Package 'fcmfd'

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Type Package

Title Fuzzy C-Means for Fuzzy Data

Version 0.1.0

Description Implements a fuzzy clustering approach for ordinal Likert-type data using triangular fuzzy numbers (TFNs). The package extends the classical fuzzy C-means algorithm to better handle uncertainty in ordinal scales and includes automatic selection of the number of clusters using the Xie-Beni validity index. References: Coppi, R., D'Urso, P., and Giordani, P. (2012), Fuzzy and possibilistic clustering for fuzzy data, <doi:10.1016/j.csda.2010.09.013>. Xie, X. L. and Beni, G. (1991), A validity measure for fuzzy clustering, <doi:10.1109/34.85677>.

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LazyData true

Depends R (>= 3.5)

Imports stats, graphics

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr

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Repository CRAN

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Contents

`cluster_assignment` *Hard Cluster Assignment*

Description

Assigns each observation to the cluster with the highest membership value.

Usage

```
cluster_assignment(object)
```

Arguments

`object`	An object of class "fcmTFN".

Value

A factor indicating cluster labels.

`fcmTFN` *Fuzzy C-Means Clustering for Triangular Fuzzy Numbers*

Description

Performs fuzzy clustering on ordinal Likert-type data represented as triangular fuzzy numbers (TFNs).

Usage

```
fcmTFN(
  data,
  type = "symmetric",
  option = "B",
  dictionary = NULL,
  k_values = 2:6,
  m = 2,
  epsilon = 1e-06,
  max_iter = 1000,
  verbose = TRUE
)
```

Arguments

data	A data.frame or matrix containing ordinal Likert-type values.
type	Dictionary type ("symmetric" or "asymmetric").
option	Dictionary option ("A", "B", "C", or "D").
dictionary	Optional custom dictionary for asymmetric definitions.
k_values	Numeric vector of candidate numbers of clusters.
m	Fuzzifier parameter (m > 1).
epsilon	Convergence tolerance.
max_iter	Maximum number of iterations.
verbose	Logical; if TRUE, prints progress messages.

Details

The function automatically determines the optimal number of clusters based on the Xie-Beni validity index.

Value

An object of class ‘"fcmTFN"‘ and ‘"fcm"‘.

References

Coppi, R., D'Urso, P., & Giordani, P. (2012). Fuzzy and possibilistic clustering for fuzzy data. <doi:10.1016/j.csda.2010.09.013>

Xie, X. L., & Beni, G. (1991). A validity measure for fuzzy clustering. <doi:10.1109/34.85677>

membership *Extract Membership Matrix*

Description

Returns the fuzzy membership matrix obtained from the Fuzzy C-Means clustering process.

Usage

```
membership(object)
```

Arguments

object	An object of class "fcmTFN".

Value

A matrix where rows represent observations and columns represent clusters.

plot_dictionary *Plot Fuzzy Dictionary*

Description

Plots the triangular fuzzy numbers defining the Likert-scale dictionary.

Usage

```
plot_dictionary(object)
```

Arguments

object	An object of class "fcmTFN".

Value

A plot showing triangular membership functions.

plot_prototypes *Plot Cluster Prototypes*

Description

Visualizes cluster prototypes as interval plots using triangular fuzzy numbers (l, c, r).

Usage

```
plot_prototypes(
  object,
  cluster = 1,
  use_var_names = FALSE,
  var_names = NULL,
  ...
)
```

Arguments

object	An object of class "fcmTFN".
cluster	Integer cluster to plot.
use_var_names	Logical.
var_names	Optional variable names.
...	Additional graphical parameters.

Value

Invisibly returns NULL.

plot_xb *Plot Xie-Beni Index*

Description

Plots the Xie-Beni validity index across candidate numbers of clusters.

Usage

```
plot_xb(object, mark_optimal = TRUE, type = "b", ...)
```

Arguments

object	An object of class "fcmTFN".
mark_optimal	Logical. Whether to highlight the optimal k.
type	Plot type (default = "b").
...	Additional graphical parameters.

Value

Invisibly returns NULL.

`print_fcmTFN` *Print Method for fcmTFN Objects*

Description

Displays a concise summary of a fitted fuzzy C-means model using triangular fuzzy numbers.

Usage

```
print_fcmTFN(x, ...)
```

Arguments

`x`	An object of class "fcmTFN".
`...`	Additional arguments (not used).

Value

The input object (invisibly).

`prototype_matrix` *Prototype Matrix Extraction*

Description

Returns cluster prototypes as a readable matrix containing l, c, r values for each variable.

Usage

```
prototype_matrix(object, use_var_names = FALSE, var_names = NULL)
```

Arguments

`object`	An object of class "fcmTFN".
`use_var_names`	Logical.
`var_names`	Optional variable names.

Value

A data.frame containing prototype values.

`sim_likert7` *Simulated Likert 1–7 Survey Dataset*

Description

A simulated Likert-type dataset with three well-separated clusters. Designed for testing fuzzy clustering of ordinal data.

Usage

```
sim_likert7
```

Format

A data.frame with 300 rows and 12 variables:

Q1 Likert response (1–7)

Q2 Likert response (1–7)

Q3 Likert response (1–7)

Q4 Likert response (1–7)

Q5 Likert response (1–7)

Q6 Likert response (1–7)

Q7 Likert response (1–7)

Q8 Likert response (1–7)

Q9 Likert response (1–7)

Q10 Likert response (1–7)

Q11 Likert response (1–7)

Q12 Likert response (1–7)

Details

The dataset contains responses measured on a 1–7 Likert scale across 12 variables.

The dataset was generated using three latent profiles centered approximately at:

• Low agreement (≈ 2) • Moderate agreement (≈ 4) • High agreement (≈ 6)

Each cluster contains 100 observations.

Source

Simulated data generated for package examples.

`sim_likert_0_10` *Simulated Likert Data (0–10 Scale)*

Description

A synthetic dataset representing ordinal Likert-type responses measured on a 0–10 scale.

Usage

```
sim_likert_0_10
```

Format

A data.frame with 500 observations and 10 variables:

life_satisfaction Overall life satisfaction

happiness Self-reported happiness

anxiety Anxiety level

depression Depression level

health Self-rated health

income_satisfaction Income satisfaction

job_satisfaction Job satisfaction

social_relationships Social relationships quality

trust_in_others Trust in others

future_expectations Future expectations

Details

The dataset is designed with an underlying cluster structure (low, medium, high profiles) to support clustering validation.

The dataset contains three latent groups representing different levels of well-being.

Source

Simulated data

`summary.fcmTFN` *Summary for fcmTFN Objects*

Description

Displays a summary of the Fuzzy C-Means clustering results for triangular fuzzy numbers.

Usage

```
## S3 method for class 'fcmTFN'
summary(object, ...)
```

Arguments

`object`	An object of class "fcmTFN".
`...`	Additional arguments (not used).

Value

Prints a formatted summary of the clustering result.

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