Package ‘RegularizedSCA’

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cv_sparseSCA

A K-fold cross-validation procedure when common/distinctive processes are unknown with Lasso and Group Lasso penalties.

Description

cv_sparseSCA helps to find a range of Lasso and Group Lasso tuning parameters for the common component so as to generate sparse common component.

Usage

cv_sparseSCA(DATA, Jk, R, MaxIter, NRSTARTS, LassoSequence, GLassoSequence, nfolds, method)

Arguments

DATA The concatenated data block, with rows representing subjects.
Jk A vector. Each element of this vector is the number of columns of a data block.
R The number of components (R>=2).
MaxIter Maximum number of iterations for this algorithm. The default value is 400.
NRSTARTS The number of multistarts for this algorithm. The default value is 1.
LassoSequence The range of Lasso tuning parameters. The default value is a sequence of 20 numbers from 0.00000001 to the smallest Lasso tuning parameter value that makes all the component loadings equal to zero. Note that by default the 50 numbers are equally spaced on the log scale.
GLassoSequence The range of Group Lasso tuning parameters. The default value is a sequence of 20 numbers from 0.00000001 to the smallest Group Lasso tuning parameter value that makes all the component loadings equal to zero. Note that by default the 50 numbers are equally spaced (but not on the log scale). Note that if LassoSequence contains only one number, then by default GLassoSequence is a sequence of 50 values.
cv_sparseSCA

nfolds  Number of folds. If missing, then 10 fold cross-validation will be performed.
method  "datablock" or "component". These are two options with respect to the grouping of the loadings as used in the Group Lasso penalty. If method = "component", the block-grouping of the coefficients is applied per component separately. If method = "datablock", the grouping is applied on the concatenated data block, with loadings of all components together. If method is missing, then the "component" method is used by default.

Details

This function searches through a range of Lasso and Group Lasso tuning parameters for identifying common and distinctive components

Value

- **MSPE** A matrix of mean squared prediction error (MSPE) for the sequences of Lasso and Group Lasso tuning parameters.
- **SE_MSE** A matrix of standard errors for **MSPE**.
- **MSPE1SE** The lowest MSPE + 1SE.
- **VarSelected** A matrix of number of variables selected for the sequences of Lasso and Group Lasso tuning parameters.
- **Lasso_values** The sequence of Lasso tuning parameters used for cross-validation. Users may also consult **Lambdaregion** (explained below).
- **Glasso_values** The sequence of Group Lasso tuning parameters used for cross-validation. For example, suppose from the plot we found that the index number for Group Lasso is 6, its corresponding Group Lasso tuning parameter is **Glasso_values[6]**.

#'

- **Lambdaregion** A region of proper tuning parameter values for Lasso, given a certain value for Group Lasso. This means that, for example, if 5 Group Lasso tuning parameter values have been considered, **Lambdaregion** is a 5 by 2 matrix.
- **RecommendedLambda** A pair (or sometimes a few pairs) of Lasso and Group Lasso tuning parameters that lead to a model with MSPE closest to the lowest MSPE + 1SE.
- **P_hat** Estimated component loading matrix, given the recommended tuning parameters.
- **T_hat** Estimated component score matrix, given the recommended tuning parameters.
- **plotlog** An index number for function plot, which is not useful for users.

References


Examples

```r
### Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
Jk <- c(10, 20)
cv_sparseSCA(DATA, Jk, R=5, MaxIter = 100, NRSTARTS = 40, nfolds=10)

### End(Not run)
```

**cv_structuredSCA**

_A K-fold cross-validation procedure when common/distinctive processes are known, with a Lasso penalty._

Description

cv_structuredSCA helps to find a range of lasso tuning parameters for the common component so as to generate sparse common component.

Usage

cv_structuredSCA(DATA, Jk, R, Target, Position, MaxIter, NRSTARTS, LassoSequence, nfolds)

Arguments

- **DATA**: The concatenated data block, with rows representing subjects.
- **Jk**: A vector. Each element of this vector is the number of columns of a data block.
- **R**: The number of components (R>=2).
- **Target**: A matrix containing 0's and 1's. Its number of columns equals to R, and its number of rows equals to the number of blocks to be integrated. Thus, if the element in
- **Position**: Indicate on which component(s) the Lasso Penalty is imposed. If unspecified, the algorithm assume that the Lasso penalty is imposed on the common component(s) only. If there is no common component, then Lasso penalty is applied to all components.
- **MaxIter**: Maximum number of iterations for this algorithm. The default value is 400.
- **NRSTARTS**: The number of multistarts for this algorithm. The default value is 5.
- **LassoSequence**: The range of lasso tuning parameters. The default value is a sequence of 50 numbers from 0.00000001 to the smallest Lasso tuning parameter that can make the entire common component(s) to be zeros. Note that by default the 50 numbers are equally spaced on the log scale.
- **nfolds**: Number of folds. If missing, then 10 fold cross-validation will be performed.
Details

This function searches through a range of lasso tuning parameters for the common component, while keeping distinctive components fixed (i.e., the zeros in the distinctive components are fixed). This function may be of help if a user wants to obtain some sparseness in the common component.

Value

- **MSPE**: A vector of mean squared prediction error (MSPE) for the sequence of Lasso tuning parameter values.
- **MSPE1SE**: The lowest MSPE + 1SE.
- **Standard_Error**: Standard errors.
- **LassoSequence**: The sequence of Lasso tuning parameters used in cross-validation.
- **plot**: A plot of mean square errors +/- 1 standard error against Lasso tuning parameters. The plot is plotted against a log scale of lambda if `lassosequence` is not defined by users.
- **LassoRegion**: A region where the suitable lambda can be found, according to the "1 SE rule".
- **RecommendedLasso**: A Lasso tuning parameter that leads to a model with PRESS closest to the lowest PRESS + 1SE.
- **P_hat**: Estimated component loading matrix, given the recommended tuning parameter.
- **T_hat**: Estimated component score matrix, given the recommended tuning parameter.
- **plotlog**: An index number for function `plot()`, which is not useful for users.

References


Examples

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
JK <- c(10, 20) #DATA1 has 10 columns, DATA2 20.
R <- 4
Target <- matrix(c(1,1,1,0,1,0,0,1), 2, 4)
cv_structuredSCA(DATA, JK, R, Target, MaxIter = 100, NRSTARTS = 40,
    LassoSequence = seq(from= 0.002, to=0.1,
    length.out = 10))

## End(Not run)
```
Description

A DISCO-SCA procedure for identifying common and distinctive components.

Usage

DISCOSca(DATA, R, Jk)

Arguments

DATA   A matrix, which contains the concatenated data with the same subjects from multiple blocks. Note that each row represents a subject.
R      Number of components (R>=2).
Jk     A vector containing number of variables in the concatenated data matrix.

Value

Trot_best  Estimated component score matrix (i.e., T)
Prot_best  Estimated component loading matrix (i.e., P)
comdist    A matrix representing common distinctive components. (Rows are data blocks and columns are components.) 0 in the matrix indicating that the corresponding component of that block is estimated to be zeros, and 1 indicates that (at least one component loading in) the corresponding component of that block is not zero. Thus, if a column in the comdist matrix contains only 1’s, then this column is a common component, otherwise distinctive component.
propExp_component Proportion of variance per component.

References


Examples

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
R <- 5
Jk <- c(10, 20)
DISCOSca(DATA, R, Jk)

## End(Not run)
```
**Herring**

**Herring data**

**Description**

This dataset contains data from ripening experiments of herring regarding the physical/chemical changes observed in the herrings and quantitative descriptive sensory evaluation on the same herrings.

**Usage**

Herring

**Format**

The dataset contains the following list:

- **Herring_ChemPhy**: A 7x10 matrix of observation x physical/chemical changes of herrings.
- **Herring_Sensory**: A 7x10 matrix of observation x sensory data of herrings

**Note**

This dataset is a small part of a large, publicly available dataset stored at http://www.models.life.ku.dk.

**Source**


**maxLGlasso**

An algorithm for determining the smallest values for Lasso and Group Lasso tuning parameters that yield all zeros.

**Description**

maxLGlasso identify the minimum value for Lasso and Group Lasso tuning parameters that lead to an estimated P matrix with all of its elements equal 0. This minimum value is thus the maximum value (the boundary) that users should consider for Lasso and Group Lasso. Note that the algorithm is based on the "component" method; see sparseSCA.R
Usage

maxLGlasso(DATA, Jk, R)

Arguments

DATA The concatenated data block, with rows representing subjects.
Jk A vector. Each element of this vector is the number of columns of a data block.
R The number of components.

Value

Glasso The maximum value for Group Lasso tuning parameter.
Lasso The maximum value for Lasso tuning parameter.

Note

The description of how to obtain the maximum value for Lasso tuning parameter can be found in page 17 of Hastie, Tibshirani, and Wainwright (2015). We are not aware of any literature that mentions how to obtain the maximum value for Group Lasso, but this value can easily be derived from the algorithm.

References


Examples

## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
Jk <- c(10, 20)
results <- maxLGlasso(DATA, Jk, R=5)
maxGLasso <- results$Glasso
maxLasso <- results$Lasso

## End(Not run)

pca_gca

PCA-GCA method for selecting the number of common and distinctive components.

Description

Use PCA-GCA method to identify the number of common and distinctive components.
Usage

pca_gca(DATA, Jk, cor_min, return_scores)

Arguments

DATA A concatenated data matrix with the same number of rows.
Jk A vector containing number of variables in the concatenated data matrix. Please see the example below.
cor_min The minimum correlation between two components. The default value is .7; thus, it means that if the correlation between the two component is at least .7, then these two components are regarded as forming a single common component.
return_scores If TRUE, then the function will return the component scores for each block for further analysis.

Value

It prints out the number of components of each block and the number of common components. It also returns the component scores for each block for further analysis, if return_scores = TRUE.

Note

Please be ware of the interactive input: The function first performs PCA on each data block and then displays the eigenvalues (and a scree plot). Afterwards the function awaits the input from the user - it needs to know how many components need to be retained for that block.

References


Examples

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
R <- 5
Jk <- c(10, 20)
pca_gca(DATA, Jk, cor_min = .8)

## End(Not run)
```
plot.CVstructuredSCA  

### Description

A plot of mean square errors + 1 standard error against Lasso tuning parameters. The plot is plotted against a log scale of lambda if LassoSequence is not defined by users.

### Usage

```r
## S3 method for class 'CVstructuredSCA'
plot(x, ...)
```

### Arguments

- `x` A object for plot.
- `...` Argument to be passed to or from other methods.

### Examples

```r
## Not run:
## S3 method for class 'CVstructuredSCA'
plot(x)
## End(Not run)
```
Argument

- **x**: A object for plot.
- **...**: Argument to be passed to or from other methods.

Examples

```r
## Not run:
## S3 method for class 'CVstructuredSCA'
plot(x)

## End(Not run)
```

---

**pre_process** | Standardize the given data matrix per column, over the rows, with multiple imputation for missing data.

---

**Description**

Standardize the given data matrix per column, over the rows, with multiple imputation for missing data.

**Usage**

```r
pre_process(DATA, weight)
```

**Arguments**

- **DATA**: A data matrix
- **weight**: Whether the data matrix is weighted. `weight = TRUE` indicates that the data is weighted. Default is `weight = FALSE`.

**Value**

A standardized matrix

**Note**

Weighting a data matrix (i.e., `weight = TRUE`) is performed as follows. Each cell in the data is divided by the square root of the number of variables.

More details regarding data pre-processing, please see:


The missing values are handled by means of Multivariate Imputation by Chained Equations (MICE). The number of multiple imputation is 5. More details see:

Examples

```r
## Not run:
pre_process(matrix(1:12, nrow = 3, ncol = 4))

## End(Not run)
```

---

RSCA

RSCA: A package for regularized simultaneous component analysis (SCA) for data integration.

Description

The RSCA provides the following functions for performing regularized SCA.

DISCOSca

A DISCO-SCA procedure for identifying common and distinctive components.

TuckerCoef

Tucker’s coefficient of congruence between columns but after accounting for permutational freedom and reflections.

VAF

Proportion of variance accounted for (VAF) for each block and each principal component.

cv_sparseSCA

A K-fold cross-validation procedure when common/distinctive processes are unknown with Lasso and Group Lasso penalties.

cv_structuredSCA

A K-fold cross-validation procedure when common/distinctive processes are known, with a Lasso penalty.

maxLGlasso

An algorithm for determining the smallest values for Lasso and Group Lasso tuning parameters that yield all zeros.

mySTD

Standardize the given data matrix per column, over the rows.

pca_gca

PCA-GCA method for selecting the number of common and distinctive components.
sparseSCA

Variable selection with Lasso and Group Lasso with a multi-start procedure.

structuredSCA

Variable selection algorithm with a predefined component loading structure.

undoShrinkage

Undo shrinkage (on estimated component loading matrix).

**Description**

Variable selection with Lasso and Group Lasso penalties to identify component and distinctive components. This algorithm incorporates a multi-start procedure to deal with the possible existence of local minima.

**Usage**

sparseSCA(DATA, Jk, R, LASSO, GROUPLASSO, MaxIter, NRSTARTS, method)

**Arguments**

- **DATA**
  A matrix, which contains the concatenated data with the same subjects from multiple blocks.

- **Jk**
  A vector containing number of variables in the concatenated data matrix.

- **R**
  Number of components (R>=2).

- **LASSO**
  A Lasso tuning parameter.

- **GROUPLASSO**
  A group Lasso tuning parameter.

- **MaxIter**
  The maximum rounds of iterations. It should be a positive integer. The default value is 400.

- **NRSTARTS**
  Multi-start procedure: The number of multi-starts. The default value is 20.

- **method**
  "datablock" or "component". If method="component", the algorithm treats each component across all blocks independently, and thus sparse Group Lasso is applied per component. If method="datablock", the algorithm applies sparse Group Lasso on the entire concatenated data block altogether. If method is missing, then the "component" method is used.
structuredSCA

**Value**

- **Pmatrix**: The best estimated component loading matrix (i.e., P), if multi-starts >= 2.
- **Tmatrix**: The best estimated component score matrix (i.e., T), if multi-starts >= 2.
- **Lossvec**: A list of vectors containing the loss in each iteration for each multi-start.

**References**


**Examples**

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
Jk <- c(10, 20)
R <- 5
LASSO <- 0.2
GROUPLASSO <- 0.4
MaxIter <- 400
results <- sparseSCA(DATA, Jk, R, LASSO, GROUPLASSO,
                      MaxIter, NRSTARTS = 10, method = "datablock")

results$Pmatrix
## End(Not run)
```

---

**structuredSCA**

Variable selection algorithm with a predefined component loading structure.

**Description**

Variable selection algorithm when the common/distinctive structure is known a priori. The common component can also be sparse, which is to be estimated by Lasso. The distinctive components are not sparse in the sense that the entire variables in a component (belonging to a certain block) are either all zeros or non-zeros.

**Usage**

```r
structuredSCA(DATA, Jk, R, Target, Position, LASSO, MaxIter, NRSTARTS)
```
**Arguments**

- DATA: A matrix, which contains the concatenated data with the same subjects from multiple blocks.
- Jk: A vector containing number of variables in the concatenated data matrix.
- R: Number of components (R>=2).
- Target: A matrix containing 0’s and 1’s. Its number of columns equals to R, and its number of rows equals to the number of blocks to be integrated. Thus, if the element in
- Position: Indicate on which component(s) the Lasso Penalty is imposed. If unspecified, the algorithm assume that the Lasso penalty is imposed on the common component(s) only. If there is no common component, then Lasso penalty is applied to all components.
- LASSO: A Lasso tuning parameter.
- MaxIter: The maximum rounds of iterations. It should be a positive integer. The default value is 400.
- NRSTARTS: Multi-start procedure: The number of multi-starts. The default value is 20.

**Value**

- Pmatrix: The best estimated component loading matrix (i.e., P), if multi-starts >= 2.
- Tmatrix: The best estimated component score matrix (i.e., T), if multi-starts >= 2.
- Lossvec: A list of vectors containing the loss in each iteration for each multi-start.

**References**


**Examples**

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
Jk <- c(10, 20)
R <- 5
Target <- matrix(c(1,1,1,0,1,0,0,1,0,1), 2, 5)
LASSO <- 0.2
MaxIter <- 400
NRSTARTS <- 5
structuredSCA(data, Jk, R, Target, LASSO = LASSO)

## End(Not run)
```
Display a summary of the results of `cv_sparseSCA()`.

### Description
Display a summary of the results of `cv_sparseSCA()`.

### Usage
```r
## S3 method for class 'CVsparseSCA'
summary(object, disp, ...)```

### Arguments
- **object**: Object of class inheriting from `CVsparseSCA`.
- **disp**: The default is "tuning"; in this case, the recommended tuning parameter values are presented. If "estimatedPT", then the estimated component loading and estimated component score matrices (based on the recommended tuning parameter values) are presented. If "full", then information is displayed regarding 1) the recommended tuning parameter values, 2) the estimated component loading and estimated component score matrices (based on the recommended tuning parameter values), 3) # of variable selected, 4) Mean squared prediction error (MSPE), 5) standard errors for MSPE, 6) Lasso and Group Lasso tuning parameter values that have been evaluated.
- **...**: Argument to be passed to or from other methods.

### Examples
```r
## Not run:
## S3 method for class 'CVsparseSCA'
summary(object, disp="full")
## End(Not run)
```

Display a summary of the results of `cv_structuredSCA()`.

### Description
Display a summary of the results of `cv_structuredSCA()`.


**Usage**

```r
## S3 method for class 'CVstructuredSCA'
summary(object, disp, ...)
```

**Arguments**

- `object` Object of class inheriting from 'CVstructuredSCA'.
- `disp` The default is "tuning"; in this case, the recommended tuning parameter values for Lasso is displayed. If "estimatedPT", then the estimated component loading and component score matrices (given the recommended tuning parameter) is displayed. If "full", then information is displayed regarding 1) the recommended tuning parameter values for Lasso, 2) the estimated component loading and component score matrices, 3) the proper region for Lasso tuning parameter values, based on the 1SE rule, 4) mean squared prediction error (MSPE), 5) Lasso tuning parameter values that have been evaluated.

... Argument to be passed to or from other methods.

**Examples**

```r
## Not run:
## S3 method for class 'CVstructuredSCA'
summary(object, disp="full")

## End(Not run)
```

---

**summary.DISCOsca**

*Display a summary of the results of DISCOsca().*

**Description**

Display a summary of the results of DISCOsca().

**Usage**

```r
## S3 method for class 'DISCOsca'
summary(object, disp, ...)
```

**Arguments**

- `object` Object of class inheriting from 'DISCOsca'.
- `disp` The default is "simple"; in this case, the best-fitted common/distinctive structure is displayed. If "full", then information is displayed regarding 1) the best-fitted common/distinctive structure, 2) Estimated component score matrix (i.e., T), 3) Estimated component loading matrix (i.e., P), and 4) Proportion of variance per component.

... Argument to be passed to or from other methods.
Examples

```r
## Not run:
## S3 method for class 'DISCOsca'
summary(object, disp="full")

## End(Not run)
```

---

**summary.sparseSCA**  
*Display a summary of the results of sparseSCA().*

---

**Description**

Display a summary of the results of sparseSCA().

**Usage**

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

**Arguments**

- `object`  
  Object of class inheriting from `sparseSCA`.

- `...`  
  Argument to be passed to or from other methods.

**Examples**

```r
## Not run:
## S3 method for class 'sparseSCA'
summary(object)

## End(Not run)
```

---

**summary.structuredSCA**  
*Display a summary of the results of structuredSCA().*

---

**Description**

Display a summary of the results of structuredSCA().

**Usage**

```r
## S3 method for class 'structuredSCA'
summary(object, ...)
```
summary.undoS

Arguments

object Object of class inheriting from 'structuredSCA'.

... Argument to be passed to or from other methods.

Examples

## Not run:
## S3 method for class 'structuredSCA'
summary(object)

## End(Not run)

summary.undoS

Display a summary of the results of undoShrinkage().

Description

Display a summary of the results of undoShrinkage().

Usage

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

Arguments

object Object of class inheriting from 'undoS'.

... Argument to be passed to or from other methods.

Examples

## Not run:
## S3 method for class 'undoS'
summary(object)

## End(Not run)
### TuckerCoef

*Tucker coefficient of congruence.*

#### Description

TuckerCoef calculate Tucker’s coefficient of congruence between columns but after accounting for permutational freedom and reflections.

#### Usage

```r
TuckerCoef(MatrixA, MatrixB)
```

#### Arguments

- **MatrixA** A matrix
- **MatrixB** A matrix, which is to be compared to MatrixA

---

### summary.VAF

*Display a summary of the results of VAF().*

#### Description

Display a summary of the results of VAF().

#### Usage

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

#### Arguments

- **object** Object of class inheriting from 'VAF'.
- **...** Argument to be passed to or from other methods.

#### Examples

```r
## Not run:
## S3 method for class 'VAF'
summary(object)

## End(Not run)
```
undoShrinkage

Value

perm the permutation order.
tucker_value the Tucker coefficient.
tucker_vector the Tucker vector.

References


Examples

## Not run:
maxtrix1 <- matrix(rnorm(50), nrow=5)
maxtrix2 <- matrix(rnorm(50), nrow=5)
TuckerCoef(maxtrix1, maxtrix2)

## End(Not run)

undoShrinkage Undo shrinkage.

Description

undoShrinkage re-estimates the component loading matrix (P) while keeping the 0 loadings fixed so as to remove the shrinkage due to Lasso and Group Lasso.

Usage

undoShrinkage(DATA, R, Phat, MAXITER)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA</td>
<td>The concatenated data block, with rows representing subjects</td>
</tr>
<tr>
<td>R</td>
<td>The number of components.</td>
</tr>
<tr>
<td>Phat</td>
<td>The estimated component loading matrix by means of, for example, sparseSCA().</td>
</tr>
<tr>
<td>MAXITER</td>
<td>The maximum rounds of iterations. It should be a positive integer. The default value is 400.</td>
</tr>
</tbody>
</table>

Value

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pmatrix</td>
<td>The re-estimated component loading matrix after the shrinkage has been removed.</td>
</tr>
<tr>
<td>Tmaxix</td>
<td>The corresponding estimated component score matrix.</td>
</tr>
<tr>
<td>Lossvec</td>
<td>A vector of loss.</td>
</tr>
</tbody>
</table>
References


---

Proportion of variance accounted for (VAF) for each block and each principal component.

Description

Proportion of variance accounted for (VAF) is calculated for each block and each column.

Usage

```r
VAF(data, jk, R)
```

Arguments

- `data`: A matrix, which contains the concatenated data with the same subjects from multiple blocks. Note that each row represents a subject.
- `jk`: A vector containing number of variables in the concatenated data matrix.
- `R`: Number of components (R>=2).

Value

- `block`: Proportion of VAF for each block.
- `component`: Proportion of VAF for each component of each block.

References


Examples

```r
## Not run:
DATA1 <- matrix(rnorm(50), nrow=5)
DATA2 <- matrix(rnorm(100), nrow=5)
DATA <- cbind(DATA1, DATA2)
jk <- c(10, 20)
R <- 5
VAF(DATA, jk, R)

## End(Not run)
```
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