Package ‘FuzzyMCDM’

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Description Implementation of several MCDM methods for fuzzy data (triangular fuzzy numbers) for decision making problems. The methods that are implemented in this package are Fuzzy TOPSIS (with two normalization procedures), Fuzzy VIKOR, Fuzzy Multi-MOORA and Fuzzy WASPAS. In addition, function MetaRanking() calculates a new ranking from the sum of the rankings calculated, as well as an aggregated ranking.

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FuzzyMMOORA


Description

The FuzzyMMOORA function implements both the Fuzzy Multi-Objective Optimization by Ration Analysis (MOORA) and the Fuzzy "Full Multiplicative Form" (Fuzzy MULTIMOORA).

Usage

FuzzyMMOORA(decision, weights, cb)

Arguments

decision The decision matrix \((m \times (n*3))\) with the values of the \(m\) alternatives, for the \(n\) criteria, and multiplied by 3 since they are triangular fuzzy numbers.

weights A vector of length \(n*3\), containing the fuzzy weights for the criteria.

cb A vector of length \(n\). Each component is either \(cb(i)='max'\) if the \(i\)-th criterion is benefit or \(cb(i)='min'\) if the \(i\)-th criterion is a cost.

Value

FuzzyMMOORA returns a data frame which contains the scores and the four rankings calculated (Ratio System, Reference Point, Multiplicative Form and Multi-MOORA ranking).

References


Examples

d <- matrix(c(0.63, 0.42, 0.63, 0.67, 0.8, 0.59, 0.8, 0.84, 0.92, 0.75, 0.92, 0.92, 0.29, 0.71, 0.75, 0.42, 0.46, 0.88, 0.92, 0.59, 0.63, 1, 1, 0.71, 0.75, 0.59, 0.42, 0.42, 0.92, 0.75, 0.58, 0.59, 1, 0.88, 0.76, 0.75, 0.59, 0.71, 0.42, 0.33, 0.75, 0.88, 0.58, 0.51, 0.88, 0.58, 0.51, 0.88, 0.96, 0.71, 0.67, 0.5, 0.67, 0.67, 0.67, 0.67, 0.84, 0.84, 0.84, 0.92, 0.96, 0.96, 0.96, 0.67, 0.54, 0.54, 0.25, 0.84, 0.71, 0.71, 0.42, 0.96, 0.88, 0.88, 0.59, 0.67, 0.71, 0.42, 0.25, 0.84, 0.88, 0.59, 0.42, 0.96, 0.96, 0.96, 0.75, 0.58, 0.54, 0.625, 0.625, 0.295, 0.705, 0.79, 0.795, 0.46, 0.88, 0.92, 0.875, 0.62), nrow=4, ncol=24)
w <- c(1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24, 1/24)
cb <- c('max', 'max', 'max', 'max', 'max', 'max', 'max', 'max')
FuzzyMMOORA(d, w, cb)
**Description**

The `FuzzyTOPSISLinear` function implements the Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (Fuzzy TOPSIS) Method with the linear transformation (maximum) as normalization method.

**Usage**

```r
FuzzyTOPSISLinear(decision, weights, cb)
```

**Arguments**

- `decision` The decision matrix \((m \times (n \times 3))\) with the values of the \(m\) alternatives, for the \(n\) criteria, and multiplied by 3 since they are triangular fuzzy numbers.
- `weights` A vector of length \(n \times 3\), containing the fuzzy weights for the criteria.
- `cb` A vector of length \(n\). Each component is either \(cb(i)=\text{\textquote{\text{max}}}\) if the \(i\)-th criterion is benefit or \(cb(i)=\text{\textquote{\text{min}}}\) if the \(i\)-th criterion is a cost.

**Value**

`FuzzyTOPSISLinear` returns a data frame which contains the score of the \(R\) index and the ranking of the alternatives.

**References**


**Examples**

```r
d <- matrix(c(5,7,6.3,6.3,7,7,7,7,8.3,3,3,9,7,9,5,9,7,7,10,9,10,10,5.7,8.3,7,7,7,7,7,9,7,9,9,10,10,8,3,3,9,7,9,6,10,9,10,10,10,3,7,6,3,5,9,8,3,7,10,9,7),nrow=3,ncol=15)
w <- c(0.7,0.9,1,0.9,1,1,0.7,0.93,1,0.9,1,1,0.43,0.63,0.83)
cb <- c('max', 'max', 'max', 'max', 'max')
FuzzyTOPSISLinear(d,w,cb)
```
### FuzzyTOPSISVector

**Implementation of Fuzzy TOPSIS Method for Multi-Criteria Decision Making Problems.**

### Description

The FuzzyTOPSISVector function implements the Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (Fuzzy TOPSIS) Method with the vector normalization procedure.

### Usage

```r
FuzzyTOPSISVector(decision, weights, cb)
```

### Arguments

- **decision**: The decision matrix \(m \times (n*3)\) with the values of the \(m\) alternatives, for the \(n\) criteria, and multiplied by 3 since they are triangular fuzzy numbers.
- **weights**: A vector of length \(n*3\), containing the fuzzy weights for the criteria.
- **cb**: A vector of length \(n\). Each component is either \(cb(i) = 'max'\) if the \(i\)-th criterion is benefit or \(cb(i) = 'min'\) if the \(i\)-th criterion is a cost.

### Value

FuzzyTOPSISVector returns a data frame which contains the score of the R index and the ranking of the alternatives.

### References


### Examples

```r
d <- matrix(c(0.68, 0.4, 0.6, 0.2, 0.4, 1.44, 0.67, 0.9, 0.45, 0.6, 2.2, 0.95, 1.2, 0.7, 0.8, 18, 8, 8, 25, 6, 21, 11.5, 11.5, 32, 5.9, 24, 15, 15, 40, 12.9, 0.66, 0.66, 0.10, 2.33, 2.33, 0.66, 0.33, 10, 4.33, 4.33, 2.33, 1.66, 5.1, 33, 1.33, 5.66, 1.7, 3.3, 7.66, 2.8, 6.6, 5.5, 5.9, 33, 3.66, 2.33, 0.66, 0.33, 1.33, 1.66, 4.33, 2.1, 3.3, 3.2, 6.6, 3.3, 3.66, 3.5, 4.33), nrow=5, ncol=15)
w <- c(0.189, 0.214, 0.243, 0.397, 0.432, 0.462, 0.065, 0.078, 0.096, 0.068, 0.084, 0.106, 0.174, 0.190, 0.287)
cb <- c('min', 'max', 'max', 'min', 'min')
FuzzyTOPSISVector(d, w, cb)
```
FuzzyVIKOR

Implementation of Fuzzy VIKOR Method for Multi-Criteria Decision
Making Problems.

Description

The FuzzyVIKOR function implements the Fuzzy "VIseKriterijumska Optimizacija I Kompromisno
Resenje" (Fuzzy VIKOR) Method.

Usage

FuzzyVIKOR(decision, weights, cb, v)

Arguments

decision  The decision matrix (m x (n*3)) with the values of the m alternatives, for the n
criteria, and multiplied by 3 since they are triangular fuzzy numbers.
weights  A vector of length n*3, containing the fuzzy weights for the criteria.
cb  A vector of length n. Each component is either cb(i)='max' if the i-th criterion
is benefit or cb(i)='min' if the i-th criterion is a cost.
v  A value in [0,1]. It is used in the calculation of the Q index.

Value

FuzzyVIKOR returns a data frame which contains the score of the S, R and Q index and the ranking
of the alternatives according to Q index.

References

Opricovic, S. Fuzzy VIKOR with an application to water resources planning. Expert Systems with
Applications, 38(10), 12983-12990, 2011.

Examples

d <- matrix(c(38,20,24.58,44.54,33.33,33.86,40.01,21.06,25.87,46.89,33.33,33.86,48,24,
29.75,56.27,43.33,42.32,3.26,2.57,2.82,2.46,2.25,2.47,4.00,2.87,2.97,2.73,2.5,2.74,4.80,
2.87,2.97,2.73,2.62,2.85,43.6,38,68,6,6,47,6,42,6,6,48,6,50,68,6,6,10,10,1,0,2,3,10,
10,1,0,2,3,10,10,1,0,2,3,10,10,1,0,2,3,10,10,1,0,2,3,10,10,1,0,2,3,10,10,1,0,2,3,10),
nrow=6,ncol=12)
w <- c(1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12)
cb <- c('min','max','min','min')
v <- 0.625
FuzzyVIKOR(d,w,cb,v)
Description

The FuzzyWASPAS function implements the Fuzzy Weighted Aggregated Sum Product ASsessment (Fuzzy WASPAS) Method.

Usage

FuzzyWASPAS(decision, weights, cb, lambda)

Arguments

decision The decision matrix \((m \times (n\times 3))\) with the values of the \(m\) alternatives, for the \(n\) criteria, and multiplied by 3 since they are triangular fuzzy numbers.
weights A vector of length \(n \times 3\), containing the fuzzy weights for the criteria.
cb A vector of length \(n\). Each component is either \(\text{cb}(i)='\text{max}'\) if the \(i\)-th criterion is benefit or \(\text{cb}(i)='\text{min}'\) if the \(i\)-th criterion is a cost.
lambda A value in \([0,1]\). It is used in the calculation of the \(W\) index.

Value

FuzzyWASPAS returns a data frame which contains the score of the \(W\) index and the ranking of the alternatives.

References


Examples

d <- matrix(c(0.5,0.6,0.6,0.6,0.6,0.7,0.7,0.7,0.7,0.7,0.8,0.8,0.8,0.8,0.6,0.6,0.6,0.8,0.5,0.7,0.7,0.9,0.6,0.8,0.8,0.7,0.7,0.7,0.7,0.8,0.7,0.5,0.6,0.5,0.5,0.4,0.6,0.7,0.6,0.5,0.7,0.8,0.7,0.6,0.5,0.9,0.8,0.7,0.6,1,0.9,0.8,0.7,0.5,0.8,0.6,0.8,0.9,0.7,0.9,0.7,1,0.8,1,0.4,0.5,0.8,0.7,0.5,0.5,0.9,0.8,0.6,0.7,1,0.9,0.5,0.4,0.5,0.6,0.5,0.5,0.6,0.7,0.6,0.6,0.7), nrow=4, ncol=24)
w <- c(0.21,0.28,0.35,0.16,0.20,0.23,0.14,0.16,0.17,0.09,0.12,0.17,0.07,0.08,0.12,0.05,0.06,0.09,0.03,0.05,0.07,0.01,0.03,0.06)
cb <- c('max','max','max','max','max','max','max','max')
lambda <- 0.49
FuzzyWASPAS(d,w,cb,lambda)
MetaRanking

Implementation of MetaRanking function for Multi-Criteria Decision Making Problems.

Description

The MetaRanking function internally calls functions FuzzyMOORA, FuzzyTOPSISLinear, FuzzyTOPSISVector, FuzzyVIKOR and FuzzyWASPAS and then calculates a sum of the their rankings and an aggregated ranking by applying the RankAggreg package.

Usage

MetaRanking(decision, weights, cb, lambda, v)

Arguments

decision The decision matrix (m x n) with the values of the m alternatives, for the n criteria.
weights A vector of length n, containing the weights for the criteria. The sum of the weights has to be 1.
cb A vector of length n. Each component is either cb(i)="max" if the i-th criterion is benefit or cb(i)="min" if the i-th criterion is a cost.
lambda A value in [0,1]. It is used in the calculation of the W index for WASPAS method.
v A value in [0,1]. It is used in the calculation of the Q index for VIKOR method.

Value

MetaRanking returns a data frame which contains the rankings of the Fuzzy Multi-MOORA, Fuzzy TOPSIS (linear transformation and vectorial normalization), Fuzzy VIKOR, Fuzzy WASPAS Methods and the MetaRankings of the alternatives.

Examples

d <- matrix(c(0.68, 0.4, 0.6, 0.2, 0.4, 1.44, 0.67, 0.9, 0.45, 0.6, 2.2, 0.95, 1.2, 0.7, 0.8, 18, 8, 25, 6, 21, 11.5, 11.5, 32.5, 9, 24, 15, 15, 40, 12, 9, 0.66, 0.66, 0, 10, 2.33, 2.33, 0.66, 0.66, 0.33, 18, 4.33, 4.33, 2.33, 1.66, 5, 1.33, 1.33, 5.66, 1, 7, 3, 1.66, 2, 8.66, 5, 5, 9.33, 3.66, 2.33, 0.66, 0.33, 1.33, 1.66, 4.33, 2, 1.33, 3, 2.66, 6.33, 3.66, 3.5, 5, 4.33), nrow=5, ncol=15)
w <- c(0.189, 0.214, 0.243, 0.397, 0.432, 0.462, 0.665, 0.078, 0.096, 0.086, 0.084, 0.106, 0.174, 0.190, 0.207)
cb <- c('min','max','max','min','min')
lambda <- 0.5
v <- 0.5
MetaRanking(d,w,cb,lambda,v)
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