Package 'simuclustfactor'

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Type Package

Title Simultaneous Clustering and Factorial Decomposition of Three-Way Datasets

Version 0.0.3

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Description Implements two iterative techniques called T3Clus and 3Fkmeans, aimed at simultaneously clustering objects and a factorial dimensionality reduction of variables and occasions on three-mode datasets developed by Vichi et al. (2007) <doi:10.1007/s00357-007-0006-x>. Also, we provide a convex combination of these two simultaneous procedures called CT3Clus and based on a hyperparameter alpha (alpha in [0,1], with 3FKMeans for alpha=0 and T3Clus for alpha= 1) also developed by Vichi et al. (2007) <doi:10.1007/s00357-007-0006-x>. Furthermore, we implemented the traditional tandem procedures of T3Clus (TWCFTA) and 3FKMeans (TWFCTA) for sequential clustering-factorial decomposition (TWCFTA), and vice-versa (TWFCTA) proposed by P. Arabie and L. Hubert (1996) <doi:10.1007/978-3-642-79999-0_1>.

License GPL-3

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Imports methods, stats, Rdpack

RdMacros Rdpack

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R topics documented:

`attributes.simultaneous-class`
Simultaneous results attributes

Description

Simultaneous results attributes

Slots

`U_i_g0` matrix. Initial object membership function matrix

`B_j_q0` matrix. Initial factor/component matrix for the variables

`C_k_r0` matrix. Initial factor/component matrix for the occasions

`U_i_g` matrix. Final/updated object membership function matrix

`B_j_q` matrix. Final/updated factor/component matrix for the variables

`C_k_r` matrix. Final/updated factor/component matrix for the occasions

`Y_g_qr` matrix. Derived centroids in the reduced space (data matrix)

`X_i_jk_scaled` matrix. Standardized dataset matrix

`BestTimeElapsed` numeric. Execution time for the best iterate

`BestLoop` numeric. Loop that obtained the best iterate

`BestIteration` numeric. Iteration yielding the best results

`Converged` numeric. Flag to check if algorithm converged for the K-means

nConverges numeric. Number of loops that converged for the K-means

TSS_full numeric. Total deviance in the full-space

BSS_full numeric. Between deviance in the reduced-space

RSS_full numeric. Residual deviance in the reduced-space

PF_full numeric. PseudoF in the full-space

TSS_reduced numeric. Total deviance in the reduced-space

BSS_reduced numeric. Between deviance in the reduced-space

RSS_reduced numeric. Residual deviance in the reduced-space

PF_reduced numeric. PseudoF in the reduced-space

PF numeric. Weighted PseudoF score

Labels integer. Object cluster assignments

Fs numeric. Objective function values for the KM best iterate

Enorm numeric. Average l2 norm of the residual norm.

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attributes.tandem-class

Tandem results attributes

Description

Tandem results attributes

Slots

U_i_g0 matrix. Initial object membership function matrix.

B_j_q0 matrix. Initial factor/component matrix for the variables.

C_k_r0 matrix. Initial factor/component matrix for the occasions.

U_i_g matrix. Final/updated object membership function matrix.

B_j_q matrix. Final/updated factor/component matrix for the variables.

C_k_r matrix. Final/updated factor/component matrix for the occasions.

Y_g_qr matrix. Derived centroids in the reduced space (data matrix).

X_i_jk_scaled matrix. Standardized dataset matrix.

BestTimeElapsed numeric. Execution time for the best iterate.

BestLoop numeric. Loop that obtained the best iterate.

BestKmIteration numeric. Number of iteration until best iterate for the K-means.

BestFaIteration numeric. Number of iteration until best iterate for the FA.

FaConverged numeric. Flag to check if algorithm converged for the K-means.

KmConverged numeric. Flag to check if algorithm converged for the Factor Decomposition.

nKmConverges numeric. Number of loops that converged for the K-means.

`nFaConverges` numeric. Number of loops that converged for the Factor decomposition.

`TSS_full` numeric. Total deviance in the full-space.

`BSS_full` numeric. Between deviance in the reduced-space.

`RSS_full` numeric. Residual deviance in the reduced-space.

`PF_full` numeric. PseudoF in the full-space.

`TSS_reduced` numeric. Total deviance in the reduced-space.

`BSS_reduced` numeric. Between deviance in the reduced-space.

`RSS_reduced` numeric. Residual deviance in the reduced-space.

`PF_reduced` numeric. PseudoF in the reduced-space.

`PF` numeric. Actual PseudoF value to obtain best loop.

`Labels` integer. Object cluster assignments.

`FsKM` numeric. Objective function values for the KM best iterate.

`FsFA` numeric. Objective function values for the FA best iterate.

`Enorm` numeric. Average l2 norm of the residual norm.

`fit.3fkmeans` *3FKMeans Model*

Description

Implements simultaneous version of TWFCTA

Usage

```
fit.3fkmeans(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)

## S4 method for signature 'simultaneous'
fit.3fkmeans(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)
```

Arguments

`model`	Initialized simultaneous model.
`X_i_jk`	Matricized tensor along mode-1 (I objects).
`full_tensor_shape`	Dimensions of the tensor in full-space.
`reduced_tensor_shape`	Dimensions of tensor in the reduced-space.

Details

The procedure performs simultaneously the sequential TWFCTA model. The model finds B_j_q and C_k_r such that the within-clusters deviance of the component scores is minimized.

Value

Output attributes accessible via the '@' operator.

- U_i_g0 - Initial object membership function matrix
- B_j_q0 - Initial factor/component matrix for the variables
- C_k_r0 - Initial factor/component matrix for the occasions
- U_i_g - Final/updated object membership function matrix
- B_j_q - Final/updated factor/component matrix for the variables
- C_k_r - Final/updated factor/component matrix for the occasions
- Y_g_qr - Derived centroids in the reduced space (data matrix)
- X_i_jk_scaled - Standardized dataset matrix
- BestTimeElapsed - Execution time for the best iterate
- BestLoop - Loop that obtained the best iterate
- BestIteration - Iteration yielding the best results
- Converged - Flag to check if algorithm converged for the K-means
- nConverges - Number of loops that converged for the K-means
- TSS_full - Total deviance in the full-space
- BSS_full - Between deviance in the reduced-space
- RSS_full - Residual deviance in the reduced-space
- PF_full - PseudoF in the full-space
- TSS_reduced - Total deviance in the reduced-space
- BSS_reduced - Between deviance in the reduced-space
- RSS_reduced - Residual deviance in the reduced-space
- PF_reduced - PseudoF in the reduced-space
- PF - Weighted PseudoF score
- Labels - Object cluster assignments
- Fs - Objective function values for the KM best iterate
- Enorm - Average l2 norm of the residual norm.

References

Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html. Vichi M, Kiers HAL (2001). "Factorial k-means analysis for two-way data." *Computational Statistics and Data Analysis*, **37**(1), 49-64. https://EconPapers.repec.org/RePEc:eee:csdana:v:37:y:2001:i:1:p:49-64. Vichi M, Rocci R, Kiers H (2007). "Simultaneous Component and Clustering Models for Three-way Data: Within and Between Approaches." *Journal of Classification*, **24**, 71-98. doi:10.1007/s003570070006x.

Examples

```
X_i_jk = generate_dataset()$X_i_jk
model = simultaneous()
tfkmeans = fit.3fkmeans(model, X_i_jk, c(8,5,4), c(3,3,2))
```

`fit.ct3clus` *CT3Clus Model*

Description

Implements simultaneous T3Clus and 3FKMeans integrating an alpha value between 0 and 1 inclusive for a weighted result.

Usage

```
fit.ct3clus(
  model,
  X_i_jk,
  full_tensor_shape,
  reduced_tensor_shape,
  alpha = 0.5
)

## S4 method for signature 'simultaneous'
fit.ct3clus(
  model,
  X_i_jk,
  full_tensor_shape,
  reduced_tensor_shape,
  alpha = 0.5
)
```

Arguments

`model`	Initialized simultaneous model.
`X_i_jk`	Matricized tensor along mode-1 (I objects).
`full_tensor_shape`	Dimensions of the tensor in full space.
`reduced_tensor_shape`	Dimensions of tensor in the reduced space.
`alpha`	0<alpha>1 hyper parameter. Model is T3Clus when alpha=1 and 3FKMeans when alpha=0.

Value

Output attributes accessible via the '@' operator.

- U_i_g0 - Initial object membership function matrix
- B_j_q0 - Initial factor/component matrix for the variables
- C_k_r0 - Initial factor/component matrix for the occasions
- U_i_g - Final/updated object membership function matrix

- B_j_q - Final/updated factor/component matrix for the variables
- C_k_r - Final/updated factor/component matrix for the occasions
- Y_g_qr - Derived centroids in the reduced space (data matrix)
- X_i_jk_scaled - Standardized dataset matrix
- BestTimeElapsed - Execution time for the best iterate
- BestLoop - Loop that obtained the best iterate
- BestIteration - Iteration yielding the best results
- Converged - Flag to check if algorithm converged for the K-means
- nConverges - Number of loops that converged for the K-means
- TSS_full - Total deviance in the full-space
- BSS_full - Between deviance in the reduced-space
- RSS_full - Residual deviance in the reduced-space
- PF_full - PseudoF in the full-space
- TSS_reduced - Total deviance in the reduced-space
- BSS_reduced - Between deviance in the reduced-space
- RSS_reduced - Residual deviance in the reduced-space
- PF_reduced - PseudoF in the reduced-space
- PF - Weighted PseudoF score
- Labels - Object cluster assignments
- Fs - Objective function values for the KM best iterate
- Enorm - Average l2 norm of the residual norm.

References

Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html. Rocci R, Vichi M (2005). "Three-Mode Component Analysis with Crisp or Fuzzy Partition of Units." *Psychometrika*, **70**, 715-736. doi:10.1007/s113360010926z. Vichi M, Kiers HAL (2001). "Factorial k-means analysis for two-way data." *Computational Statistics and Data Analysis*, **37**(1), 49-64. https://EconPapers.repec.org/RePEc:eee:csdana:v:37:y:2001:i:1:p:49-64. Vichi M, Rocci R, Kiers H (2007). "Simultaneous Component and Clustering Models for Three-way Data: Within and Between Approaches." *Journal of Classification*, **24**, 71-98. doi:10.1007/s003570070006x.

See Also

fit.t3clus fit.3fkmeans simultaneous

Examples

```
X_i_jk = generate_dataset()$X_i_jk
model = simultaneous()
ct3clus = fit.ct3clus(model, X_i_jk, c(8,5,4), c(3,3,2), alpha=0.5)
```

`fit.t3clus` *T3Clus Model*

Description

Implements simultaneous version of TWCFTA

Usage

```
fit.t3clus(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)

## S4 method for signature 'simultaneous'
fit.t3clus(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)
```

Arguments

`model`	Initialized simultaneous model.
`X_i_jk`	Matricized tensor along mode-1 (I objects).
`full_tensor_shape`	Dimensions of the tensor in full-space.
`reduced_tensor_shape`	Dimensions of tensor in the reduced-space.

Details

The procedure performs simultaneously the sequential TWCFTA model. The model finds B_j_q and C_k_r such that the between-clusters deviance of the component scores is maximized.

Value

Output attributes accessible via the '@' operator.

- U_i_g0 - Initial object membership function matrix
- B_j_q0 - Initial factor/component matrix for the variables
- C_k_r0 - Initial factor/component matrix for the occasions
- U_i_g - Final/updated object membership function matrix
- B_j_q - Final/updated factor/component matrix for the variables
- C_k_r - Final/updated factor/component matrix for the occasions
- Y_g_qr - Derived centroids in the reduced space (data matrix)
- X_i_jk_scaled - Standardized dataset matrix
- BestTimeElapsed - Execution time for the best iterate
- BestLoop - Loop that obtained the best iterate
- BestIteration - Iteration yielding the best results
- Converged - Flag to check if algorithm converged for the K-means

- nConverges - Number of loops that converged for the K-means
- TSS_full - Total deviance in the full-space
- BSS_full - Between deviance in the reduced-space
- RSS_full - Residual deviance in the reduced-space
- PF_full - PseudoF in the full-space
- TSS_reduced - Total deviance in the reduced-space
- BSS_reduced - Between deviance in the reduced-space
- RSS_reduced - Residual deviance in the reduced-space
- PF_reduced - PseudoF in the reduced-space
- PF - Weighted PseudoF score
- Labels - Object cluster assignments
- Fs - Objective function values for the KM best iterate
- Enorm - Average l2 norm of the residual norm.

References

Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html. Rocci R, Vichi M (2005). "Three-Mode Component Analysis with Crisp or Fuzzy Partition of Units." *Psychometrika*, **70**, 715-736. doi:10.1007/s113360010926z. Vichi M, Rocci R, Kiers H (2007). "Simultaneous Component and Clustering Models for Three-way Data: Within and Between Approaches." *Journal of Classification*, **24**, 71-98. doi:10.1007/s003570070006x.

Examples

```
X_i_jk = generate_dataset()$X_i_jk
model = simultaneous()
t3clus = fit.t3clus(model, X_i_jk, c(8,5,4), c(3,3,2))
```

`fit.twcfta` *TWCFTA model*

Description

Implements K-means clustering and afterwards factorial reduction in a sequential fashion.

Usage

```
fit.twcfta(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)

## S4 method for signature 'tandem'
fit.twcfta(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)
```

Arguments

`model`	Initialized tandem model.
`X_i_jk`	Matricized tensor along mode-1 (I objects).
`full_tensor_shape`	Dimensions of the tensor in full space.
`reduced_tensor_shape`	Dimensions of tensor in the reduced space.

Details

The procedure requires sequential clustering and factorial decomposition.

- The K-means clustering algorithm is initially applied to the matricized tensor X_i_jk to obtain the centroids matrix X_g_jk and the membership matrix U_i_g.
- The Tucker2 decomposition technique is then implemented on the centroids matrix X_g_jk to yield the core centroids matrix Y_g_qr and the component weights matrices B_j_q and C_k_r.

Value

Output attributes accessible via the '@' operator.

- U_i_g0 - Initial object membership function matrix.
- B_j_q0 - Initial factor/component matrix for the variables.
- C_k_r0 - Initial factor/component matrix for the occasions.
- U_i_g - Final/updated object membership function matrix.
- B_j_q - Final/updated factor/component matrix for the variables.
- C_k_r - Final/updated factor/component matrix for the occasions.
- Y_g_qr - Derived centroids in the reduced space (data matrix).
- X_i_jk_scaled - Standardized dataset matrix.
- BestTimeElapsed - Execution time for the best iterate.
- BestLoop - Loop that obtained the best iterate.
- BestKmIteration - Number of iteration until best iterate for the K-means.
- BestFaIteration - Number of iteration until best iterate for the FA.
- FaConverged - Flag to check if algorithm converged for the K-means.
- KmConverged - Flag to check if algorithm converged for the Factor Decomposition.
- nKmConverges - Number of loops that converged for the K-means.
- nFaConverges - Number of loops that converged for the Factor decomposition.
- TSS_full - Total deviance in the full-space.
- BSS_full - Between deviance in the reduced-space.
- RSS_full - Residual deviance in the reduced-space.
- PF_full - PseudoF in the full-space.
- TSS_reduced - Total deviance in the reduced-space.

- BSS_reduced - Between deviance in the reduced-space.
- RSS_reduced - Residual deviance in the reduced-space.
- PF_reduced - PseudoF in the reduced-space.
- PF - Actual PseudoF value to obtain best loop.
- Labels - Object cluster assignments.
- FsKM - Objective function values for the KM best iterate.
- FsFA - Objective function values for the FA best iterate.
- Enorm - Average l2 norm of the residual norm.

Note

- This procedure is useful to further interpret the between clusters variability of the data and to understand the variables and/or occasions that most contribute to discriminate the clusters. However, the application of this technique could lead to the masking of variables that are not informative of the clustering structure.
- since the Tucker2 model is applied after the clustering, this cannot help select the most relevant information for the clustering in the dataset.

References

Arabie P, Hubert L (1996). "Advances in Cluster Analysis Relevant to Marketing Research." In Gaul W, Pfeifer D (eds.), *From Data to Knowledge*, 3–19. Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html.

See Also

`fit.twfcta` `tandem`

Examples

```
X_i_jk = generate_dataset()$X_i_jk
model = tandem()
twcfta = fit.twcfta(model, X_i_jk, c(8,5,4), c(3,3,2))
```

`fit.twfcta` *TWFCTA model*

Description

Implements factorial reduction and then K-means clustering in a sequential fashion.

Usage

```
fit.twfcta(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)

## S4 method for signature 'tandem'
fit.twfcta(model, X_i_jk, full_tensor_shape, reduced_tensor_shape)
```

Arguments

`model`	Initialized tandem model.
`X_i_jk`	Matricized tensor along mode-1 (I objects).
`full_tensor_shape`	Dimensions of the tensor in full space.
`reduced_tensor_shape`	Dimensions of tensor in the reduced space.

Details

The procedure implements sequential factorial decomposition and clustering.

- The technique performs Tucker2 decomposition on the X_i_jk matrix to obtain the matrix of component scores Y_i_qr with component weights matrices B_j_q and C_k_r.
- The K-means clustering algorithm is then applied to the component scores matrix Y_i_qr to obtain the desired core centroids matrix Y_g_qr and its associated stochastic membership function matrix U_i_g.

Value

Output attributes accessible via the '@' operator.

- U_i_g0 - Initial object membership function matrix.
- B_j_q0 - Initial factor/component matrix for the variables.
- C_k_r0 - Initial factor/component matrix for the occasions.
- U_i_g - Final/updated object membership function matrix.
- B_j_q - Final/updated factor/component matrix for the variables.
- C_k_r - Final/updated factor/component matrix for the occasions.
- Y_g_qr - Derived centroids in the reduced space (data matrix).
- X_i_jk_scaled - Standardized dataset matrix.
- BestTimeElapsed - Execution time for the best iterate.
- BestLoop - Loop that obtained the best iterate.
- BestKmIteration - Number of iteration until best iterate for the K-means.
- BestFaIteration - Number of iteration until best iterate for the FA.
- FaConverged - Flag to check if algorithm converged for the K-means.
- KmConverged - Flag to check if algorithm converged for the Factor Decomposition.
- nKmConverges - Number of loops that converged for the K-means.

- nFaConverges - Number of loops that converged for the Factor decomposition.
- TSS_full - Total deviance in the full-space.
- BSS_full - Between deviance in the reduced-space.
- RSS_full - Residual deviance in the reduced-space.
- PF_full - PseudoF in the full-space.
- TSS_reduced - Total deviance in the reduced-space.
- BSS_reduced - Between deviance in the reduced-space.
- RSS_reduced - Residual deviance in the reduced-space.
- PF_reduced - PseudoF in the reduced-space.
- PF - Actual PseudoF value to obtain best loop.
- Labels - Object cluster assignments.
- FsKM - Objective function values for the KM best iterate.
- FsFA - Objective function values for the FA best iterate.
- Enorm - Average l2 norm of the residual norm.

Note

- The technique helps interpret the within clusters variability of the data. The Tucker2 tends to explain most of the total variation in the dataset. Hence, the variance of variables that do not contribute to the clustering structure in the dataset is also included.
- The Tucker2 dimensions may still mask some essential clustering structures in the dataset.

References

Arabie P, Hubert L (1996). "Advances in Cluster Analysis Relevant to Marketing Research." In Gaul W, Pfeifer D (eds.), *From Data to Knowledge*, 3–19. Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html.

See Also

fit.twcfta tandem

Examples

```
X_i_jk = generate_dataset()$X_i_jk
model = tandem()
twfCta = fit.twfcta(model, X_i_jk, c(8,5,4), c(3,3,2))
```

fold *Folding Matrix to Tensor by Mode.*

Description

X_i_jk => X_i_j_k, X_j_ki => X_i_j_k, X_k_ij => X_i_j_k

Usage

```
fold(X, mode, shape)
```

Arguments

X	Data matrix to fold.
mode	Mode of operation.
shape	Dimension of original tensor.

Value

X_i_j_k Three-mode tensor.

Examples

```
X_i_jk = generate_dataset()$X_i_jk
X_i_j_k = fold(X_i_jk, mode=1, shape=c(I=8,J=5,K=4)) # X_i_j_k
```

generate_dataset *Three-Mode Dataset Generator for Simulations*

Description

Generate G clustered synthetic dataset of I objects measured on J variables for K occasions with additive noise.

Usage

```
generate_dataset(
  I = 8,
  J = 5,
  K = 4,
  G = 3,
  Q = 3,
  R = 2,
  centroids_spread = c(0, 1),
```

```
  noise_mean = 0,
  noise_stdev = 0.5,
  seed = NULL
)
```

Arguments

I	Number of objects.
J	Number of variables per occasion.
K	Number of occasions.
G	Number of clusters.
Q	Number of factors for the variables.
R	Number of factors for the occasions.
centroids_spread	interval from which to uniformly pick the centroids.
noise_mean	Mean of noise to generate.
noise_stdev	Noise effect level/spread/standard deviation.
seed	Seed for random sequence generation.

Value

Z_i_jk: Component scores in the full space.

E_i_jk: Generated noise at the given noise level.

X_i_jk: Dataset with noise level set to noise_stdev specified.

Y_g_qr: Centroids matrix in the reduced space.

U_i_g: Stochastic membership function matrix.

B_j_q: Objects component scores matrix.

C_k_r: Occasions component scores matrix.

Examples

```
generate_dataset(seed=0)
```

---

generate_rmfm *Random Membership Function Matrix Generator*

Description

Generates random binary stochastic membership function matrix for the I objects.

Usage

```
generate_rmfm(I, G, seed = NULL)
```

Arguments

I	Number of objects.
G	Number of groups/clusters.
seed	Seed for random number generation.

Value

U_i_g, binary stochastic membership matrix.

Examples

```
generate_rmfm(I=8,G=3)
```

---

onekmeans *One-run of the K-means clustering technique*

Description

Initializes centroids based on a given membership function matrix or randomly. Iterate once over the input data to update the membership function matrix assigning objects to the closest centroids.

Usage

```
onekmeans(Y_i_qr, G, U_i_g = NULL, seed = NULL)
```

Arguments

Y_i_qr	Input data to group/cluster.
G	Number of clusters to find.
U_i_g	Initial membership matrix for the I objects.
seed	Seed for random values generation.

Value

updated membership matrix U_i_g.

References

Oti EU, Olusola MO, Eze FC, Enogwe SU (2021). "Comprehensive Review of K-Means Clustering Algorithms." *International Journal of Advances in Scientific Research and Engineering (IJASRE), ISSN:2454-8006, DOI: 10.31695/IJASRE*, **7**(8), 64–69. doi:10.31695/IJASRE.2021.34050, https://ijasre.net/index.php/ijasre/article/view/1301.

Examples

```
X_i_jk = generate_dataset(seed=0)$X_i_jk
onekmeans(X_i_jk, G=5)
```

`pseudof.full` *PseudoF Score in the Full-Space*

Description

Computes the PseudoF score in the full space.

Usage

```
pseudof.full(bss, wss, full_tensor_shape, reduced_tensor_shape)
```

Arguments

`bss`	Between sums of squared deviations between clusters.
`wss`	Within sums of squared deviations within clusters.
`full_tensor_shape`	Dimensions of the tensor in the original space.
`reduced_tensor_shape`	Dimension of the tensor in the reduced space.

Value

PseudoF score

References

Caliński T, Harabasz J (1974). "A dendrite method for cluster analysis." *Communications in Statistics*, **3**(1), 1-27. doi:10.1080/03610927408827101, https://www.tandfonline.com/doi/pdf/10.1080/03610927408827101 , https://www.tandfonline.com/doi/abs/10.1080/03610927408827101. Rocci R, Vichi M (2005). "Three-Mode Component Analysis with Crisp or Fuzzy Partition of Units." *Psychometrika*, **70**, 715-736. doi:10.1007/s113360010926z.

Examples

```
pseudof.full(12,6,c(8,5,4),c(3,3,2))
```

pseudof.reduced *PseudoF Score in the Reduced-Space*

Description

Computes the PseudoF score in the reduced space.

Usage

```
pseudof.reduced(bss, wss, full_tensor_shape, reduced_tensor_shape)
```

Arguments

bss	Between sums of squared deviations between clusters.
wss	Within sums of squared deviations within clusters.
full_tensor_shape	Dimensions of the tensor in the original space.
reduced_tensor_shape	Dimension of the tensor in the reduced space.

Value

PseudoF score

References

Caliński T, Harabasz J (1974). "A dendrite method for cluster analysis." *Communications in Statistics*, **3**(1), 1-27. doi:10.1080/03610927408827101, https://www.tandfonline.com/doi/pdf/10.1080/03610927408827101 , https://www.tandfonline.com/doi/abs/10.1080/03610927408827101.

Examples

```
pseudof.reduced(12,6,c(8,5,4),c(3,3,2))
```

simultaneous *Simultaneous Model Constructor*

Description

Initialize model object required by the simultaneous methods.

Usage

```
simultaneous(
  seed = NULL,
  verbose = TRUE,
  init = "svd",
  n_max_iter = 10,
  n_loops = 10,
  tol = 1e-05,
  U_i_g = NULL,
  B_j_q = NULL,
  C_k_r = NULL
)
```

Arguments

seed	Seed for random sequence generation.
verbose	Flag to display output result for each loop.
init	The initialization method for the model parameters. Values could be 'svd','random','twcfta' or 'twfcta' Defaults to svd.
n_max_iter	Maximum number of iterations to optimize objective function.
n_loops	Number of runs/loops in search of the global result.
tol	Acceptable tolerance level.
U_i_g	Membership function matrix for the objects.
B_j_q	Component matrix for the variables.
C_k_r	Component matrix for the occasions.

Details

Two simultaneous models T3Clus and 3FKMeans are the implemented methods.

- T3Clus finds B_j_q and C_k_r such that the between-clusters deviance of the component scores is maximized.
- 3FKMeans finds B_j_q and C_k_r such that the within-clusters deviance of the component scores is minimized.

Value

An object of class "simultaneous".

Note

The model finds the best partition described by the best orthogonal linear combinations of the variables and orthogonal linear combinations of the occasions.

References

Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html. Vichi M, Rocci R, Kiers H (2007). "Simultaneous Component and Clustering Models for Three-way Data: Within and Between Approaches." *Journal of Classification*, **24**, 71-98. doi:10.1007/s003570070006x.

See Also

fit.t3clus fit.3fkmeans fit.ct3clus tandem

Examples

```
simultaneous()
```

`simultaneous-class` *Simultaneous Model*

Description

Simultaneous Model

Slots

`seed` numeric. Seed for random sequence generation. Defaults to None.

`verbose` logical. Whether to display executions output or not. Defaults to False.

`init` character. The parameter initialization method. Defaults to 'svd'.

`n_max_iter` numeric. Maximum number of iterations. Defaults to 10.

`n_loops` numeric. Number of initialization to guarantee global results. Defaults to 10.

`tol` numeric. Tolerance level/acceptable error. Defaults to 1e-5.

`U_i_g` numeric. (I,G) initial stochastic membership function matrix.

`B_j_q` numeric. (J,Q) initial component weight matrix for variables.

`C_k_r` numeric. (K,R) initial component weight matrix for occasions.

tandem *Initializes an instance of the tandem model required by the tandem methods.*

Description

Initializes an instance of the tandem model required by the tandem methods.

Usage

```
tandem(
  seed = NULL,
  verbose = TRUE,
  init = "svd",
  n_max_iter = 10,
  n_loops = 10,
  tol = 1e-05,
  U_i_g = NULL,
  B_j_q = NULL,
  C_k_r = NULL
)
```

Arguments

seed	Seed for random sequence generation.
verbose	Flag to display iteration outputs for each loop.
init	Parameter initialization method, 'svd' or 'random'.
n_max_iter	Maximum number of iteration to optimize the objective function.
n_loops	Maximum number of loops/runs for global results.
tol	Allowable tolerance to check convergence.
U_i_g	Initial membership function matrix for the objects.
B_j_q	Initial component scores matrix for the variables.
C_k_r	Initial component sores matrix for the occasions.

Value

An object of class "tandem".

References

Arabie P, Hubert L (1996). "Advances in Cluster Analysis Relevant to Marketing Research." In Gaul W, Pfeifer D (eds.), *From Data to Knowledge*, 3–19. Tucker L (1966). "Some mathematical notes on three-mode factor analysis." *Psychometrika*, **31**(3), 279-311. doi:10.1007/BF02289464, https://ideas.repec.org/a/spr/psycho/v31y1966i3p279-311.html.

See Also

fit.twcfta fit.twfcta simultaneous

---

tandem-class *Tandem Class*

Description

Tandem Class

Slots

seed Seed for random sequence generation. Defaults to None.

verbose logical. Whether to display executions output or not. Defaults to False.

init character. The parameter initialization method. Defaults to 'svd'.

n_max_iter numeric. Maximum number of iterations. Defaults to 10.

n_loops numeric. Number of initialization to guarantee global results. Defaults to 10.

tol numeric. Tolerance level/acceptable error. Defaults to 1e-5.

U_i_g matrix. (I,G) initial stochastic membership function matrix.

B_j_q matrix. (J,Q) initial component weight matrix for variables.

C_k_r matrix. (K,R) initial component weight matrix for occasions.

---

unfold *Tensor Matricization*

Description

Unfold/Matricize tensor. convert matrix to tensor by mode.

Usage

```
unfold(tensor, mode)
```

Arguments

tensor	Three-mode tensor array.
mode	Mode of operation.

Value

Matrix

Examples

```
X_i_jk = generate_dataset()$X_i_jk
X_i_j_k = fold(X_i_jk, mode=1, shape=c(I=8,J=5,K=4))
unfold(X_i_j_k, mode=1) # X_i_jk
```

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