Package: SpecDetec (via r-universe)

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Title Change Points Detection with Spectral Clustering

Version 1.0.0

Description Calculate change point based on spectral clustering with
the option to automatically calculate the number of clusters if
this information is not available.

Depends R (>= 3.4.0)

License GPL-3

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Contents

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calculateAffinityMatrix

Calculate the affinity matrix based on the similarity matrix

Description

Calculate the affinity matrix based on the similarity matrix

Usage

```
calculateAffinityMatrix(similarityMatrix, neighboorsNumber = 2)
```

Arguments

similarityMatrix

Matrix of similarity between all points in the time series

neighboorsNumber

Number of neighbors to consider affinity between nodes

Details

Calculate the affinity matrix based on the similarity matrix If the number of neighbors is equal to or greater than the similarity matrix then the similarity and affinity matrix are equal

Value

Affinity matrix based on the similarity matrix

Author(s)

Luis Gustavo Uzai

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clusterEstimatetNumber

Estimate the number of possible clusters

Description

Adaptation of the bartlett method of the speccalt package to estimate the number of clusters in the context of spectral clustering to detect change points

Usage

```
clusterEstimatetNumber(eigenvectorValues, tolerance, maxClusterNumber)
```

Arguments

eigenvectorValues

Eigenvector matrix based on the affinity matrix

tolerance   approximation to consider valid clusters

maxClusterNumber

maximum number of calculable clusters

Details

Adaptation of the bartlett method of the speccalt package to estimate the number of clusters in the context of spectral clustering to detect change points

Value

An estimated number of clusters

Author(s)

Luis Gustavo Uzai

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convertToMatrixTimeSeries

Converts the time series to position and value matrix

Description

Converts the time series to position and value matrix

Usage

```
convertToMatrixTimeSeries(data)
```

Arguments

data   List of values corresponding to the time series

Details

Gets a list of values of any size and creates a key and value array of all positions

Value

The key matrix and value of the time series.

Author(s)

Luis Gustavo Uzai

DEVICE1   *DEVICE1*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

DEVICE1

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

DEVICE2   *DEVICE2*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

DEVICE2

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

DEVICE3	*DEVICE3*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

DEVICE3

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

DEVICE4	*DEVICE4*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

DEVICE4

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

DEVICE5	*DEVICE5*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

```
DEVICE5
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

DEVICE6	*DEVICE6*

Description

Derivation of RefrigerationDevices of the UCR Time Series Classification Repository These problems were taken from data recorded as part of government sponsored study called Powering the Nation. The intention was to collect behavioural data about how consumers use electricity within the home to help reduce the UK's carbon footprint.

Usage

```
DEVICE6
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR1 *FTIR1*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

FTIR1

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR2 *FTIR2*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

FTIR2

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR3	*FTIR3*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

```
FTIR3
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR4	*FTIR4*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

```
FTIR4
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR5 *FTIR5*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

```
FTIR5
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

FTIR6 *FTIR6*

Description

Derivation of Meat of the UCR Time Series Classification Repository Food spectrographs are used in chemometrics to classify food types, a task that has obvious applications in food safety and quality assurance. The classes are chicken, pork and turkey.

Usage

```
FTIR6
```

Format

The format is: Value Class 1.063400 1 -0.953410 1 ... -0.596090 2 ...

| gaussianKernel | *Calculate Gaussian Kernel* |

Description

Measure of similarity between two points represented by x1 and x2

Usage

```
gaussianKernel(x1, x2, alpha = 1)
```

Arguments

x1	first valor to computate
x2	second valor to computate
alpha	Alpha Measure

Details

Measure of similarity between two points represented by x1 and x2

Value

Measure of similarity between two points.

Author(s)

Luis Gustavo Uzai

| generateEigenvectorMatrix | |
| | *Calculate the eigenvector of the affinity matrix* |

Description

Calculate the eigenvector of the affinity matrix

Usage

```
generateEigenvectorMatrix(affinityMatrix)
```

Arguments

affinityMatrix	Affinity matrix based on the similarity matrix based on key and value matrix of the time series

Details

Calculates the laplacian matrix based on the affinity matrix and calculates the auto values of the graph with the eigen function

Value

Eigenvector matrix based on the affinity matrix

Author(s)

Luis Gustavo Uzai

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generateSimilarityMatrix

Calculate Similarity Matrix

Description

Use some similarity measure to calculate the similarity matrix

Usage

```
generateSimilarityMatrix(data, similarityMeasure)
```

Arguments

data   Key and value matrix of a time series

similarityMeasure

Measure of similarity between two points represented by x1 and x2

Details

Use some similarity measure to calculate the similarity matrix

Value

Matrix of similarity calculated from the key and value matrix.

Author(s)

Luis Gustavo Uzai

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getClusterFact	*Get the Factor of the cluster position in relation to the matrix of eigen-vectors*

Description

Get the Factor of the cluster position in relation to the matrix of eigenvectors

Usage

```
getClusterFact(eigenvectorValues, eigenvectorLengthLessOne, clusterNumber,
  reverseClusterNumber)
```

Arguments

eigenvectorValues
                  Eigenvector matrix based on the affinity matrix

eigenvectorLengthLessOne
                  the eigenvector matrix size minus 1

clusterNumber   the cluster position number being tested

reverseClusterNumber
                  the number of the inverse position of the cluster being tested

Details

Gets the factor of the value and its opposite in relation to the matrix of the eigenvectors

Value

Factor of the cluster position in relation to the matrix of eigenvectors

Author(s)

Luis Gustavo Uzai

---

getClusterProd	*Get the Product of the cluster position in relation to the matrix of eigenvectors*

Description

Get the Product of the cluster position in relation to the matrix of eigenvectors

Usage

```
getClusterProd(eigenvectorValues, eigenvectorLengthLessOne, clusterNumber,
  reverseClusterNumber)
```

Arguments

eigenvectorValues

                Eigenvector matrix based on the affinity matrix

eigenvectorLengthLessOne

                the eigenvector matrix size minus 1

clusterNumber   the cluster position number being tested

reverseClusterNumber

                the number of the inverse position of the cluster being tested

Details

Gets the product of the value and its opposite in relation to the matrix of the eigenvectors

Value

Product of the cluster position in relation to the matrix of eigenvectors

Author(s)

Luis Gustavo Uzai

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getSpectralClusters   *Clustering with the smallest eigenvectors from eigenvector Matrix*

Description

Clustering with the smallest eigenvectors from eigenvector Matrix

Usage

```
getSpectralClusters(eigenvectorMatrix, numberOfClusters = 2)
```

Arguments

eigenvectorMatrix

                Eigenvector matrix based on the affinity matrix

numberOfClusters

                maximum number of clusters for prediction

Details

Modified standard function present in kernlab to perform clustering with graph spectrum using standard version of K-Means

Value

K-Means Cluster Object

Author(s)

Luis Gustavo Uzai

Spec   *Calculate change points with spectral cluster*

Description

Calculate change point based on spectral clustering you have the option to automatically calculate the number of clusters if this information is not available

Usage

```
Spec(data, neighboorsNumber = 5, tolerance = 0.01,
  maxNumberOfChangePoints = 19, estimationChangePointsNumber = NULL)
```

Arguments

data	List of values corresponding to the time series
neighboorsNumber	
	Number of neighbors to consider affinity between nodes
tolerance	approximation to consider valid clusters, used only for calculation of forecast of change points, default 0.01
maxNumberOfChangePoints	
	maximum number of clusters for prediction : default 19
estimationChangePointsNumber	
	predicted number of change points in the series, if null, is automatically calculated: default null

Details

Calculate change point based on spectral clustering you have the option to automatically calculate the number of clusters if this information is not available. It uses the Gaussian Kernel for the calculation of affinity matrix and Kmeans for the spectral cluster, however, several other options can be used and the package must be customized to better suit the use.

Value

Numerical array with the position of the change points in the time series

Author(s)

Luis Gustavo Uzai

Examples

```
data <- DEVICE1[, 1]
realChangePoints <- c(which(diff(DEVICE1$Class) != 0))
calculateChangePoints <- Spec(data, neighboorsNumber = 6,
          tolerance = 0.005, estimationChangePointsNumber = 2)
minValue <- -99999
maxValue <- 99999
plot(data, type = "l", xlab = "x", ylab = "y")
for (r in 1:length(realChangePoints)) {
    lines(x = c(realChangePoints[r], realChangePoints[r]),
          y = c(minValue, maxValue), lwd = 2, col = "red")
}
for (n in 1:length(calculateChangePoints)) {
 lines(x = c(calculateChangePoints[n], calculateChangePoints[n]),
       y = c(minValue, maxValue), lwd = 2, col = "blue")
}
```

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