Package 'pfclust'

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Type Package

Title Power Fuzzy Clustering and Cluster-Wise Regression

Version 0.1.1

Description Implementations of Power Fuzzy Clustering (PFC) and Power Fuzzy Cluster-wise Regression (PFCR) for multivariate data. The package supports Minkowski distances, with the L1 case solved via iteratively re-weighted least squares and the case p > 1 solved via coordinate-wise root finding, as well as an adaptive, regularised Mahalanobis distance with per-cluster covariance matrices. Both plain fuzzy clustering and cluster-wise linear regression are provided. The corresponding paper can be found at Nguyen P.T., Tortora C., and Punzo A. (2026) <doi:10.1109/TFUZZ.2026.3683998>.

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Depends R (>= 3.5.0)

Imports stats

Suggests flexCWM

RoxygenNote 7.3.3

NeedsCompilation no

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Contents

PFC *Power Fuzzy Clustering*

Description

Clusters the rows of ‘Y‘ into ‘K‘ groups using Minkowski, adaptive regularised Mahalanobis, or Euclidean distance.

Usage

```
PFC(
  Y,
  K,
  m = 2,
  q = 2,
  distance = "Euclidean",
  p = 2,
  alpha = 0.5,
  beta = 10^15,
  threshold = 0.01,
  max.iter = 100
)
```

Arguments

Y	An ‘n x dy‘ data frame or matrix of observations.
K	Number of clusters (positive integer).
m	Fuzzifier, must be strictly greater than 1. Default ‘2‘.
q	Distance exponent, must be strictly greater than 0. Default ‘2‘.
distance	One of ‘"Minkowski"‘, ‘"Mahalanobis"‘, or ‘"Euclidean"‘. Default ‘"Euclidean"‘.
p	Minkowski exponent (‘>= 1‘). Ignored when ‘distance‘ is ‘"Mahalanobis"‘ or ‘"Euclidean"‘. Default ‘2‘.
alpha	Regularisation weight for the Mahalanobis covariance. Default ‘0.5‘.
beta	Eigenvalue ratio bound for the Mahalanobis covariance. Default ‘1e15‘.
threshold	Convergence tolerance. Default ‘0.01‘.
max.iter	Maximum number of iterations. Default ‘100‘.

Value

A list with elements ‘B‘ (or ‘C‘) for cluster centres, ‘d‘ (distances), ‘p‘ (memberships), ‘JDF‘ (objective history), and ‘l‘ (hard labels). For Mahalanobis, also ‘rho‘ and ‘cov‘.

Examples

```
res <- PFC(iris[, 1:4], K = 3)
table(res$l, iris[, 5])
```

PFCR *Power Fuzzy Cluster-wise Regression*

Description

Fits ‘K‘ cluster-specific linear models $Y = XB_k + \varepsilon$, selecting an internal solver based on the chosen distance and exponent.

Usage

```
PFCR(
  X,
  Y,
  K,
  m = 2,
  q = 2,
  distance = "Euclidean",
  p = 2,
  alpha = 0.5,
  beta = 10^15,
  threshold = 0.01,
  max.iter = 100
)
```

Arguments

X	An ‘n x dx‘ data frame or matrix of covariates.
Y	An ‘n x dy‘ data frame or matrix of dependent variables.
K	Number of clusters (positive integer).
m	Fuzzifier, must be strictly greater than 1. Default ‘2‘.
q	Distance exponent, must be strictly greater than 0. Default ‘2‘.
distance	One of ‘"Minkowski"‘, ‘"Mahalanobis"‘, or ‘"Euclidean"‘. Default ‘"Euclidean"‘.
p	Minkowski exponent (‘>= 1‘). Ignored when ‘distance‘ is ‘"Mahalanobis"‘ or ‘"Euclidean"‘. Default ‘2‘.
alpha	Regularisation weight for the Mahalanobis covariance. Default ‘0.5‘.
beta	Eigenvalue ratio bound for the Mahalanobis covariance. Default ‘1e15‘.
threshold	Convergence tolerance on successive coefficient updates. Default ‘0.01‘.
max.iter	Maximum number of iterations. Default ‘100‘.

Value

A list with elements:

B Array of regression coefficients.

d Data frame of distances (‘n x K‘).

p Data frame of membership degrees (‘n x K‘).

JDF Vector of objective-function values per iteration.

l Hard cluster labels (length ‘n‘).

rho, cov (Mahalanobis only) cluster proportions and covariance matrices.

Examples

```
## Not run:
library(flexCWM)
data("students")
Y <- students[, 2:3]
X <- students[, 4]
res <- PFCR(X, Y, K = 2, distance = "Mahalanobis")
table(res$l, students[, 1])

## End(Not run)
```

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