Package 'Rfmtool'

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Title Fuzzy Measure Tools

Author Gleb Beliakov [aut, cre],
Quan Vu [ctb],
Andrei Kelarev [ctb],
Michel Berkelaar [ctb],
Kjell Eikland [ctb],
Samuel E. Buttrey [ctb],
Stefan I. Larimore [ctb],
Timothy A. Davis [ctb],
John Gilbert [ctb],
Esmond Ng [ctb],
Peter Notebaert [ctb],
Richard Stallman [ctb],
Jeroen Dirks [ctb]

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

Depends R (>= 2.9.2)

Suggests

Description Various tools for handling fuzzy measures, calculating Shapley value and interaction index, Choquet and Sugeno integrals, as well as fitting fuzzy measures to empirical data are provided. Construction of fuzzy measures from empirical data is done by solving a linear programming problem by using 'lpsolve' package, whose source in C adapted to the R environment is included. The description of the basic theory of fuzzy measures is in the manual in the Doc folder in this package.

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NeedsCompilation yes

Repository CRAN

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R topics documented:

`fm` *Rfmtool package*

Description

This function shows a list of function included in this toolbox

Usage

```
fm()
```

Details

The following functions involve the parameters v (the array containing the fuzzy measure in standard representation) or Mob (in Mobius representation), n - the dimension and m = 2^n. The values of the fuzzy measure always obey the binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272. [3] G. Beliakov, H. Bustince, T. Calvo, A Practical guide to Averaging, Springer, Berlin, New York, 2016. [4] G. Beliakov, Programming Library Fmtools for Handling and Fiffing Fuzzy Measures, User manual, provided with this package in the Doc folder.

Examples

```
fm()
```

`fm.Banzhaf` *Banzhaf value computation function*

Description

Calculates the Banzhaf indices of input criteria from general fuzzy measure.

Usage

```
fm.Banzhaf(v,env=NULL)
```

Arguments

`v`	is fuzzy measure in general representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size n, which contain Banzhaf indices of input criteria.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Banzhaf(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.BanzhafMob` *Banzhaf value computation function*

Description

Calculates the Banzhaf indices of input criteria from general fuzzy measure in Mobius representation.

Usage

```
fm.BanzhafMob(Mob,env=NULL)
```

Arguments

`Mob`	is fuzzy measure in Mobius representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size n, which contain Banzhaf indices of input criteria.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.BanzhafMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.Bipartition` *Bipartition interaction index computation function*

Description

Calculates the Bipartition interaction indices of input criteria from general fuzzy measure.

Usage

```
fm.Bipartition(v,env=NULL)
```

Arguments

`v`	is fuzzy measure in general representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size 2^n, which contain bipartition interaction indices of input criteria coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Bipartition(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.BipartitionBanzhaf` *Bipartition Banhzaf interaction index computation function*

Description

Calculates the Banzhaf Bipartition interaction indices of input criteria from general fuzzy measure.

Usage

```
fm.BipartitionBanzhaf(v,env=NULL)
```

Arguments

`v`	is fuzzy measure in general representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size 2^n, which contain Banzhaf bipartition interaction indices of input criteria coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.BipartitionBanzhaf(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.Choquet` *Choquet function*

Description

Calculates the value of a discrete Choquet integral of input x, with fuzzy measure in general representation

Usage

```
fm.Choquet(x, v, env=NULL)
```

Arguments

`x`	input vector of size n, containing utility value of input criteria. x is in [0,1].
`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is a single value of the computed Choquet integral.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Choquet(c(0.6, 0.3, 0.8), c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.ChoquetMob` *ChoquetMob function*

Description

This is an alternative calculation of the Choquet integral from the fuzzy measure in Mobius representation.

Usage

```
fm.ChoquetMob(x, Mob, env=NULL)
```

Arguments

`x`	input vector of size n, containing utility value of input criteria. x is in [0,1].
`Mob`	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	the ouput is a single value of the computed Choquet integral.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.ChoquetMob(c(0.6, 0.3, 0.8), c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.ConstructLambdaMeasure` *ConstructLambdaMeasure function*

Description

Finds the value of lambda and calculates the rest of the values of the fuzzy measure, given its values at singletons; singletons is an array of size n. The outputs are lambda and v, v is in standard representation and binary ordering.

Usage

```
fm.ConstructLambdaMeasure(singletons,env)
```

Arguments

`singletons`	singletons is an array of n.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is the list (lambda, measure), where measure is a fuzzy measure in standard representation.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
w <- fm.ConstructLambdaMeasure(c(0, 0.3, 0.5),env)
```

fm.ConstructLambdaMeasureMob

ConstructLambdaMeasureMob function

Description

Finds the value of lambda and calculates the rest of the values of the fuzzy measure, given its values at singletons; singletons is an array of size n. The outputs are lambda and measure, measure is in Mobius representation.

Usage

```
fm.ConstructLambdaMeasureMob(singletons,env)
```

Arguments

singletons	singletons is an array of n.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is the list (lambda, measure), where measure is a fuzzy measure in Mobius representation.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
w <- fm.ConstructLambdaMeasureMob(c(0, 0.3, 0.5),env)
w$measure
```

`fm.dualm` *dualm function*

Description

Calculates the dual of fuzzy measure v, returns it as value of the function (array of size m).

Usage

```
fm.dualm(v, env=NULL)
```

Arguments

`v`	the general fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from emperical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is an array of size m with the dual of fuzzy measure v.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
w <- fm.dualm(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.dualmMob` *dualm function*

Description

Calculates the dual of fuzzy measure v, returns it as value of the function (array of size m).

Usage

```
fm.dualmMob(Mob,env=NULL)
```

Arguments

`Mob`	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from emperical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is an array of size m with the dual of fuzzy measure v.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
w <- fm.dualm(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.EntropyChoquet` *EntropyChoquet function*

Description

Calculates entropy value of the Choquet integral for the fuzzy measure v in general representation

Usage

```
fm.EntropyChoquet(v,env)
```

Arguments

`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is entropy value of the Choquet integral for the fuzzy measure.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A EntropyChoquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.EntropyChoquet(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1))
```

`fm.EntropyChoquetMob` *EntropyChoquet function*

Description

Calculates entropy value of the Choquet integral for the fuzzy measure v in Mobius representation

Usage

```
fm.EntropyChoquetMob(Mob,env)
```

Arguments

`Mob`	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is entropy value of the Choquet integral for the fuzzy measure.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A EntropyChoquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.EntropyChoquetMob(c(0.0,0.3,0.5,-0.2,0.4,0.1,-0.2,0.1),env)
```

fm.errorcheck *Basic error check*

Description

This function checks that the enviromnemt variable is internally consistent.

Usage

```
fm.errorcheck(env)
```

Arguments

env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is TRUE or FALSE.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.errorcheck(env)
```

fm.fitting *Fuzzy Measure Fitting function*

Description

Esimate values of the fuzzy measures from empirical data.

Usage

```
fm.fitting(data, env=NULL, kadd="NA")
```

Arguments

data	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
env	Environment variable obtained from fm.Init(n).
kadd	is the value of k-additivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n.

Value

output	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
```

```
       ncol=4);
fm.fitting(d,env)
```

`fm.fittingKinteractive`

Fuzzy Measure Fitting function

Description

Esimate values of the k-interacive fuzzy measures from empirical data.

Usage

```
fm.fittingKinteractive(data, env=NULL, kadd="NA", K="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-interactivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = 2.
`K`	is the value of FM value for sets of cardinality kadd+1, its default value is K = 0.5.

Value

`output`	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKinteractive(d,env,2,0.8)
```

`fm.fittingKinteractiveAuto`

Fuzzy Measure Fitting function

Description

Esimate values of the k-interacive fuzzy measures from empirical data.

Usage

```
fm.fittingKinteractiveAuto(data, env=NULL, kadd="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).

kadd — is the value of k-interactivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = 2. The constant K the value of FM value for sets of cardinality kadd+1 is computed from data.

Value

output — The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
            0.808716, 0.584991, 0.479858, 0.544309,
            0.350281, 0.895935, 0.822815, 0.625868,
            0.746582, 0.174103, 0.858917, 0.480347,
            0.71048, 0.513519, 0.303986, 0.387631,
            0.0149841, 0.0914001, 0.364441, 0.134229,
            0.147308, 0.165894, 0.988495, 0.388044,
            0.445679, 0.11908, 0.00466919, 0.0897714,
            0.00891113, 0.377869, 0.531647, 0.258585,
            0.571167, 0.601746, 0.607147, 0.589803,
            0.166229, 0.663025, 0.450775, 0.357412,
            0.352112, 0.0570374, 0.607666, 0.270228,
            0.783295, 0.802582, 0.519867, 0.583348,
            0.301941, 0.875946, 0.726654, 0.562174,
            0.955872, 0.92569, 0.539337, 0.633631,
            0.142334, 0.462067, 0.235321, 0.228419,
            0.862213, 0.209595, 0.779633, 0.498077,
            0.843628, 0.996765, 0.999664, 0.930197,
            0.611481, 0.92426, 0.266205, 0.334666,
            0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKinteractiveAuto(d,env,2)
```

`fm.fittingKinteractiveMarginal` *Fuzzy Measure Fitting function*

Description

Esimate values of the k-interacive fuzzy measures from empirical data using marginal representation.

Usage

```
fm.fittingKinteractiveMarginal(data, env=NULL, kadd="NA", K="NA", submod ="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-interactivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = 2.
`K`	The constant K the value of FM value for sets of cardinality kadd+1 is computed from data, default 0.5.
`submod`	-1 indicates supermodular FM is needed, +1 inducates submodular, 0 otherwise. Should be consistent with K and n, see manual

Value

`output`	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
            0.808716, 0.584991, 0.479858, 0.544309,
            0.350281, 0.895935, 0.822815, 0.625868,
            0.746582, 0.174103, 0.858917, 0.480347,
            0.71048, 0.513519, 0.303986, 0.387631,
            0.0149841, 0.0914001, 0.364441, 0.134229,
            0.147308, 0.165894, 0.988495, 0.388044,
            0.445679, 0.11908, 0.00466919, 0.0897714,
            0.00891113, 0.377869, 0.531647, 0.258585,
            0.571167, 0.601746, 0.607147, 0.589803,
            0.166229, 0.663025, 0.450775, 0.357412,
            0.352112, 0.0570374, 0.607666, 0.270228,
            0.783295, 0.802582, 0.519867, 0.583348,
            0.301941, 0.875946, 0.726654, 0.562174,
            0.955872, 0.92569, 0.539337, 0.633631,
            0.142334, 0.462067, 0.235321, 0.228419,
            0.862213, 0.209595, 0.779633, 0.498077,
            0.843628, 0.996765, 0.999664, 0.930197,
            0.611481, 0.92426, 0.266205, 0.334666,
            0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKinteractiveMarginal(d,env,2,0.6, 0)
```

`fm.fittingKinteractiveMarginalMC`

Fuzzy Measure Fitting function

Description

Esimate values of the k-interacive fuzzy measures from empirical data using marginal representation and maximal chains method.

Usage

```
fm.fittingKinteractiveMarginalMC(data, env=NULL, kadd="NA", K="NA", submod ="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.

env	Environment variable obtained from fm.Init(n).
kadd	is the value of k-interactivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = 2.
K	The constant K the value of FM value for sets of cardinality kadd+1 is computed from data, default 0.5.
submod	-1 indicates supermodular FM is needed, +1 inducates submodular, 0 otherwise. Should be consistent with K and n, see manual

Value

output	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKinteractiveMarginalMC(d,env,2,0.6,0)
```

`fm.fittingKinteractiveMC` *Fuzzy Measure Fitting function*

Description

Esimate values of the k-interacive fuzzy measures from empirical data using maximal chains method.

Usage

```
fm.fittingKinteractiveMC(data, env=NULL, kadd="NA", K="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-interactivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = 2.
`K`	The constant K the value of FM value for sets of cardinality kadd+1 is computed from data, default 0.5.

Value

`output`	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
            0.808716, 0.584991, 0.479858, 0.544309,
            0.350281, 0.895935, 0.822815, 0.625868,
            0.746582, 0.174103, 0.858917, 0.480347,
            0.71048, 0.513519, 0.303986, 0.387631,
            0.0149841, 0.0914001, 0.364441, 0.134229,
            0.147308, 0.165894, 0.988495, 0.388044,
            0.445679, 0.11908, 0.00466919, 0.0897714,
            0.00891113, 0.377869, 0.531647, 0.258585,
            0.571167, 0.601746, 0.607147, 0.589803,
            0.166229, 0.663025, 0.450775, 0.357412,
            0.352112, 0.0570374, 0.607666, 0.270228,
            0.783295, 0.802582, 0.519867, 0.583348,
            0.301941, 0.875946, 0.726654, 0.562174,
            0.955872, 0.92569, 0.539337, 0.633631,
            0.142334, 0.462067, 0.235321, 0.228419,
            0.862213, 0.209595, 0.779633, 0.498077,
            0.843628, 0.996765, 0.999664, 0.930197,
            0.611481, 0.92426, 0.266205, 0.334666,
            0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKinteractiveMC(d,env,2,0.6)
```

`fm.fittingKmaxitive` *Fuzzy Measure Fitting function*

Description

Esimate values of the k-maxitive fuzzy measures from empirical data.

Usage

```
fm.fittingKmaxitive(data, env=NULL, kadd="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-maxitivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n.

Value

`output` The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingKmaxitive(d,env,2)
```

`fm.fittingKtolerant` *Fuzzy Measure Fitting function*

Description

Esimate values of the k-tolerant fuzzy measures from empirical data.

Usage

```
fm.fittingKtolerant(data, env=NULL, kadd="NA")
```

Arguments

data	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
env	Environment variable obtained from fm.Init(n).
kadd	is the value of k-tolerance, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n.

Value

output	The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
            0.808716, 0.584991, 0.479858, 0.544309,
            0.350281, 0.895935, 0.822815, 0.625868,
            0.746582, 0.174103, 0.858917, 0.480347,
            0.71048, 0.513519, 0.303986, 0.387631,
            0.0149841, 0.0914001, 0.364441, 0.134229,
            0.147308, 0.165894, 0.988495, 0.388044,
            0.445679, 0.11908, 0.00466919, 0.0897714,
            0.00891113, 0.377869, 0.531647, 0.258585,
            0.571167, 0.601746, 0.607147, 0.589803,
            0.166229, 0.663025, 0.450775, 0.357412,
            0.352112, 0.0570374, 0.607666, 0.270228,
            0.783295, 0.802582, 0.519867, 0.583348,
            0.301941, 0.875946, 0.726654, 0.562174,
            0.955872, 0.92569, 0.539337, 0.633631,
            0.142334, 0.462067, 0.235321, 0.228419,
            0.862213, 0.209595, 0.779633, 0.498077,
```

```
            0.843628, 0.996765, 0.999664, 0.930197,
            0.611481, 0.92426, 0.266205, 0.334666,
            0.297272, 0.840118, 0.0237427, 0.168081),
          nrow=20,
          ncol=4);
fm.fittingKtolerant(d,env,2)
```

`fm.fittingMob` *Mobius Fuzzy Measure Fitting function*

Description

Esimate values of the Mobius fuzzy measures from empirical data.

Usage

```
fm.fittingMob(data, env=NULL ,kadd="NA")
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 store the observed aggregating value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-additivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n.

Value

`output`	The output is an array of size 2^n containing estimated Mobius fuzzy measure in binary ordering.

Note

The fit might not be perfect, and not all the constraints can be fully met.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
env<-fm.Init(3)
fm.fittingMob(d,env)
```

`fm.fittingOWA` *Symmetric Fuzzy Measure Fitting function*

Description

Esimate values of the symmetric fuzzy measures from empirical data. The resulting Choquet integral is the OWA function.

Usage

```
fm.fittingOWA(data, env=NULL)
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
`env`	Environment variable obtained from fm.Init(n).

Value

output The output is an array of size n containing estimated OWA coefficients.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
            0.808716, 0.584991, 0.479858, 0.544309,
            0.350281, 0.895935, 0.822815, 0.625868,
            0.746582, 0.174103, 0.858917, 0.480347,
            0.71048, 0.513519, 0.303986, 0.387631,
            0.0149841, 0.0914001, 0.364441, 0.134229,
            0.147308, 0.165894, 0.988495, 0.388044,
            0.445679, 0.11908, 0.00466919, 0.0897714,
            0.00891113, 0.377869, 0.531647, 0.258585,
            0.571167, 0.601746, 0.607147, 0.589803,
            0.166229, 0.663025, 0.450775, 0.357412,
            0.352112, 0.0570374, 0.607666, 0.270228,
            0.783295, 0.802582, 0.519867, 0.583348,
            0.301941, 0.875946, 0.726654, 0.562174,
            0.955872, 0.92569, 0.539337, 0.633631,
            0.142334, 0.462067, 0.235321, 0.228419,
            0.862213, 0.209595, 0.779633, 0.498077,
            0.843628, 0.996765, 0.999664, 0.930197,
            0.611481, 0.92426, 0.266205, 0.334666,
            0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
fm.fittingOWA(d,env)
```

`fm.fittingWAM` *Additive Fuzzy Measure Fitting function*

Description

Esimate values of an additive fuzzy measure from empirical data. In this case the Choquet integral is the weighted arithmetic mean WAM.

Usage

```
fm.fittingWAM(data, env=NULL)
```

Arguments

data	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector containing utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 stores the observed aggregated value y.
env	Environment variable obtained from fm.Init(n).

Value

output	The output is an array of size n containing estimated weighting vector of WAM.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
```

```
      ncol=4);
fm.fittingWAM(d,env)
```

`fm.FuzzyMeasureFitLP` *Fuzzy Measure Fitting function.*

Description

Esimates values of the fuzzy measures from empirical data. The result is an array containing the values of a standard fuzzy measure in binary ordering. kadd defines the complexity of fuzzy measure. If kadd is not provided, its default value is equal to the number of inputs.

Usage

```
fm.FuzzyMeasureFitLP(data, env=NULL, kadd="NA",
        options=0, indexlow=(NULL), indexhigh=(NULL) , option1=0, orness=(NULL)
)
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector contains utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 store the observed aggregating value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-additivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n. kadd is k in k-additive f-measure, 1 < kadd < n+1; if kdd=n - f.m. is unrestricted
`options`	options (default value is 0) 1 - lower bounds on Shapley values supplied in indexlow, 2 - upper bounds on Shapley values supplied in indexhigh, 3 - lower and upper bounds on Shapley values supplied in indexlow and indexhigh, 4 - lower bounds on all interaction indices supplied in indexlow, 5 - upper bounds on all interaction indices supplied in indexhigh, 6 - lower and upper bounds on all interaction indices supplied inindexlow and indexhigh. All these value will be treated as additional constraints in the LP.
`indexlow`	array of size n (options =1,2,3) or m (options=4,5,6) containing the lower bounds on the Shapley values or interaction indices
`indexhigh`	array of size n (options =1,2,3) or m (options=4,5,6) containing the upper bounds on the Shapley values or interaction indices
`option1`	if the value is 1, the interval of orness values will be fitted (and the desired low and high orness values should be provided). If 0, no additional orness constraints.
`orness`	array of size 2, for example c(0.1,1)

Value

`output` The output is an array of size 2^n containing estimated standard fuzzy measure in binary ordering.

Note

The fit might not be perfect, and not all the constraints can be fully met.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
env<-fm.Init(3)
fm.FuzzyMeasureFitLP(d,env)
indexlow=c(0.1,0.1,0.2);
indexhigh=c(0.9,0.9,0.5);
fm.FuzzyMeasureFitLP(d,env, kadd=2, indexlow, indexhigh,
  options=3, option1=1, orness=c(0.1,0.7))
```

`fm.FuzzyMeasureFitLPMob` *Mobius Fuzzy Measure Fitting function, R wrapper for FuzzyMeasureFitLP() in fuzzymeasurefit.cpp*

Description

Esimate values of the Mobius fuzzy measures from empirical data. The result is an array containing the values of the fuzzy measure in Mobius, ordered according to set cardinalities. kadd defines the complexity of fuzzy measure. if kadd is not provided, its default value is equal to the number of inputs.

Usage

```
fm.FuzzyMeasureFitLPMob(data, env=NULL, kadd="NA",
        options=0, indexlow=(NULL), indexhigh=(NULL) , option1=0, orness=(NULL)
)
```

Arguments

`data`	is the empirical data set in pairs (x_1,y_1),(x_2,y_2),...,(x_d,y_d) where x_i in [0,1]^n is a vector contains utility values of n input criteria x_i1,x_i2,...,x_in, y_i in [0,1] is a single aggregated value given by decision makers. The data is stored as a matrix of M by n+1 elements, where M is the number of data instances, and n is the number of input criteria, the column n + 1 store the observed aggregating value y.
`env`	Environment variable obtained from fm.Init(n).
`kadd`	is the value of k-additivity, which is used for reducing the complexity of fuzzy measures. kadd is defined as an optional argument, its default value is kadd = n. kadd is k in k-additive f-measure, 1 < kadd < n+1; if kdd=n - f.m. is unrestricted
`options`	options (default value is 0) 1 - lower bounds on Shapley values supplied in indexlow, 2 - upper bounds on Shapley values supplied in indexhigh, 3 - lower and upper bounds on Shapley values supplied in indexlow and indexhigh, 4 - lower bounds on all interaction indices supplied in indexlow, 5 - upper bounds on all interaction indices supplied in indexhigh, 6 - lower and upper bounds on all interaction indices supplied inindexlow and indexhigh. All these value will be treated as additional constraints in the LP.
`indexlow`	array of size n (options =1,2,3) or m (options=4,5,6) containing the lower bounds on the Shapley values or interaction indices
`indexhigh`	array of size n (options =1,2,3) or m (options=4,5,6) containing the upper bounds on the Shapley values or interaction indices
`option1`	if the value is 1, the interval of orness values will be fitted (and the desired low and high orness values should be provided). If 0, no additional orness constraints.
`orness`	array of size 2, for example c(0.1,1)

Value

`output` The output is an array of size 2^n containing estimated Mobius fuzzy measure in binary ordering.

Note

The fit might not be perfect, and not all the constraints can be fully met.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
d <-  matrix( c( 0.00125122, 0.563568, 0.193298, 0.164338,
             0.808716, 0.584991, 0.479858, 0.544309,
             0.350281, 0.895935, 0.822815, 0.625868,
             0.746582, 0.174103, 0.858917, 0.480347,
             0.71048, 0.513519, 0.303986, 0.387631,
             0.0149841, 0.0914001, 0.364441, 0.134229,
             0.147308, 0.165894, 0.988495, 0.388044,
             0.445679, 0.11908, 0.00466919, 0.0897714,
             0.00891113, 0.377869, 0.531647, 0.258585,
             0.571167, 0.601746, 0.607147, 0.589803,
             0.166229, 0.663025, 0.450775, 0.357412,
             0.352112, 0.0570374, 0.607666, 0.270228,
             0.783295, 0.802582, 0.519867, 0.583348,
             0.301941, 0.875946, 0.726654, 0.562174,
             0.955872, 0.92569, 0.539337, 0.633631,
             0.142334, 0.462067, 0.235321, 0.228419,
             0.862213, 0.209595, 0.779633, 0.498077,
             0.843628, 0.996765, 0.999664, 0.930197,
             0.611481, 0.92426, 0.266205, 0.334666,
             0.297272, 0.840118, 0.0237427, 0.168081),
       nrow=20,
       ncol=4);
env<-fm.Init(3)
fm.FuzzyMeasureFitLPMob(d,env)
indexlow=c(0.1,0.1,0.2);
indexhigh=c(0.9,0.9,0.5);
fm.FuzzyMeasureFitLPMob(d,env, kadd=2, indexlow, indexhigh,
  options=3, option1=1, orness=c(0.1,0.7))
```

fm.Init *Initialisation function*

Description

This function initialises the internal structures which makes computations faster. The structures are saved in the output environment variable, which should be subsequently passed to other functions. Several environment variables (for different dimensions) can be initialised at the same time.

Usage

```
fm.Init(n1)
```

Arguments

n1	the number of variables.

Value

output	The ouput is the enviromnet variable containing the internal structures.

Author(s)

Gleb Beliakov

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
```

fm.Interaction *Interaction Index computation function*

Description

Calculates all the interaction indices of input criteria for standard fuzzy measure.

Usage

```
fm.Interaction(v,env)
```

Arguments

v	fuzzy measure value in standard representation
env	Environment variable obtained from fm.Init(n).

Value

output	the output is a matrix, whose first column stores the interaction index values, and the second column stores the indices of criteria in coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Interaction(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

---

fm.InteractionB *Banzhaf Interaction Index computation function*

Description

Calculates all the Banzhaf Interaction indices of input criteria for a standard fuzzy measure.

Usage

```
fm.InteractionB(v,env)
```

Arguments

v	fuzzy measure value in standard representation
env	Environment variable obtained from fm.Init(n).

Value

output	the output is a matrix, whose first column stores the Banzhaf Interaction index values, and the second column stores the indices of criteria in coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.InteractionB(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

---

fm.InteractionBMob *Banzhaf InteractionB Index computation function*

Description

Calculates all the Banzhaf InteractionB indices of input criteria for a Mobius fuzzy measure.

Usage

```
fm.InteractionBMob(Mob,env)
```

Arguments

Mob	fuzzy measure value in Mobius representation
env	Environment variable obtained from fm.Init(n).

Value

output	the output is a matrix, whose first column stores the Banzhaf Interaction index values, and the second column stores the indices of criteria in coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.InteractionBMob(c( 0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.InteractionMob` *Interaction Index computation function for Mobius fuzzy measure*

Description

Calculates all the interaction indices of input criteria for a Mobius fuzzy measure.

Usage

```
fm.InteractionMob(Mob,env )
```

Arguments

`Mob`	fuzzy measure value in Mobius representation
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	the output is a matrix, whose first column stores the interaction index values, and the second column stores the indices of criteria in coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.InteractionMob(c( 0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureAdditive` *IsMeasureAdditive function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureAdditive(v,env)
```

Arguments

v	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureAdditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureAdditive(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureAdditiveMob *IsMeasureAdditiveMob function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureAdditiveMob(Mob,env)
```

Arguments

Mob	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureAdditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureAdditiveMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureBalanced` *IsMeasureBalanced function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureBalanced(v,env)
```

Arguments

`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureBalanced integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureBalanced(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureBalancedMob *IsMeasureBalancedMob function*

Description

Returns 1 if yes, 0 if no; Mob is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureBalancedMob(Mob,env)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from emperical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureBalanced integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureBalancedMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureKmaxitive` *IsMeasureKmaxitive function*

Description

Returns k; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureKmaxitive(v,env=NULL)
```

Arguments

v	the general fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is k. If k=n then not k-maxitive

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A fuzzy integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureKmaxitive(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureKmaxitiveMob *IsMeasureKmaxitive function*

Description

Returns k; mob is a fuzzy measure in Moebius representation.

Usage

```
fm.IsMeasureKmaxitiveMob(Mob,env=NULL)
```

Arguments

Mob	the general fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is k. If k=n then not k-maxitive

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A fuzzy integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureKmaxitiveMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSelfdual` *IsMeasureSelfdual function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSelfdual(v,env)
```

Arguments

v	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSelfdual integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSelfdual(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSelfdualMob *IsMeasureSelfdualMob function*

Description

Returns 1 if yes, 0 if no; Mob is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSelfdualMob(Mob,env)
```

Arguments

Mob	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSelfdual integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSelfdualMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSubadditive` *IsMeasureSubadditive function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSubadditive(v,env)
```

Arguments

`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSubadditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSubadditive(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSubadditiveMob
IsMeasureSubadditiveMob function

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSubadditiveMob(Mob,env)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSubadditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSubadditiveMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSubmodular` *IsMeasureSubmodular function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSubmodular(v,env=NULL)
```

Arguments

`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSubmodular integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSubmodular(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSubmodularMob
IsMeasureSubmodularMob function

Description

Returns 1 if yes, 0 if no; Mob is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSubmodularMob(Mob,env=NULL)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSubmodular integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSubmodularMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSuperadditive` *IsMeasureSuperadditive function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSuperadditive(v,env=NULL)
```

Arguments

`v`	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSuperadditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSuperadditive(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSuperadditiveMob
IsMeasureSuperadditiveMob function

Description

Returns 1 if yes, 0 if no; Mob is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSuperadditiveMob(Mob,env=NULL)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSuperadditive integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSuperadditiveMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSupermodular` *IsMeasureSupermodular function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSupermodular(v,env=NULL)
```

Arguments

v	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSupermodular integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSupermodular(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSupermodularMob
IsMeasureSupermodularMob function

Description

Returns 1 if yes, 0 if no; Mob is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSupermodularMob(Mob,env=NULL)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSupermodular integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSupermodularMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.IsMeasureSymmetric` *IsMeasureSymmetric function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in standard representation.

Usage

```
fm.IsMeasureSymmetric(v,env=NULL)
```

Arguments

v	the genral fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSymmetric integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSymmetric(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

fm.IsMeasureSymmetricMob *IsMeasureSymmetricMob function*

Description

Returns 1 if yes, 0 if no; v is a fuzzy measure in Mobius representation.

Usage

```
fm.IsMeasureSymmetricMob(Mob,env=NULL)
```

Arguments

Mob	a Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is 1 if yes, 0 if no.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A IsMeasureSymmetric integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.IsMeasureSymmetricMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.Mobius` *Mobius transform function*

Description

calculates Mobius representation of general fuzzy measure, the input and output is an array of size 2^n=m in binary ordering.

Usage

```
fm.Mobius(v,env=NULL)
```

Arguments

`v`	fuzzy measure value in standard representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	the output is the fuzzy measure in Mobius representation.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
##---- Should be DIRECTLY executable !! ----
env<-fm.Init(3)
fm.Mobius(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.NonadditivityIndex` *Nonadditivity index computation function*

Description

Calculates the nonadditivity indices of input criteria from general fuzzy measure.

Usage

```
fm.NonadditivityIndex(v,env=NULL)
```

Arguments

v	is fuzzy measure in general representation.
env	Environment variable obtained from fm.Init(n).

Value

output	The output is an array of size 2^n, which contain nonadditivity indices of input criteria coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.NonadditivityIndex(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.NonadditivityIndexMob` *nonadditivity index computation function*

Description

Calculates the nonadditivity indices of input criteria from general fuzzy measure in Moebius representation.

Usage

```
fm.NonadditivityIndexMob(Mob,env=NULL)
```

Arguments

`Mob`	is fuzzy measure in Moebius representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size 2^n, which contain nonadditivity indices of input criteria coalitions.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.NonadditivityIndexMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

fm.OrnessChoquet *OrnessChoquet function*

Description

Calculates orness value of the Choquet integral of the fuzzy measure, where v is a standard representation.

Usage

```
fm.OrnessChoquet(v,env=NULL)
```

Arguments

v	a standard fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	the ouput is the orness the Choquet integral for the fuzzy measure.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.OrnessChoquet(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.OrnessChoquetMob` *OrnessChoquetMob function*

Description

Calculates orness value of the Choquet integral of the fuzzy measure, where Mob is the Mobius representation.

Usage

```
fm.OrnessChoquetMob(Mob,env=NULL)
```

Arguments

`Mob`	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	the ouput is the orness the Choquet integral for the fuzzy measure.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.OrnessChoquetMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.Shapley` *Shapley value computation function*

Description

Calculates the Shapley values of input criteria from general fuzzy measure,

Usage

```
fm.Shapley(v,env=NULL)
```

Arguments

`v`	is fuzzy measure in general representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size n, which contain Shapley values of input criteria.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Shapley(c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.ShapleyMob` *Shapley value computation function*

Description

Calculates the Shapley values of input criteria from Mobius fuzzy measure,

Usage

```
fm.ShapleyMob(Mob,env=NULL)
```

Arguments

`Mob`	is fuzzy measure in Mobius representation.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The output is an array of size n, which contain Shapley values of input criteria.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.ShapleyMob(c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

`fm.Sugeno` *Sugeno function*

Description

Calculates the value of a Sugeno integral of input x, with fuzzy measure in standard representation

Usage

```
fm.Sugeno(x, v,env=NULL)
```

Arguments

x	input vector of size n, containing utility value of input criteria. x is in [0,1].
v	the general fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
env	Environment variable obtained from fm.Init(n).

Value

output	The ouput is a single value of the computed Sugeno integral.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A Sugeno integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Sugeno(c(0.6, 0.3, 0.8), c(0, 0.3, 0.5, 0.6, 0.4, 0.8, 0.7, 1),env)
```

`fm.SugenoMob` *Sugeno function in Mobius representation*

Description

Calculates the value of a Sugeno integral of input x, with fuzzy measure in mobius representation

Usage

```
fm.SugenoMob(x, Mob,env=NULL)
```

Arguments

`x`	input vector of size n, containing utility value of input criteria. x is in [0,1].
`Mob`	the Mobius fuzzy measure of size m=2^n. Its values can be provided by users, or by estimating from empirical data.
`env`	Environment variable obtained from fm.Init(n).

Value

`output`	The ouput is a single value of the computed Sugeno integral.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A Sugeno integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.SugenoMob(c(0.6, 0.3, 0.8), c(0.0, 0.3, 0.5, -0.2, 0.4, 0.1, -0.2, 0.1),env)
```

fm.test *A Test function*

Description

This function provide some examples of how fuzzy measure operation in this toolbox are used. It can be used to test if the toolbox has been installed successfully or not.

Usage

```
fm.test()
```

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
fm.test()
```

fm.Zeta *Zeta transform function*

Description

Calculates the general fuzzy measure from Mobius representation. The input and output is an array of size 2^n=m in binary ordering. This is the inverse of the Mobius function.

Usage

```
fm.Zeta(Mob,env)
```

Arguments

Mob	fuzzy measure value in Mobius representation.
env	Environment variable obtained from fm.Init(n).

Value

`output` the output is the fuzzy measure in general representation.

Author(s)

Gleb Beliakov, Andrei Kelarev, Quan Vu, Deakin University

References

[1] http://www.deakin.edu.au/~gleb/fmtools.html [2] H.Q. Vu, G. Beliakov, G. Li, 2014, A choquet integral toolbox and its application in customer preference analysis, in Data mining applications with R, Elsevier Inc., Waltham, MA., pp.247-272.

Examples

```
env<-fm.Init(3)
fm.Zeta(c(0.0,0.3,0.5,-0.2,0.4,0.1,-0.2,0.1),env)
```

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