership function

Usage

```
leftfootfinding(x, n)
```

Arguments

x	A data set in the form of document-term matrix
n	A constant value to fix the left foot value

Value

Left foot values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
leftfootfinding(x,5)
#[1] 10 5 10 10
```

---

leftshoulderfinding *Left shoulder values*

Description

Left shoulder value for trapezoidal membership function

Usage

```
leftshoulderfinding(a, b)
```

Arguments

a	A constant value for fixing the left shoulder
b	Middle values for the data set x

Value

Left shoulder values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
mid<-midvalue(x)
leftshoulderfinding(2.5,mid)
#[1] 14.0 10.5 12.0 15.0
```

memG *Gaussian membership function*

Description

Gaussian membership function with mean, standard deviation, and data set

Usage

```
memG(a, b, x)
```

Arguments

a	Mean values of individual rows of the data set x
b	Standard deviation values of individual rows of the data set x
x	A data set in the form of document-term matrix

Value

Gaussian membership values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
memG(a,b,x)
#       [,1]      [,2]      [,3]
#[1,] 0.5169457 0.7958771 0.8941586
#[2,] 0.5179406 0.9000876 0.7891159
#[3,] 0.8464817 0.5134171 0.8464817
#[4,] 0.8464817 0.5134171 0.8464817
```

memT *Triangular membership function*

Description

Triangular membership function with leftfooting, midvalue, rightfooting, and data set

Usage

```
memT(a, b, c, x)
```

Arguments

a	Leftfooting value of the data set x
b	Middle value of the data set x
c	Rightfooting value of the data set x
x	A data set in the form of document-term matrix

Value

Triangular membership values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-leftfootfinding(x,5)
b<-midvalue(x)
c<-rightfootfinding(x,5)
memT(a,b,c,x)
#       [,1]      [,2]      [,3]
#[1,] 0.3076923 0.4705882 0.5882353
#[2,] 0.5000000 0.5714286 0.4285714
#[3,] 0.8888889 0.9090909 0.8888889
#[4,] 0.1333333 0.1333333 0.1333333
```

---

memTP *Trapezoidal membership function*

Description

Trapezoidal membership function with leftfooting, leftshoulder, rightshoulder, rightfooting, and data set

Usage

```
memTP(a, b, c, d, x)
```

Arguments

a	Leftfooting value of the data set x
b	Leftshoulder value of the data set x
c	Rightshoulder value of the data set x
d	Rightfooting value of the data set x
x	A data set in the form of document-term matrix

Value

Trapezoidal membership values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-leftfootfinding(x,5)
mid<-midvalue(x)
b<-leftshoulderfinding(2.5,mid)
c<-rightshoulderfinding(mid,2.5)
d<-rightfootfinding(x,5)
memTP(a,b,c,d,x)
#       [,1]      [,2]      [,3]
#[1,] 0.5000000 0.6666667 0.8333333
#[2,] 0.7272727 0.8888889 0.6666667
#[3,] 1.0000000 1.0000000 1.0000000
#[4,] 0.2000000 0.2000000 0.2000000
```

---

midvalue *Middle values*

Description

Middle value for triangular or trapezoidal membership function

Usage

```
midvalue(x)
```

Arguments

x	A data set in the form of document-term matrix

Value

Middle values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
midvalue(x)
#[1] 16.5 13.0 14.5 17.5
```

mn *Mean values*

Description

Mean values of the data set for gaussian membership function

Usage

```
mn(x)
```

Arguments

x	A data set in the form of document-term matrix

Value

Mean values for individual row of the input data set X.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
mn(x)
#[1] 17.66667 14.00000 14.33333 15.33333
```

nonmemS *Sugeno and Terano's non membership function*

Description

Sugeno and Terano's non membership function with membership values and lambda value

Usage

```
nonmemS(m, lam)
```

Arguments

m	Membership values for the data set x
lam	Control parameter to establish relationship between membership and non-membership values, values range from 0.1 to 1.0

Value

Sugeno and Terano's non membership for the data set x.

References

M. Sugeno and T. Terano. A model of learning based on fuzzy information. Kybernetes, 1977.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nonmemS(m,lam)
#        [,1]      [,2]       [,3]
#[1,] 0.3838416 0.1460171 0.07314142
#[2,] 0.3828998 0.0689030 0.15121934
#[3,] 0.1078653 0.3871883 0.10786528
#[4,] 0.1078653 0.3871883 0.10786528
```

---

nonmemY *Yager's non membership function*

Description

Yager's non membership function with membership values and lambda value

Usage

```
nonmemY(m, lam)
```

Arguments

m	Membership values for the data set x
lam	Control parameter to establish relationship between membership and non-membership values, values range from 0.1 to 1.0

Value

Yager's non membership for the data set x.

References

R. R. Yager. On the measure of fuzziness and negation part i: membership in the unit interval. 1979.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nonmemY(m,lam)
#         [,1]        [,2]        [,3]
#[1,] 0.078966962 0.011638215 0.002959405
#[2,] 0.078578801 0.002628666 0.012471988
#[3,] 0.006392896 0.080354498 0.006392896
#[4,] 0.006392896 0.080354498 0.006392896
```

---

rightfootfinding *Right foot values*

Description

Right foot value for triangular or trapezoidal membership function

Usage

```
rightfootfinding(x, n)
```

Arguments

x	A data set in the form of document-term matrix
n	A constant value to fix the right foot value

Value

Right foot values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
rightfootfinding(x,5)
#[1] 25 20 20 25
```

rightshoulderfinding *Right shoulder values*

Description

right shoulder value for trapezoidal membership function

Usage

```
rightshoulderfinding(b, c)
```

Arguments

b	Middle values for the data set x
c	A constant value for fixing the right shoulder

Value

Right shoulder values for the input data set x.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
mid<-midvalue(x)
rightshoulderfinding(mid,2.5)
#[1] 19.0 15.5 17.0 20.0
```

rmemSFS *Spherical refusal membership function*

Description

Spherical refusal membership values with membership,non-membership and indeterminacy values as input

Usage

```
rmemSFS(m, nm, im)
```

Arguments

m	SFS membership values computed using either triangular or trapezoidal or guassian membership function
nm	SFS non-membership values computed using either Sugeno and Terano's or Yager's non-membership function
im	SFS indetermincay values

Value

SFS refusal membership values

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
a<-mn(x)
b<-std(x)
m<-memG(a,b,x)
lam<-0.5
nm<-nonmemS(m,lam)
im<-imemSFS(m,nm)
rmemSFS(m,nm,im)
#       [,1]      [,2]      [,3]
#[1,] 0.7586762 0.5847071 0.4405241
#[2,] 0.7584805 0.4291073 0.5923419
#[3,] 0.5193742 0.7593476 0.5193742
#[4,] 0.5193742 0.7593476 0.5193742
```

---

simBA *IFS similarity measure simBA*

Description

IFS similarity measure values using simBA computation technique with membership, and non-membership of two objects or set of objects.

Usage

```
simBA(ma, na, mb, nb, p, t, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
t	Level of uncertainty values, values range from 1 to 10
k	A constant value depends upon the number of rows in the y data set.

Value

The IFS similarity values of data set y with data set x

References

F. E. Boran and D. Akay. A biparametric similarity measure on intuitionistic fuzzy sets with applications to pattern recognition. Information sciences, 255:45 - 57, 2014.

Examples

```
#When data set y consist of only one row use k=1
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
p<-2
t<-2
k<-1
simBA(ma,na,mb,nb,p,t,k)
#0.7072291 0.6947466 0.8919850 0.8919850

#When data set y having more than one rows
#use k = the number of rows of data set y
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,24,21,12,6,11),nrow=2)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
p<-2
t<-2
sim<-c()
for(k in 1:nrow(y)){sim<-rbind(sim,simBA(ma,na,mb,nb,p,t,k))}
sim
#       [,1]      [,2]      [,3]      [,4]
#[1,] 0.7072291 0.6947466 0.8919850 0.8919850
#[2,] 0.9410582 0.9843247 0.7380007 0.7380007
```

simC *IFS similarity measure simC*

Description

IFS similarity measure values using simC computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simC(ma, na, mb, nb, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

S.-M. Chen. Measures of similarity between vague sets. Fuzzy sets and Systems, 74(2):217 - 223, 1995.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simC(ma,na,mb,nb,k)
#[1] 0.7005061 0.7011282 0.8783314 0.8783314
```

simDC *IFS similarity measure simDC*

Description

IFS similarity measure values using simDC computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simDC(ma, na, mb, nb, ha, hb, p, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	IFS hesitancy values for the data set x
hb	IFS hesitancy values for the data set y
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

L. Dengfeng and C. Chuntian. New similarity measures of intuitionistic fuzzy sets and application to pattern recognitions. Pattern recognition letters, 23(1-3):221 - 225, 2002.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
```

```
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
p<-2
k<-1
simDC(ma,na,mb,nb,ha,hb,p,k)
#[1] 0.3553975 0.3558802 0.5378438 0.5378438
```

`simGK` *IFS similarity measure simGK*

Description

IFS similarity measure values using simGK computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simGK(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

H. Garg and K. Kumar. Distance measures for connection number sets based on set pair analysis and its applications to decision-making process. Applied Intelligence, 48(10):3346 - 3359, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simGK(ma,na,mb,nb,k)
#[1] 0.1523230 0.1534360 0.6786289 0.6786289
```

`simHK` *IFS similarity measure simHK*

Description

IFS similarity measure values using simHK computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simHK(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

D. H. Hong and C. Kim. A note on similarity measures between vague sets and between elements. Information sciences, 115(1-4):83 - 96, 1999.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simHK(ma,na,mb,nb,k)
#[1] 0.9702837 0.9702706 0.9874349 0.9874349
```

---

simHY1 *IFS similarity measure simHY1*

Description

IFS similarity measure values using simHY1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simHY1(ma, na, mb, nb, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

W.-L. Hung and M.-S. Yang. On similarity measures between intuitionistic fuzzy sets. International journal of intelligent systems, 23(3):364 - 383, 2008.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simHY1(ma,na,mb,nb,k)
#[1] 0.5562031 0.5673731 0.8158479 0.8158479
```

`simHY2` *IFS similarity measure simHY2*

Description

IFS similarity measure values using simHY2 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simHY2(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

W.-L. Hung and M.-S. Yang. On similarity measures between intuitionistic fuzzy sets. International journal of intelligent systems, 23(3):364 - 383, 2008.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simHY2(ma,na,mb,nb,k)
#[1] 0.7247430 0.7253651 0.9021400 0.9021400
```

`simHY3` *IFS similarity measure simHY3*

Description

IFS similarity measure values using simHY3 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simHY3(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

W.-L. Hung and M.-S. Yang. On similarity measures between intuitionistic fuzzy sets. International journal of intelligent systems, 23(3):364 - 383, 2008.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simHY3(ma,na,mb,nb,k)
#[1] 0.5460424 0.5468474 0.8109329 0.8109329
```

`simHY4` *IFS similarity measure simHY4*

Description

IFS similarity measure values using simHY4 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simHY4(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

W.-L. Hung and M.-S. Yang. On similarity measures between intuitionistic fuzzy sets. International journal of intelligent systems, 23(3):364 - 383, 2008.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simHY4(ma,na,mb,nb,k)
#[1] 0.7063744 0.7070477 0.8955969 0.8955969
```

`simJJLY` *IFS similarity measure simJJLY*

Description

IFS similarity measure values using simJJLY computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simJJLY(ma, na, mb, nb, ha, hb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ha`	IFS hesitancy values for the data set x
`hb`	IFS hesitancy values for the data set y
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

Q. Jiang, X. Jin, S.-J. Lee, and S. Yao. A new similarity/distance measure between intuitionistic fuzzy sets based on the transformed isosceles triangles and its applications to pattern recognition. Expert Systems with Applications, 116:439–453, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
k<-1
simJJLY(ma,na,mb,nb,ha,hb,k)
#[1] 0.7239098 0.7245767 0.8981760 0.8981760
```

---

simKKDKS *SFS similarity measure simKKDKS*

Description

SFS similarity measure values using simKKDKS computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simKKDKS(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

M. J. Khan, P. Kumam, W. Deebani,W. Kumam, and Z. Shah. Distance and similarity measures for spherical fuzzy sets and their applications in selecting mega projects. Mathematics, 8(4):519, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simKKDKS(ma,na,mb,nb,ia,ib,k)
#[1] 0.5726216 0.3223250 0.2791418 0.2791418
```

---

simL *IFS similarity measure simL*

Description

IFS similarity measure values using simL computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simL(ma, na, mb, nb, ha, hb, p, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function

nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	IFS hesitancy values for the data set x
hb	IFS hesitancy values for the data set y
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

H.-W. Liu. New similarity measures between intuitionistic fuzzy sets and between elements. Mathematical and Computer Modelling, 42(1-2):61 - 70, 2005.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
k<-1
p<-2
simL(ma,na,mb,nb,ha,hb,p,k)
#[1] 0.7022635 0.6896045 0.8890488 0.8890488
```

---

simM *IFS similarity measure simM*

Description

IFS similarity measure values using simM computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simM(ma, na, mb, nb, p, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

H. B. Mitchell. On the dengfeng–chuntian similarity measure and its application to pattern recognition. Pattern Recognition Letters, 24(16):3101 - 3104, 2003.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
p<-2
k<-1
simM(ma,na,mb,nb,p,k)
#[1] 0.3840287 0.3837673 0.3849959 0.3849959
```

simNNNG1 *PFS similarity measure simNNNG1*

Description

PFS similarity measure values using simNNNG1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simNNNG1(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. T. Nguyen, V. D. Nguyen, V. H. Nguyen, and H. Garg. Exponential similarity measures for pythagorean fuzzy sets and their applications to pattern recognition and decision-making process. Complex & Intelligent Systems, 5(2):217 - 228, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
```

```
k<-1
simNNNG1(ma,na,mb,nb,k)
#[1] 0.5885775 0.5995230 0.8202927 0.8202927
```

`simNNNG2` *PFS similarity measure simNNNG2*

Description

PFS similarity measure values using simNNNG2 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simNNNG2(ma, na, mb, nb, k)
```

Arguments

`ma`	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. T. Nguyen, V. D. Nguyen, V. H. Nguyen, and H. Garg. Exponential similarity measures for pythagorean fuzzy sets and their applications to pattern recognition and decision-making process. Complex & Intelligent Systems, 5(2):217 - 228, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
```

```
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simNNNG2(ma,na,mb,nb,k)
#[1] 0.7761019 0.7803072 0.9079870 0.9079870
```

`simNSCA` *IFS similarity measure simNSCA*

Description

IFS similarity measure values using simNSCA computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simNSCA(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

R. T. Ngan, B. C. Cuong, M. Ali, et al. H-max distance measure of intuitionistic fuzzy sets in decision making. Applied Soft Computing, 69:393 - 425, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
y<-matrix(c(11,24,21,12,6,11,15,21),nrow=1)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simNSCA(ma,na,mb,nb,k)
#[1] 0.6928792 0.6934970 0.8754130 0.8754130
```

---

simP *PFS similarity measure simP*

Description

PFS similarity measure values using simP computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simP(ma, na, mb, nb, a, b, p, t, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
a	Level of uncertainty values, values range from 1 to 10
b	Level of uncertainty values, values range from 1 to 10
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
t	Level of uncertainty values, values range from 1 to 10
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng. New similarity measure and distance measure for pythagorean fuzzy set. Complex & Intelligent Systems, 5(2):101 - 111, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
a<-2
b<-2
p<-2
t<-2
k<-1
simP(ma,na,mb,nb,a,b,p,t,k)
#[1] 0.7007663 0.6879639 0.8834981 0.8834981
```

---

simPG1 *PFS similarity measure simPG1*

Description

PFS similarity measure values using simPG1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simPG1(ma, na, mb, nb, p, l, t, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function

mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
l	Level of uncertainty values, values range from 1 to 10
t	Level of uncertainty values, values range from 1 to 10
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng and H. Garg. Multiparametric similarity measures on pythagorean fuzzy sets with applications to pattern recognition. Applied Intelligence, 49(12):4058 - 4096, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
p<-2
l<-2
t<-2
k<-1
simPG1(ma,na,mb,nb,p,l,t,k)
#[1] 0.6027082 0.5857886 0.8375740 0.8375740
```

---

simPG2 *PFS similarity measure simPG2*

Description

PFS similarity measure values using simPG2 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simPG2(ma, na, mb, nb, p, l, t, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
p	Lp norm values for measuring the p-norm distance between x and y, values range from 1 to 5
l	Level of uncertainty values, values range from 1 to 10
t	Level of uncertainty values, values range from 1 to 10
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng and H. Garg. Multiparametric similarity measures on pythagorean fuzzy sets with applications to pattern recognition. Applied Intelligence, 49(12):4058 - 4096, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
p<-2
l<-2
t<-2
k<-1
simPG2(ma,na,mb,nb,p,l,t,k)
#[1] 0.5203669 0.5000073 0.7998594 0.7998594
```

simPYY1 *PFS similarity measure simPYY1*

Description

PFS similarity measure values using simPYY1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simPYY1(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng, H. Yuan, and Y. Yang. Pythagorean fuzzy information measures and their applications. International Journal of Intelligent Systems, 32(10):991 - 1029, 2017.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simPYY1(ma,na,mb,nb,k)
#[1] 0.7253069 0.7257693 0.8985028 0.8985028
```

simPYY2 *PFS similarity measure simPYY2*

Description

PFS similarity measure values using simPYY2 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simPYY2(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng, H. Yuan, and Y. Yang. Pythagorean fuzzy information measures and their applications. International Journal of Intelligent Systems, 32(10):991 - 1029, 2017.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simPYY2(ma,na,mb,nb,k)
#[1] 0.4082725 0.4321653 0.7383688 0.7383688
```

simPYY3 *PFS similarity measure simPYY3*

Description

PFS similarity measure values using simPYY3 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simPYY3(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Peng, H. Yuan, and Y. Yang. Pythagorean fuzzy information measures and their applications. International Journal of Intelligent Systems, 32(10):991 - 1029, 2017.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simPYY3(ma,na,mb,nb,k)
#[1] 0.6973456 0.7033537 0.8813094 0.8813094
```

simSGFDK1 *SFS similarity measure simSGFDK1*

Description

SFS similarity measure values using simSGFDK1 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simSGFDK1(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
```

```
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simSGFDK1(ma,na,mb,nb,ia,ib,k)
#[1] 0.5765316 0.5799590 0.9132581 0.9132581
```

`simSGFDK2` *SFS similarity measure simSGFDK2*

Description

SFS similarity measure values using simSGFDK2 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simSGFDK2(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ia`	SFS indeterminacy membership values for the data set x
`ib`	SFS indeterminacy membership values for the data set y
`ra`	SFS refusal membership values for the data set x
`rb`	SFS refusal membership values for the data set y
`k`	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simSGFDK2(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.5582521 0.5488739 0.8922309 0.8922309
```

`simSGFDK3` *SFS similarity measure simSGFDK3*

Description

SFS similarity measure values using simSGFDK3 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simSGFDK3(ma, na, mb, nb, ia, ib, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ia`	SFS indeterminacy membership values for the data set x
`ib`	SFS indeterminacy membership values for the data set y
`k`	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simSGFDK3(ma,na,mb,nb,ia,ib,k)
#[1] 0.5433799 0.5440421 0.8018367 0.8018367
```

`simSGFDK4` *SFS similarity measure simSGFDK4*

Description

SFS similarity measure values using simSGFDK4 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simSGFDK4(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function

mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
ra	SFS refusal membership values for the data set x
rb	SFS refusal membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simSGFDK4(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.5433799 0.4910220 0.6803727 0.6803727
```

---

simSGFDK5 *SFS similarity measure simSGFDK5*

Description

SFS similarity measure values using simSGFDK5 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simSGFDK5(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simSGFDK5(ma,na,mb,nb,ia,ib,k)
#[1] 0.6563487 0.6447030 0.8547821 0.8547821
```

simSGFDK6 *SFS similarity measure simSGFDK6*

Description

SFS similarity measure values using simSGFDK6 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simSGFDK6(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
ra	SFS refusal membership values for the data set x
rb	SFS refusal membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simSGFDK6(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.6563487 0.6334610 0.7893601 0.7893601
```

---

simSGFDK7 *SFS similarity measure simSGFDK7*

Description

SFS similarity measure values using simSGFDK7 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simSGFDK7(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simSGFDK7(ma,na,mb,nb,ia,ib,k)
#[1] 0.9670246 0.9661003 0.9976603 0.9976603
```

---

simSGFDK8 *SFS similarity measure simSGFDK8*

Description

SFS similarity measure values using simSGFDK8 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simSGFDK8(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function

mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
ra	SFS refusal membership values for the data set x
rb	SFS refusal membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

S. A. S. Shishavan, F. K. Gundogdu, E. Farrokhizadeh, Y. Donyatalab, and C. Kahraman. Novel similarity measures in spherical fuzzy environment and their applications. Engineering Applications of Artificial Intelligence, 94:103837, 2020.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simSGFDK8(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.8558748 0.8421080 0.8994662 0.8994662
```

---

simSWLX *IFS similarity measure simSWLX*

Description

IFS similarity measure values using simSWLX computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simSWLX(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	IFS hesitancy values for the data set x
hb	IFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

Y. Song, X. Wang, L. Lei, and A. Xue. A new similarity measure between intuitionistic fuzzy sets and its application to pattern recognition. In Abstract and Applied Analysis, volume 2014. Hindawi, 2014.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
k<-1
simSWLX(ma,na,mb,nb,ha,hb,k)
#[1] 0.9241207 0.9180258 0.9853267 0.9853267
```

simSY *IFS similarity measure simSY*

Description

IFS similarity measure values using simSY computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simSY(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	IFS hesitancy values for the data set x
hb	IFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

L. Shi and J. Ye. Study on fault diagnosis of turbine using an improved cosine similarity measure for vague sets. Journal of Applied Sciences, 13(10):1781 - 1786, 2013.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
```

```
ha<-hmemIFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemIFS(mb,nb)
k<-1
simSY(ma,na,mb,nb,ha,hb,k)
#[1] 0.8982202 0.8904059 0.9890627 0.9890627
```

`simWW1` *PFS similarity measure simWW1*

Description

PFS similarity measure values using simWW1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simWW1(ma, na, mb, nb, k)
```

Arguments

`ma`	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simWW1(ma,na,mb,nb,k)
#[1] 0.9360206 0.9342653 0.9953501 0.9953501
```

---

simWW2 *PFS similarity measure simWW2*

Description

PFS similarity measure values using simWW2 computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simWW2(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	PFS hesitancy values for the data set x
hb	PFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simWW2(ma,na,mb,nb,ha,hb,k)
#[1] 0.7061971 0.6841839 0.9511029 0.9511029
```

---

simWW3 *PFS similarity measure simWW3*

Description

PFS similarity measure values using simWW3 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simWW3(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simWW3(ma,na,mb,nb,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

---

simWW4 *PFS similarity measure simWW4*

Description

PFS similarity measure values using simWW4 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simWW4(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simWW4(ma,na,mb,nb,k)
#[1] 0.8971627 0.8883797 0.9843815 0.9843815
```

---

simWW5 *PFS similarity measure simWW5*

Description

PFS similarity measure values using simWW5 computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simWW5(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function

ha	PFS hesitancy values for the data set x
hb	PFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simWW5(ma,na,mb,nb,ha,hb,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

---

simWW6 *PFS similarity measure simWW6*

Description

PFS similarity measure values using simWW6 computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simWW6(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	PFS hesitancy values for the data set x
hb	PFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

G.Wei and Y.Wei. Similarity measures of pythagorean fuzzy sets based on the cosine function and their applications. International Journal of Intelligent Systems, 33(3):634 - 652, 2018.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simWW6(ma,na,mb,nb,ha,hb,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

simWWLWW1 *SFS similarity measure simWWLWW1*

Description

SFS similarity measure values using simWWLWW1 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simWWLWW1(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
```

```
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simWWLWW1(ma,na,mb,nb,ia,ib,k)
#[1] 0.9357619 0.9339882 0.9953291 0.9953291
```

`simWWLWW10` *SFS similarity measure simWWLWW10*

Description

SFS similarity measure values using simWWLWW10 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simWWLWW10(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ia`	SFS indeterminacy membership values for the data set x
`ib`	SFS indeterminacy membership values for the data set y
`ra`	SFS refusal membership values for the data set x
`rb`	SFS refusal membership values for the data set y
`k`	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simWWLWW10(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.04488958 0.04334510 0.08280306 0.08280306
```

`simWWLWW2` *SFS similarity measure simWWLWW2*

Description

SFS similarity measure values using simWWLWW2 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simWWLWW2(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ia`	SFS indeterminacy membership values for the data set x
`ib`	SFS indeterminacy membership values for the data set y
`ra`	SFS refusal membership values for the data set x
`rb`	SFS refusal membership values for the data set y
`k`	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simWWLWW2(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.7092608 0.6874359 0.9519182 0.9519182
```

---

simWWLWW3 *SFS similarity measure simWWLWW3*

Description

SFS similarity measure values using simWWLWW3 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simWWLWW3(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function

mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simWWLWW3(ma,na,mb,nb,ia,ib,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

---

simWWLWW4 *SFS similarity measure simWWLWW4*

Description

SFS similarity measure values using simWWLWW4 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simWWLWW4(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simWWLWW4(ma,na,mb,nb,ia,ib,k)
#[1] 0.8946430 0.8856546 0.9840049 0.9840049
```

simWWLWW5 *SFS similarity measure simWWLWW5*

Description

SFS similarity measure values using simWWLWW5 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simWWLWW5(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
ra	SFS refusal membership values for the data set x
rb	SFS refusal membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
```

```
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simWWLWW5(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

`simWWLWW6` *SFS similarity measure simWWLWW6*

Description

SFS similarity measure values using simWWLWW6 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simWWLWW6(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

`ma`	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ia`	SFS indeterminacy membership values for the data set x
`ib`	SFS indeterminacy membership values for the data set y
`ra`	SFS refusal membership values for the data set x
`rb`	SFS refusal membership values for the data set y
`k`	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simWWLWW6(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.7362461 0.7150021 0.9511755 0.9511755
```

---

simWWLWW7 *SFS similarity measure simWWLWW7*

Description

SFS similarity measure values using simWWLWW7 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simWWLWW7(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function

ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simWWLWW7(ma,na,mb,nb,ia,ib,k)
#[1] 0.04488958 0.04334510 0.08280306 0.08280306
```

---

simWWLWW8 *SFS similarity measure simWWLWW8*

Description

SFS similarity measure values using simWWLWW8 computation technique with membership,non-membership, and indeterminacy membership values of two objects or set of objects.

Usage

```
simWWLWW8(ma, na, mb, nb, ia, ib, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
k<-1
simWWLWW8(ma,na,mb,nb,ia,ib,k)
#[1] 0.06899567 0.06819133 0.09416530 0.09416530
```

simWWLWW9 *SFS similarity measure simWWLWW9*

Description

SFS similarity measure values using simWWLWW9 computation technique with membership,non-membership, indeterminacy membership, and refusal membership values of two objects or set of objects.

Usage

```
simWWLWW9(ma, na, mb, nb, ia, ib, ra, rb, k)
```

Arguments

ma	SFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	SFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	SFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	SFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ia	SFS indeterminacy membership values for the data set x
ib	SFS indeterminacy membership values for the data set y
ra	SFS refusal membership values for the data set x
rb	SFS refusal membership values for the data set y
k	A constant value, considered as 1

Value

The SFS similarity values of data set y with data set x

References

G. Wei, J. Wang, M. Lu, J. Wu, and C. Wei. Similarity measures of spherical fuzzy sets based on cosine function and their applications. IEEE Access, 7:159069 - 159080, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
```

```
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ia<-imemSFS(ma,na)
ra<-rmemSFS(ma,na,ia)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
ib<-imemSFS(mb,nb)
rb<-rmemSFS(mb,nb,ib)
k<-1
simWWLWW9(ma,na,mb,nb,ia,ib,ra,rb,k)
#[1] 0.04488958 0.04334510 0.08280306 0.08280306
```

`simY` *IFS similarity measure simY*

Description

IFS similarity measure values using simY computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simY(ma, na, mb, nb, k)
```

Arguments

`ma`	IFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	IFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	IFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	IFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`k`	A constant value, considered as 1

Value

The IFS similarity values of data set y with data set x

References

J. Ye. Cosine similarity measures for intuitionistic fuzzy sets and their applications. Mathematical and computer modelling, 53(1-2):91 - 97, 2011.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simY(ma,na,mb,nb,k)
#[1] 0.9024655 0.8950394 0.9898896 0.9898896
```

`simZ` *PFS similarity measure simZ*

Description

PFS similarity measure values using simZ computation technique with membership,non-membership, and hesitancy values of two objects or set of objects.

Usage

```
simZ(ma, na, mb, nb, ha, hb, k)
```

Arguments

`ma`	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
`na`	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
`mb`	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
`nb`	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
`ha`	PFS hesitancy values for the data set x
`hb`	PFS hesitancy values for the data set y
`k`	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

X. Zhang. A novel approach based on similarity measure for pythagorean fuzzy multiple criteria group decision making. International Journal of Intelligent Systems, 31(6):593 - 611, 2016.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simZ(ma,na,mb,nb,ha,hb,k)
#[1] 0.6128632 0.6335697 0.7722389 0.7722389
```

---

simZHFLL1 *PFS similarity measure simZHFLL1*

Description

PFS similarity measure values using simZHFLL1 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simZHFLL1(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

Q. Zhang, J. Hu, J. Feng, A. Liu, and Y. Li. New similarity measures of pythagorean fuzzy sets and their applications. IEEE Access, 7:138192 - 138202, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simZHFLL1(ma,na,mb,nb,k)
#[1] 0.4742565 0.4823949 0.7745995 0.7745995
```

---

simZHFLL2 *PFS similarity measure simZHFLL2*

Description

PFS similarity measure values using simZHFLL2 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simZHFLL2(ma, na, mb, nb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

Q. Zhang, J. Hu, J. Feng, A. Liu, and Y. Li. New similarity measures of pythagorean fuzzy sets and their applications. IEEE Access, 7:138192 - 138202, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
k<-1
simZHFLL2(ma,na,mb,nb,k)
#[1] 0.6572330 0.6610095 0.8652155 0.8652155
```

---

simZHFLL3 *PFS similarity measure simZHFLL3*

Description

PFS similarity measure values using simZHFLL3 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simZHFLL3(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function

ha	PFS hesitancy values for the data set x
hb	PFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

Q. Zhang, J. Hu, J. Feng, A. Liu, and Y. Li. New similarity measures of pythagorean fuzzy sets and their applications. IEEE Access, 7:138192 - 138202, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simZHFLL3(ma,na,mb,nb,ha,hb,k)
#[1] 0.4742565 0.4823949 0.7745995 0.7745995
```

---

simZHFLL4 *PFS similarity measure simZHFLL4*

Description

PFS similarity measure values using simZHFLL4 computation technique with membership, and non-membership values of two objects or set of objects.

Usage

```
simZHFLL4(ma, na, mb, nb, ha, hb, k)
```

Arguments

ma	PFS membership values for the data set x computed using either triangular or trapezoidal or guassian membership function
na	PFS non-membership values for the data set x computed using either Sugeno and Terano's or Yager's non-membership function
mb	PFS membership values for the data set y computed using either triangular or trapezoidal or guassian membership function
nb	PFS non-membership values for the data set y computed using either Sugeno and Terano's or Yager's non-membership function
ha	PFS hesitancy values for the data set x
hb	PFS hesitancy values for the data set y
k	A constant value, considered as 1

Value

The PFS similarity values of data set y with data set x

References

Q. Zhang, J. Hu, J. Feng, A. Liu, and Y. Li. New similarity measures of pythagorean fuzzy sets and their applications. IEEE Access, 7:138192 - 138202, 2019.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
y<-matrix(c(11,21,6),nrow=1)
a<-mn(x)
b<-std(x)
a1<-mn(y)
b1<-std(y)
lam<-0.5
ma<-memG(a,b,x)
na<-nonmemS(ma,lam)
ha<-hmemPFS(ma,na)
mb<-memG(a1,b1,y)
nb<-nonmemS(mb,lam)
hb<-hmemPFS(mb,nb)
k<-1
simZHFLL4(ma,na,mb,nb,ha,hb,k)
#[1] 0.4742565 0.4823949 0.7745995 0.7745995
```

std *Standard deviation values*

Description

Standard deviation of the data set for gaussian membership function

Usage

```
std(x)
```

Arguments

x	A data set in the form of document-term matrix

Value

Standard deviation values for individual row of the input data set X.

Examples

```
x<-matrix(c(12,9,14,11,21,16,15,24,20,17,14,11),nrow=4)
std(x)
#[1] 4.9328829 4.3588989 0.5773503 7.5055535
```

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