Package 'EvCombR'

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Type Package

Title Evidence Combination in R

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Description Combine pieces of evidence in the form of uncertainty representations.

License GPL (>= 3)

Imports methods, utils

NeedsCompilation no

Repository CRAN

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R topics documented:

`EvCombR-package` *EvCombR - Evidence Combination in R*

Description

Package for combining pieces of evidence.

Details

Implements Dempster's, Yager's, modified Dempster's, Bayesian, and credal combination (based on intervals).

Author(s)

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Maintainer: Alexander Karlsson <alexander.karlsson@his.se>

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G. (1976), A Mathematical Theory of Evidence Princeton University Press

Yager, R. (1987), On the Dempster-Shafer Framework and New Combination Rules, *Information Sciences 41: 93-137*.

Fixsen, D., Mahler, R. P. S. (1997), The modified Dempster-Shafer approach to classification, *IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans*, **27**, 96-104

Arnborg, S. (2006), Robust Bayesianism: Relation to Evidence Theory, *Journal of Advances in Information Fusion*, **1**, 63-74

Karlsson, A., Johansson, R., and Andler, S. F. (2011), Characterization and Empirical Evaluation of Bayesian and Credal Combination Operators, *Journal of Advances in Information Fusion*, **6**, 150-166

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

# construct credal sets with the given state space
c1 <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)
c2 <- credal(c(0.2, 0.2, 0.2), c(0.9, 0.9, 0.9), stateSpace)

# combine the credal sets
cComb(c1, c2)

# construct mass functions
m1 <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)
m2 <- mass(list("a"=0.2, "b"=0.2, "c"=0.2, "a/b/c"=0.4), stateSpace)

# combine the mass functin by using Dempster's combination
dComb(m1, m2)

# Yager's combination operator
yComb(m1, m2)

# modified Dempster's combination using uniform prior
mComb(m1, m2)
```

---

cComb *Credal Combination Operator (restricted to intervals)*

Description

Combine evidence in the form of credal sets (based on intervals) using the credal combination operator (also known as the robust Bayesian combination operator). The resulting credal set is approximated by using probability intervals.

Usage

```
cComb(x,y)
```

Arguments

x	credal set or a list of credal sets
y	credal set if x is a credal set, otherwise missing

Value

credal set

Author(s)

Alexander Karlsson

References

Levi, I. (1983), The enterprise of knowledge, The MIT press

Arnborg, S. (2006), Robust Bayesianism: Relation to Evidence Theory, *Journal of Advances in Information Fusion*, **1**, 63-74

Karlsson, A., Johansson, R., and Andler, S. F. (2011), Characterization and Empirical Evaluation of Bayesian and Credal Combination Operators, *Journal of Advances in Information Fusion*, **6**, 150-166

See Also

dComb, yComb, mComb

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

# construct credal sets with the given state space
c1 <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)
c2 <- credal(c(0.2, 0.2, 0.2), c(0.9, 0.9, 0.9), stateSpace)

# combine the credal sets
cComb(c1, c2)
# or by
cComb(list(c1, c2))
```

cComb-methods *Methods for Function* cComb

Description

Combine credal sets (based on intervals) using the credal combination operator (also known as the robust Bayesian combination operator). For more detail see cComb.

Methods

`signature(x = "credal", y = "credal")` Combine two credal sets using the credal combination operator

`signature(x = "list", y = "missing")` Combine a list of credal sets using the credal combination operator

credal *Constructor Function for Credal Sets (based on intervals)*

Description

Construct a credal set based on probability intervals or a single probability function. The algorithm used for finding the extreme points corresponding to lower and upper bounds is described in De Campos et al. (1994).

Usage

```
credal(x, y, z)
```

Arguments

x	lower bounds of probability intervals (in the form of a numeric vector)
y	upper bounds for probability intervals or missing (i.e., upper bound of 1)
z	character vector representing the state space

Value

A credal set represented by a set of extreme points.

Author(s)

Alexander Karlsson

References

Levi, I. (1983), The enterprise of knowledge, The MIT press

Arnborg, S. (2006), Robust Bayesianism: Relation to Evidence Theory, *Journal of Advances in Information Fusion*, **1**, 63-74

Karlsson, A., Johansson, R., Andler, S. F. (2011), Characterization and Empirical Evaluation of Bayesian and Credal Combination Operators, *Journal of Advances in Information Fusion*, **6**, 150-166

De Campos L. M., Huete, J. F., Moral S., Probability Intervals: a Tool for Uncertain Reasoning,*International Journal of Uncertainty, Fuzziness, and Knowledge-Based Systems*, **2**, 167-196

See Also

cComb

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# lower and upper bounds for probability intervals
c1 <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)

# single probability function (lower and upper bounds of probability intervals are equal)
c2 <- credal(c(0.1, 0.2, 0.7), c(0.1, 0.2, 0.7), stateSpace)
```

---

credal-class *Class* "credal"

Description

Represents a credal set by a set of extreme points. For more detail see credal.

Objects from the Class

Objects can be created by credal.

Slots

extPoints: Object of class "matrix". Each row is an extreme point of the credal set.

Methods

[`signature(x="credal", i="ANY", j="ANY")`: extract an extreme point

[<- `signature(x="credal", i="ANY", j="ANY", value="ANY")`: replace and extreme point

cComb `signature(x = "credal", y = "credal")`: combine two credal sets

lower `signature(x = "credal", set = "character")`: calculate the lower bound for a specific set of states

lower `signature(x = "credal", set = "missing")`: calculate the lower bounds for all singleton states

upper `signature(x = "credal", set = "character")`: calculate the upper bound for a specific set of states

upper `signature(x = "credal", set = "missing")`: calculate the upper bounds for all singleton states

extPoints `signature(x = "credal")`: access method for the slot points

space `signature(x = "credal")`: access method for names of singleton states

space<- `signature(x = "credal")`: replace method for names of singleton states

Author(s)

Alexander Karlsson

`credal-methods` *Methods for Function* `credal`

Description

Methods for constructing a credal set. For more detail see `credal`.

Methods

`signature(x = "numeric", y = "missing", z = "character")` Construct a credal set based on the lower bounds of probability intervals for states (1 will be the upper bound for all probability intervals)

`signature(x = "numeric", y = "numeric", z = "character")` Construct a credal based on probability intervals for states

Author(s)

Alexander Karlsson

dComb *Dempster's Combination Operator*

Description

Combine evidence in the form of mass functions using Dempster's combination operator.

Usage

```
dComb(x,y)
```

Arguments

x	single mass function or a list of mass functions
y	single mass function if x is a single mass function, otherwise missing

Value

mass function

Author(s)

Alexander Karlsson

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G. (1976), A Mathematical Theory of Evidence Princeton University Press

See Also

yComb, mComb, cComb

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass functions
m1 <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)
m2 <- mass(list("a"=0.2, "a/b/c"=0.8), stateSpace)

# Dempster's combination
dComb(m1, m2)
# or
dComb(list(m1, m2))
```

dComb-methods *Methods for Function* dComb

Description

Combine mass functions using Dempster's combination operator. For more detail see dComb.

Methods

`signature(x = "mass", y = "mass")` Combine two mass functions using Dempster's combination operator

`signature(x = "list", y = "missing")` Combine a list of mass functions using Dempster's combination operator

Author(s)

Alexander Karlsson

disc *Discounting Operator*

Description

Discounts a mass function.

Usage

```
disc(x,y)
```

Arguments

x	a mass function
y	degree of reliability

Value

mass function

Author(s)

Alexander Karlsson

References

Smets, P. (2000), Data Fusion in the Transferable Belief Model, Proceedings of the Third International Conference on Information Fusion

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)

# source is only 80% reliable
mDisc <- disc(m, 0.8)
```

`disc-methods` *Methods for Function* `disc`

Description

Discount an evidence structure. For more detail see `disc`

Methods

`signature(x = "mass", y = "numeric")` Discount a mass function.

`EvCombRLicense` *License information for EvCombR*

Description

Displays some license information about EvCombR.

Usage

```
EvCombRLicense()
```

Author(s)

Alexander Karlsson

Examples

```
EvCombRLicense()
```

`extPoints` *Extreme Points of a Credal Set*

Description

Returns the extreme points of a credal set

Usage

```
extPoints(x)
```

Arguments

`x`	a credal set

Value

a matrix where the extreme points are stored by row

Author(s)

Alexander Karlsson

See Also

`lower`, `upper`

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# construct credal set
c <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)

# obtain extrem points
eMat <- extPoints(c)
```

extPoints-methods *Methods for Function* extPoints

Description

Returns the set of extreme points of a credal set. For more detail see extPoints.

Methods

signature(x = "credal") Returns the set of extreme points

Author(s)

Alexander Karlsson

focal *Focal Elements of a Mass Function*

Description

Returns the set of focal elements of a mass function.

Usage

```
focal(x)
```

Arguments

x	a mass function

Value

focal elements of x

Author(s)

Alexander Karlsson

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G., (1976), A Mathematical Theory of Evidence Princeton University Press, 1976

See Also

points

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass functions
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# obtain focal elements
focal(m)
```

`focal-methods` *Methods for Function* `focal`

Description

Methods for function `focal`

Methods

`signature(x = "mass")` Access function for slot focal

Note

See further `focal`

`focal<-` *Replacement Function for Focal Elements*

Description

Replaces focal elements of a mass function.

Usage

```
focal(x) <- value
```

Arguments

`x`	a mass function
`value`	new focal elements for the mass function

Value

mass function with focal elements replaced.

Author(s)

Alexander Karlsson

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G., (1976), A Mathematical Theory of Evidence Princeton University Press

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass functions
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# replace focal elements
focal(m) <- list("a/b"=1)
```

`focal<-methods` *Methods for Function* `focal<-`

Description

Replacement function for focal elements. For more detail see `focal<-`

Methods

`signature(x = "mass")` Replace focal elements

`lower` *Lower Bounds Based on Evidence Structure*

Description

Calculate the lower bounds for a vector of sets

Usage

```
lower(x, sets)
```

Arguments

`x`	credal set or mass function
`sets`	vector of sets where each set is represented by state names separated by "/". If sets are missing, lower bounds on singletons are calculated.

Value

lower bound of mass or probability for each set in the vector sets or if sets is missing lower bounds on singletons

Note

This is equivalent to belief in Dempster-Shafer theory

Author(s)

Alexander Karlsson

References

Shafer, G., (1976), A Mathematical Theory of Evidence Princeton University Press

Walley, P. (2000), Towards a unified theory of imprecise probability, *International Journal of Approximate Reasoning, **24**, 125-148*

See Also

upper

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "b"=0.1 ,
               "c"=0.4, "a/b/c"=0.4), stateSpace)

# credal set
c <- credal(c(0.1, 0.1, 0.1),
            c(0.8, 0.8, 0.8), stateSpace)

# calculate lower bounds
lower(m, c("a", "a/b"))
lower(c, c("a", "a/b"))

# lower bounds on singletons
lower(m)
```

lower-methods *Methods for Function* lower

Description

Calculate lower bounds for a vector of sets with respect to the evidence structure. For more detail see lower

Methods

`signature(x = "credal", sets = "character")` obtain lower bounds for a vector of sets

`signature(x = "credal", sets = "missing")` obtain lower bounds for all singleton states

`signature(x = "mass", sets = "character")` obtain the belief, or lower bounds, for a vector of sets

`signature(x = "mass", sets = "missing")` obtain the belief, or lower bounds, for all singleton states

mass *Constructor Function for Mass Functions*

Description

Construct a mass function based on a named list of focal elements or a massQ-class object. For more information, see the details section.

Usage

```
mass(x, y)
```

Arguments

x	a named list of focal elements or a massQ-class object
y	a character vector representing the state space or missing if x is an massQ object.

Details

Focal elements are represented by the notation "<*s1*>/.../<*sn*>" where <*s1*>...<*sn*> are any states within the state space (see the examples below). Note that the word "ES" and the symbol "/" are reserved.

Value

mass function

Author(s)

Alexander Karlsson

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G. (1976), A Mathematical Theory of Evidence Princeton University Press

See Also

dComb, mComb, yComb

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# construct mass functions
m1 <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)
m2 <- mass(list("a"=0.1, "b"=0.1, "c"=0.1, "a/b"=0.1, "a/c"=0.1,
                "b/c"=0.1, "a/b/c"=0.4), stateSpace)

# apply Yager's combination operator, m12 will be a massQ-object
m12Q <- yComb(m1,m2)

# contruct a mass function from an massQ-object
m12 <- mass(m12Q)
```

---

mass-class *Class* "mass"

Description

Represents a mass function by a list of focal elements and corresponding mass. For more detail see mass.

Objects from the Class

Objects can be created by credal.

Slots

focal: a list of focal elements represented by statenames seperated by "/"

space: the state space represented by a character vector

Methods

[`signature(x = "mass", i = "character", j = "missing")`: extract focal elements

[[`signature(x = "mass", i = "character", j = "missing")`: extract a single focal element

[<- `signature(x="mass", i="character", j="missing", value="ANY")`: replace focal elements

[[<- `signature(x="mass", i="character", j="missing", value="ANY")`: replace a single focal element

dComb `signature(x = "mass", y = "mass")`: combine two mass functions by Dempster's combination

focal `signature(x = "mass")`: access focal elements

focal<- `signature(x = "mass")`: replace focal elements

lower `signature(x = "mass", set = "character")`: calculate the lower bounds for some focal element

lower `signature(x = "mass", set = "missing")`: calculate the lower bounds for singletons

mComb `signature(x = "mass", y = "mass", z = "function")`: combine two mass functions by modified Dempster's combination using a prior distribution z

mComb `signature(x = "mass", y = "mass", z = "missing")`: combine two mass functions by modified Dempster's combination using a uniform prior distribution z

pign `signature(x = "mass")`: calculate the pignistic transformation for single states

relPl `signature(x = "mass")`: calculate the relative plausibility for single states

space `signature(x = "mass")`: access the state space (frame of discernment)

space<- `signature(x = "mass")`: replace the state space (frame of discernment)

upper `signature(x = "mass", set = "character")`: calculate the upper bound for some focal element

upper `signature(x = "mass", set = "character")`: calculate the upper bounds for singletons

yComb `signature(x = "mass", y = "mass")`: combine two mass functions using Yager's rule

disc `signature(x = "mass", y = "numeric")`: discount mass function

Author(s)

Alexander Karlsson

References

Dempster, A. P. (1969), A generalization of Bayesian inference, *Journal of the Royal Statistical Society*, **30**, 205-247

Shafer, G., (1976), A Mathematical Theory of Evidence Princeton University Press

Yager, R. (1987), On the Dempster-Shafer Framework and New Combination Rules, *Information Sciences 41: 93-137*.

Fixsen, D., Mahler, R. P. S. (1997), The modified Dempster-Shafer approach to classification, *IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans*, **27**, 96-104

mass-methods *Methods for Function* mass

Description

Methods for constructing a mass function. For more detail see mass

Methods

signature(x = "list", y = "character") Construct a mass functions by a named list of focal elements and a given state space

signature(x = "massQ", y = "missing") Construct a mass function from a massQ-class object

Author(s)

Alexander Karlsson

massQ-class *Class* "massQ"

Description

Class that maintains information about the mass on the empty set. The class is used for Yager's combination operator

Objects from the Class

A massQ-object is obtained as a result of Yager's combination operator yComb.

Slots

qEmpty: mass on the empty set with respect to the previous combination

focal: a list of focal elements represented by statenames seperated by "/"

space: the state space represented by a character vector

Extends

Class "mass", directly.

Methods

All methods inherited from mass-class and in addition:

mass signature(x = "massQ", y = "missing"): convert the massQ-object to a mass-object

Author(s)

Alexander Karlsson

References

Yager, R. (1987), On the Dempster-Shafer Framework and New Combination Rules, *Information Sciences 41: 93-137*.

---

mComb *Modified Dempster's Combination Operator*

Description

Combine evidence in the form of mass functions using modified Dempster's combination operator.

Usage

```
mComb(x,y,z)
```

Arguments

x	single mass function or a list of mass functions
y	single mass function if x is a single mass function, a prior distribution or missing if x is a list
z	prior distribution if x and y are mass functions, otherwise missing

Details

The prior distribution is provided in the form of a list where the names are equivalent to the state space. See the examples.

Value

mass function

Author(s)

Alexander Karlsson

References

Fixsen, D., Mahler, R. P. S. (1997), The modified Dempster-Shafer approach to classification, *IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans*, **27**, 96-104

See Also

dComb, yComb, cComb

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass functions
m1 <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)
m2 <- mass(list("a"=0.2, "a/b/c"=0.8), stateSpace)

# modified Dempster's combination using the uniform prior
mComb(m1, m2)
# or
mComb(list(m1, m2))

# modified Dempster's combination using a specific prior
mComb(m1, m2, list("a"=0.1, "b"=0.1, "c"=0.8))
# or
mComb(list(m1, m2), list("a"=0.1, "b"=0.1, "c"=0.8))
```

---

mComb-methods *Methods for Function* mComb

Description

Combine mass functions using modified Dempster's combination operator. For more detail see mComb.

Methods

`signature(x = "mass", y = "mass", z = "list")` Combine two mass functions using modified Dempster's combination operator and a prior

`signature(x = "mass", y = "mass", z = "missing")` Combine two mass functions using modified Dempster's combination operator and the uniform prior

`signature(x = "list", y = "list", z = "missing")` Combine a list of mass functions using modified Dempster's combination operator and a prior

`signature(x = "list", y = "missing", z = "missing")` Combine a list of mass functions using modified Dempster's combination operator and the uniform prior

---

pign *Pignistic Tranformation*

Description

The pignistic transformation transforms a mass function into a probability function.

Usage

```
pign(x)
```

Arguments

x	a mass function

Value

a singleton credal set

Author(s)

Alexander Karlsson

References

Smets, P. & Kennes, R. (1994), The transferable belief model, *Artificial Intelligence*, **66**, 191-234

See Also

relPl

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)

# obtaina singleton credal set
c <- pign(m)
```

---

pign-methods *Methods for Function* pign

Description

The pignistic transformation transform a mass function to probability function. For more detail see pign

Methods

signature(x = "mass")	Apply the pignistic transformation on a mass function

relPl *Relative Plausibility Transform*

Description

The relative plausibility transform transform a mass function to a probability function

Usage

```
relPl(x)
```

Arguments

x	a mass function

Value

a singleton credal set

Author(s)

Alexander Karlsson

References

Cobb, B. & Shenoy, P. (2006), On the plausibility transformation for translating belief function models to probability models, *International Journal of Approximate Reasoning*, **42**, 3, 314 - 330

See Also

pign

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)

# obtaina singleton credal set
c <- relPl(m)
```

relPl-methods *Methods for Function* relPl

Description

The relative plausability transform transforms a mass function to probability function. For more detail see relPl

Methods

signature(x = "mass") Apply the relative plausability transform on a mass function

space *State Space of and Evidence Structure*

Description

This functions returns the state space of an evidence structure.

Usage

```
space(x)
```

Arguments

x	mass function or credal set

Value

a character vector with the names within the state space

Author(s)

Alexander Karlsson

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# construct mass function
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# obtain state space
space(m)
```

space-methods *Methods for Function* space

Description

Returns the state space for an evidence structure. For more detail see space.

Methods

`signature(x = "credal")` Returns the state space for a credal set

`signature(x = "mass")` Returns the state space for a mass function

space<- *Replacement Function for State Space*

Description

Replace the names of the state space

Usage

```
space(x) <- value
```

Arguments

x	mass function or credal set
value	new state space given as a character vector

Value

new mass function or credal set with the state space replaced

Author(s)

Alexander Karlsson

See Also

focal<-

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# construct mass function
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# replace state space
space(m) <- c("d", "e", "f")
```

---

space<--methods *Methods for Function* space<-

Description

Replace the state space of an evidence structure. For more details see space.

Methods

`signature(x = "credal")` Replace state space of a credal set

`signature(x = "mass")` Replace the state space of a mass function

---

upper *Upper Bounds Based on Evidence Structure*

Description

Calculate the upper bounds for a vector of sets

Usage

```
upper(x, sets)
```

Arguments

x	credal set or mass function
sets	vector of sets where each set is represented by state names separated by "/". If sets are missing, upper bounds on singletons are calculated.

Value

upper bound of mass or probability for each set in the vector sets or if sets is missing upper bounds on singletons

Note

This is equivalent to Belief in Dempster-Shafer theory

Author(s)

Alexander Karlsson

References

Shafer, G., (1976), A mathematical theory of evidence, Princeton University Press

Walley, P. (2000), Towards a unified theory of imprecise probability, *International Journal of Approximate Reasoning, **24**, 125-148*

See Also

upper

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "b"=0.1 ,
               "c"=0.4, "a/b/c"=0.4), stateSpace)

# credal set
c <- credal(c(0.1, 0.1, 0.1),
            c(0.8, 0.8, 0.8), stateSpace)

# calculate upper bounds
upper(m, c("a", "a/b"))
upper(c, c("a", "a/b"))

# upper bounds on singletons
upper(m)
```

---

upper-methods *Methods for Function* upper

Description

Calculate lower bounds for a vector of sets with respect to the evidence structure. For more detail see upper

Methods

`signature(x = "credal", sets = "character")` obtain upper bounds for a vector of sets

`signature(x = "credal", sets = "missing")` obtain upper bounds for all singletons

`signature(x = "mass", sets = "character")` obtain the plausability, or upper bounds, for a vector of sets

`signature(x = "mass", sets = "missing")` obtain the plausability, or upper bounds, for all singletons

---

`yComb` *Yager's Combination Operator*

Description

Combine evidence in the form of mass functions using Yager's combination operator.

Usage

```
yComb(x,y)
```

Arguments

`x`	single mass function or a list of mass functions
`y`	single mass function if `x` is a single mass function, otherwise missing

Value

mass function (`massQ-class`)

Note

Yager's combination operator is quasi-associative and therefore we need to keep track of the mass on the empty set by using the class `massQ`.

Author(s)

Alexander Karlsson

References

Yager, R. (1987), On the Dempster-Shafer Framework and New Combination Rules, *Information Sciences 41: 93-137*.

See Also

`dComb`, `mComb`, `cComb`

Examples

```
# state space
stateSpace <- c("a", "b", "c")

# mass functions
m1 <- mass(list("a"=0.1, "a/b/c"=0.9), stateSpace)
m2 <- mass(list("b"=0.2, "a/b/c"=0.8), stateSpace)

# Yager's combination
yComb(m1, m2)
# or
yComb(list(m1, m2))
```

---

yComb-methods *Methods for Function* yComb

Description

Combine mass functions using Yager's combination operator. For more detail see yComb.

Methods

`signature(x = "mass", y = "mass")` Combine two mass functions using Yager's combination operator

`signature(x = "list", y = "missing")` Combine a list of mass functions using Yager's combination operator

---

[-methods *Methods for Function* [

Description

Extract part of evidence structure [

Methods

`signature(x = "credal", i = "ANY", j="ANY", value="ANY")` Extract probabilities

`signature(x = "mass", i = "character", j="missing", value="ANY")` Extract focal element(s)

Author(s)

Alexander Karlsson

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

# construct credal sets with the given state space
c <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)

# extract first and second extreme point
c[1:2,]

# mass functions
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# extract focal elements
m[c("a","a/b/c")]
```

`[<-methods` *Methods for Function* `[<-`

Description

Replace part of an evidence structure

Methods

`signature(x="credal", i="ANY", j="ANY", value="ANY")` Replace probabilities

`signature(x="mass", i="character", j="missing", value="ANY")` Replace focal element(s)

Author(s)

Alexander Karlsson

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

# construct credal sets with the given state space
c <- credal(c(0.1, 0.1, 0.1), c(0.8, 0.8, 0.8), stateSpace)

# replace first and second extreme point
c[1:2,] <- rbind(c(0.1, 0.1, 0.8), c(0.2, 0.2, 0.6))

# mass function
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# switch mass on focal elements "b" and "a/b/c"
temp <- m["b"]
m["b"] <- m["a/b/c"]
```

```
m["a/b/c"] <- temp
```

`[[-methods` *Methods for Function* `[[`

Description

Methods for function `[[`

Methods

`signature(x="mass", i="character", j="missing")` Extract a single focal element from the list of focal elements

Author(s)

Alexander Karlsson

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

#mass functions
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# extract focal element
m[["a"]]
```

`[[<--methods` *Methods for Function* `[[<-`

Description

Replace part of an evidence structure

Methods

`signature(x="mass", i="character", j="missing", value="ANY")` Replace focal element(s)

Author(s)

Alexander Karlsson

Examples

```
# construct a state space
stateSpace <- c("a", "b", "c")

# mass function
m <- mass(list("a"=0.1, "b"=0.1 , "c"=0.4, "a/b/c"=0.4), stateSpace)

# obtain value only
m[["a"]]
```

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