Package ‘IFMCDM’

February 23, 2023

Title Intuitionistic Fuzzy Multi-Criteria Decision Making Methods

Version 0.1.17

Description Implementation of two multi-criteria decision making methods (MCDM): Intuitionistic Fuzzy Synthetic Measure (IFSM) and Intuitionistic Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (IFTOPSIS) for intuitionistic fuzzy data sets for multi-criteria decision making problems. References describing the methods: Jefmański (2020) <doi:10.1007/978-3-030-52348-0_4>; Jefmański, Roszkowska, Kusterka-Jefmańska (2021) <doi:10.3390/e23121636>.

License GPL (>= 2)

Encoding UTF-8

LazyData true

RoxygenNote 7.2.0

Imports dplyr

Suggests testthat

Depends R (>= 3.5.0)

NeedsCompilation no

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R topics documented:

data_IF *The sample intuitionistic fuzzy dataset*

Description

The sample intuitionistic fuzzy dataset

Usage

```
data_IF
```

Format

An object of class `matrix` (inherits from `array`) with 5 rows and 9 columns.

Examples

```
set.seed(61222)
data(data_IF)
m<-IFSM(data_IF)
print(m)
```

IFconversion *Aggregation of primary data into Intuitionistic Representation*

Description

The `IFconversion` - Aggregation of primary data into Intuitionistic Representation. Reference describing the method: Jefmański (2020) doi:10.1007/9783030523480_4

Usage

```
IFconversion(
  primary,
  u = round(mean(c(min(primary[, -1], na.rm = TRUE), max(primary[, -1], na.rm =
    TRUE)))),
  u_is_neutral = TRUE
)
```

Arguments

`primary`	dataset with object names (not aggregated) in first column
`u`	cut level
`u_is_neutral`	if exact value of variable is equal to u (cut_level) the variable is treated as neutral (TRUE) or negative (FALSE)

Value

`IFconversion` returns the decision matrix (*m* x *n*3*) with the values of the *mi ni* and *pi* (three columns for each fuzzy representation), for the *n* criteria

References

Jefmański Bartłomiej, Intuitionistic Fuzzy Synthetic Measure for Ordinal Data. in: Classification and Data Analysis: Theory and Applications / Jajuga Krzysztof, Batóg Jacek, Walesiak Marek (eds.), Studies in Classification, Data Analysis, and Knowledge Organization, 2020, Cham, Springer, 53-72. doi:10.1007/9783030523480_4

Examples

```
set.seed(61222)
data<-sample(1:7,26*13*8,replace=TRUE)
dim(data)<-c(26*13,8)
nrColumns<-8
primary<-data.frame(name=rep(LETTERS,each=13),data)
inth<-IFconversion(primary)
```

IFSM *Implementation of the Intuitionistic Fuzzy Synthetic Measure Method for Fuzzy Multi-Criteria Decision Making Problems*

Description

The `IFSM` - Intuitionistic Fuzzy Synthetic Measure Method for Fuzzy Multi-Criteria Decision Making Problems. Reference describing the method: Jefmański, Roszkowska, Kusterka-Jefmańska (2021) doi:10.3390/e23121636

Usage

```
IFSM(
  data,
  d = "e",
  w = rep(3/ncol(data), ncol(data)/3),
  z = rep("b", ncol(data)/3),
  p = "dataBounds"
)
```

Arguments

`data`	The data matrix (*m* x *n*3*) with the values of *mi ni* and *pi* (three columns for each intuitionistic fuzzy representation of criteria for each alternative) where *m* is the number of alternatives and *n* is the number of criteria.
`d`	Distance "euclidean" or "hamming".

`w`	A vector of length *n*, containing the crisp weights for the criteria (one value for intuitionistic fuzzy representation).
`z`	A vector of length *n*, with preferences type for each criterion with "b" (benefit) and "c" (cost).
`p`	Ideal point calculation type with one of two values: "dataBounds" – ideal point contains max and min values from the dataset – see details; "idealBounds" – ideal point contains 1 and 0's - see details.

Details

For p="dataBounds" the actual ideal point is calculated for benefits as maximum from all values for *mi* and min for *ni* (*pi* = 1- *mi* - *ni*); in the case of costs, minimal value for *mi* and max for *ni* (*pi* = 1- *mi* - *ni*). For p="idealBounds" for benefitss is 1 for *mi* and 0 for *ni* (*pi* = 1- *mi* - *ni*). In the case of costs it is 0 for *mi* and 1 for *ni* (*pi* = 1- (*mi* - *ni*).

Value

`IFSM` returns a data frame that contains the scores of the Intuitionistic Fuzzy Synthetic Measure (IFSM) and the ranking of the alternatives.

References

Jefmański B, Roszkowska E, Kusterka-Jefmańska M. Intuitionistic Fuzzy Synthetic Measure on the Basis of Survey Responses and Aggregated Ordinal Data. Entropy. 2021; 23(12):1636. doi:10.3390/e23121636

Roszkowska E, Jefmański B, Kusterka-Jefmańska M. On Some Extension of Intuitionistic Fuzzy Synthetic Measures for Two Reference Points and Entropy Weights. Entropy. 2022; 24(8):1081. doi:10.3390/e24081081

Xu, Z. Some Similarity Measures of Intuitionistic Fuzzy Sets and Their Applications to Multiple Attribute Decision Making. Fuzzy Optimization and Decision Making. 2007; 6: 109–121. doi:10.1007/s107000079004z

Examples

```
set.seed(823)
data<-sample(1:7,26*13*8,replace=TRUE)
dim(data)<-c(26*13,8)
nrColumns<-8
primary<-data.frame(name=rep(LETTERS,each=13),data)
f<-IFconversion(primary)
print(f)
m<-IFSM(f)
print(m)
```

IFTOPSIS *Implementation of the Intuitionistic Fuzzy Technique for Order of Preference by Similarity to Ideal Solution for Fuzzy Multi-Criteria Decision Making Problems*

Description

The IFTOPSIS - Intuitionistic Fuzzy Technique for Order of Preference by Similarity to Ideal Solution for Fuzzy Multi-Criteria Decision Making. Reference describing the method: Roszkowska, Kusterka-Jefmańska, Jefmański (2021) doi:10.3390/e23050563

Usage

```
IFTOPSIS(
  data,
  d = "e",
  w = rep(3/ncol(data), ncol(data)/3),
  z = rep("b", ncol(data)/3),
  p = "dataBounds",
  ap = "dataBounds"
)
```

Arguments

data	The data matrix (*m* x *n*3*) with the values of *mi ni* and *pi* (three columns for each intuitionistic fuzzy representation of criteria for each alternative), where *m* is the number of alternatives and *n* is the number of criteria.
d	Distance "euclidean" or "hamming".
w	A vector of length *n*, containing the crisp weights for the criteria (one value for intuitionistic fuzzy representation)
z	A vector of length *n*, with preferences type for each criterion with "b" (benefit) and "c" (cost).
p	Ideal point calculation type with one of two values: "dataBounds" – ideal point contains max and min values from the dataset – see details; "idealBounds" – ideal point contains 1 and 0's - see details.
ap	Anti-ideal point calculation type with one of two values: "dataBounds" – anti-ideal point contains min and max from the dataset – see details; "idealBounds" – anti-ideal point contains 0 and 1's - see details.

Details

For p="dataBounds" the actual ideal point is calculated for benefits as maximum from all values for *mi* and min for *ni* (*pi* = 1- *mi* - *ni*); in the case of costs, minimal value for *mi* and max for *ni* (*pi* = 1- *mi* - *ni*). For p="idealBounds" for benefitss is 1 for *mi* and 0 for *ni* (*pi* = 1- *mi* - *ni*). In the case of costs it is 0 for *mi* and 1 for *ni* (*pi* = 1- (*mi* - *ni*). For ap="dataBounds" the actual anti-ideal point is calculated for benefit criteria as minimum of all values for *mi*, maximum of all values for *ni* and *pi*

= 1- (*mi* + *ni*); in the case of cost criteria, maximum of all values for *mi*, minimum of all values for *ni* and *pi* = 1- (*mi* + *ni*). For ap="idealBounds" in the case of benefit criteria it is 0 for *mi*, 1 for *ni*, 0 for *pi*; in the case of cost criteria it is 1 for *mi*, 0 for *ni* and 0 for *pi*.

Value

`IFTOPSIS` returns a data frame that contains the scores of the Intuitionistic Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (IFTOPSIS) and the ranking of the alternatives.

References

Roszkowska E, Kusterka-Jefmańska M, Jefmański B. Intuitionistic Fuzzy TOPSIS as a Method for Assessing Socioeconomic Phenomena on the Basis of Survey Data. Entropy. 2021; 23(5):563. doi:10.3390/e23050563

Xu, Z. Some Similarity Measures of Intuitionistic Fuzzy Sets and Their Applications to Multiple Attribute Decision Making. Fuzzy Optimization and Decision Making. 2007; 6: 109–121. doi:10.1007/s107000079004z

Examples

```
set.seed(823)
data<-sample(1:7,26*13*8,replace=TRUE)
dim(data)<-c(26*13,8)
nrColumns<-8
primary<-data.frame(name=rep(LETTERS,each=13),data)
f<-IFconversion(primary)
m<-IFTOPSIS(f)
print(m)
```

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