Package 'MCDM'

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Title Multi-Criteria Decision Making Methods for Crisp Data

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

Imports RankAggreg

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

Description

The MetaRanking function internally calls functions MMOORA, RIM, TOPSISLinear, TOPSISVector, VIKOR and WASPAS 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, AB, CD)
```

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.
AB	A matrix (*2* x *n*). AB[1,] corresponds with the A extrem, and AB[2,] represents the B extrem of the domain of each criterion.
CD	A matrix (*2* x *n*). CD[1,] corresponds with the C extrem, and CD[2,] represents the D extrem of the ideal reference of each criterion.

Value

MetaRanking returns a data frame which contains the rankings of the Multi-MOORA, RIM, TOPSISLinear, TOPSISVector, VIKOR, WASPAS Methods and the both MetaRankings of the alternatives.

Examples

```
d <- matrix(c(1,2,5,3000,3750,4500),nrow = 3,ncol = 2)
w <- c(0.5,0.5)
cb <- c('min','max')
lambda <- 0.5
v <- 0.5
AB <- matrix(c(1,5,3000,4500),nrow = 2,ncol=2)
CD <- matrix(c(1,1,4500,4500),nrow = 2,ncol=2)
MetaRanking(d,w,cb,lambda,v,AB,CD)
```

MMOORA *Implementation of MULTIMOORA Method for Multi-Criteria Decision Making Problems.*

Description

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

Usage

```
MMOORA(decision, weights, cb)
```

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.

Value

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

References

Brauers, W. K. M.; Zavadskas, E. K. Project management by MULTIMOORA as an instrument for transition economies. Technological and Economic Development of Economy, 16(1), 5-24, 2010.

Examples

```
d <- matrix(c(60,6.35,6.8,10,2.5,4.5,3,0.4,0.15,0.1,0.2,0.1,0.08,0.1,2540,1016,1727.2,
1000,560,1016,1778,500,3000,1500,2000,500,350,1000,990,1041,1676,965,915,508,920),
nrow=7,ncol=5)
w <- c(0.036,0.192,0.326,0.326,0.12)
cb <- c('max','min','max','max','max')
MMOORA(d,w,cb)
```

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

Description

The RIM function implements the Reference Ideal Method (RIM).

Usage

```
RIM(decision, weights, AB, CD)
```

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.
AB	A matrix (*2* x *n*). AB[1,] corresponds with the A extrem, and AB[2,] represents the B extrem of the domain of each criterion.
CD	A matrix (*2* x *n*). CD[1,] corresponds with the C extrem, and CD[2,] represents the D extrem of the ideal reference of each criterion.

Value

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

References

Cables, E.; Lamata, M.T.; Verdegay, J.L. RIM-reference ideal method in multicriteria decision making. Information Science, 337-338, 1-10, 2016.

Examples

```
d <- matrix(c(30,40,25,27,45,0,9,0,0,15,2,1,3,5,2,3,3,1,3,2,3,2,3,3,3,2,2,2,1,4),
nrow = 5, ncol = 6)
w <- c(0.2262,0.2143,0.1786,0.1429,0.119,0.119)
AB = matrix(c(23,60,0,15,0,10,1,3,1,3,1,5),nrow = 2,ncol = 6)
CD = matrix(c(30,35,10,15,0,0,3,3,3,3,4,5),nrow = 2,ncol = 6)
RIM(d,w,AB,CD)
```

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

Description

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

Usage

```
TOPSISLinear(decision, weights, cb)
```

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.

Value

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

References

Garcia Cascales, M.S.; Lamata, M.T. On rank reversal and TOPSIS method. Mathematical and Computer Modelling, 56(5-6), 123-132, 2012.

Examples

```
d <- matrix(c(1,4,3,5,2,3),nrow = 3,ncol = 2)
w <- c(0.5,0.5)
cb <- c('max','max')
TOPSISLinear(d,w,cb)
```

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

Description

The TOPSISVector function implements the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) Method with the vectorial normalization prodecure.

Usage

```
TOPSISVector(decision, weights, cb)
```

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.

Value

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

References

Hwang, C.L.; Yoon, K. Multiple Attribute Decision Making. In: Lecture Notes in Economics and Mathematical Systems 186. Springer-Verlag, Berlin, 1981.

Examples

```
d <- matrix(c(6,7,10,2,2.75,3.5),nrow = 3,ncol = 2)
w <- c(0.5,0.5)
cb <- c('min','max')
TOPSISVector(d,w,cb)
```

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

Description

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

Usage

```
VIKOR(decision, weights, cb, 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.
v	A value in [0,1]. It is used in the calculation of the Q index.

Value

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

References

Opricovic, S.; Tzeng, G.H. Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. European Journal of Operational Research, 156(2), 445-455, 2004.

Examples

```
d <- matrix(c(1,2,5,3000,3750,4500),nrow = 3,ncol = 2)
w <- c(0.5,0.5)
cb <- c('min','max')
v <- 0.5
VIKOR(d,w,cb,v)
```

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

Description

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

Usage

```
WASPAS(decision, weights, cb, lambda)
```

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.

Value

WASPAS returns a data frame which contains the score of the WSM, WPM and the Q index and the ranking of the alternatives.

References

Zavadskas, E. K.; Turskis, Z.; Antucheviciene, J.; Zakarevicius, A. Optimization of Weighted Aggregated Sum Product Assessment. Electronics and Electrical Engineering, 122(6), 3-6, 2012.

Examples

```
d <- matrix(c(370,314,480,850,11,7,10,16,2.69,2.37,3.09,3.17,2.75,3.27,3.67,4.10,
5,35,30,50,1.63,1.72,1.87,1.91,1.47,2.07,1.38,2.22,7.11,5.60,7.82,8.25,88,12.60,94,
23,410,100,410,65,2.93,2.13,2.87,1.10,1.98,3.21,2.94,4.37),nrow = 4,ncol = 12)
w <- c(0.0626,0.0508,0.1114,0.0874,0.0625,0.1183,0.0784,0.0984,0.053,0.1417,
0.0798,0.0557)
cb <- c('min','min','max','max','max','max','max','max','min','min','max','max')
lambda <- 0.5
WASPAS(d,w,cb,lambda)
```

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