Package 'HDcpDetect'

October 12, 2022

Type Package

Title Detect Change Points in Means of High Dimensional Data

Version 0.1.0

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Description Objective: Implement new methods for detecting change points in high-dimensional time series data. These new methods can be applied to non-Gaussian data, account for spatial and temporal dependence, and detect a wide variety of change-point configurations, including changes near the boundary and changes in close proximity. Additionally, this package helps address the "small n, large p" problem, which occurs in many research contexts. This problem arises when a dataset contains changes that are visually evident but do not rise to the level of statistical significance due to the small number of observations and large number of parameters. The problem is overcome by treating the dimensions as a whole and scaling the test statistics only by its standard deviation, rather than scaling each dimension individually. Due to the computational complexity of the functions, the package runs best on datasets with a relatively large number of attributes but no more than a few hundred observations.

License GPL-3

Depends R (>= 2.10)

Encoding UTF-8

LazyData true

RoxygenNote 6.1.0

NeedsCompilation yes

Repository CRAN

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R topics documented:

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binary.segmentation   *binary.segmentation*

Description

Detects change points in time series data using a binary segmentation algorithm.

Usage

```
binary.segmentation(data_M,alpha=.05,power_enhancement=TRUE,M_threshold=0.05)
```

Arguments

data_M	An nxp matrix representing a times series of length n with p dimensions.
alpha	The critical value for the hypothesis testing procedure.
power_enhancement	
	Indicates whether to add a power enhancement term to the test statistic.
M_threshold	Value used as a threshold to estimate temporal dependence by determining how small of a standardized difference is indistinguishable from zero.

Details

The power enhancement term reduces type II error but slows the algorithm.

Value

The returned value is a list with the following components

Foundlist	The estimated locations of the change points
pvalues	The p values corresponding to each change point estimate

Author(s)

Jun Li, Jeffrey Okamoto, and Natasha Stewart

References

Li, J., Li, L., Xu, M., Zhong, P (2018). Change Point Detection in the Mean of High-Dimensional Time Series Data under Dependence. Manuscript.

Examples

```
library(HDcpDetect)
HAPT2 <- as.matrix(HAPT[1:35,])
binary.segmentation(data_M=HAPT2,power_enhancement=FALSE)
```

---

gestureVelocity   *Gesture Phase Segmentation*

Description

The dataset is composed of features extracted from 7 videos with people gesticulating, aiming at studying gesture phase segmentation. It contains velocity and acceleration recording of the experimental subjects' hands and wrists.

Usage

```
gestureVelocity
```

Format

A data frame with 1743 observations on the following 33 variables.

'1' Vectorial velocity of left hand (x coordinate)

'2' Vectorial velocity of left hand (y coordinate)

'3' Vectorial velocity of left hand (z coordinate)

'4' Vectorial velocity of right hand (x coordinate)

'5' Vectorial velocity of right hand (y coordinate)

'6' Vectorial velocity of right hand (z coordinate)

'7' Vectorial velocity of left wrist (x coordinate)

'8' Vectorial velocity of left wrist (y coordinate)

'9' Vectorial velocity of left wrist (z coordinate)

'10' Vectorial velocity of right wrist (x coordinate)

'11' Vectorial velocity of right wrist (y coordinate)

'12' Vectorial velocity of right wrist (z coordinate)

'13' Vectorial acceleration of left hand (x coordinate)

'14' Vectorial acceleration of left hand (y coordinate)

'15' Vectorial acceleration of left hand (z coordinate)

'16' Vectorial acceleration of right hand (x coordinate)

'17' Vectorial acceleration of right hand (y coordinate)

'18' Vectorial acceleration of right hand (z coordinate)

'19' Vectorial acceleration of left wrist (x coordinate)

'20' Vectorial acceleration of left wrist (y coordinate)

'21' Vectorial acceleration of left wrist (z coordinate)

'22' Vectorial acceleration of right wrist (x coordinate)

'23' Vectorial acceleration of right wrist (y coordinate)

'24' Vectorial acceleration of z coordinate (z coordinate)

'25' Scalar velocity of left hand

'26' Scalar velocity of right hand

'27' Scalar velocity of left hand

'28' Scalar velocity of right wrist

'29' Scalar velocity of left hand

'30' Scalar velocity of right hand

'31' Scalar velocity of left wrist

'32' Scalar velocity of right wrist

Phase Phase of gesture: D(rest position),P(preparation),S(stroke),H(hold),R(retraction)

Source

https://archive.ics.uci.edu/ml/datasets/gesture+phase+segmentation#

1. Madeo, R. C. B. ; Lima, C. A. M. ; PERES, S. M. . Gesture Unit Segmentation using Support Vector Machines: Segmenting Gestures from Rest Positions. In: Symposium on Applied Computing (SAC), 2013, Coimbra. Proceedings of the 28th Annual ACM Symposium on Applied Computing (SAC), 2013. p. 46-52.

2. Wagner, P. K. ; PERES, S. M. ; Madeo, R. C. B. ; Lima, C. A. M. ; Freitas, F. A. . Gesture Unit Segmentation Using Spatial-Temporal Information and Machine Learning. In: 27th Florida Artificial Intelligence Research Society Conference (FLAIRS), 2014, Pensacola Beach. Proceedings of the 27th Florida Artificial Intelligence Research Society Conference (FLAIRS). Palo Alto : The AAAI Press, 2014. p. 101-106.

HAPT   *Human Activity Recognition Dataset*

Description

This sample data is drawn from the Human Activity Recognition (HAPT) Dataset on the UCI Machine Learning Repository. The original dataset includes sensor recordings from 30 subjects performing a range of daily activities. The data has 561 attributes, consisting of different accelerometer and gyroscope measurements. A small portion of the overall dataset (10 seconds of recordings for subject A) is included in this package.

Usage

HAPT

Format

    '1'**X0.043579674** a numeric vector

    '2'**X.0.005970221** a numeric vector

    '3'**X.0.035054344** a numeric vector

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Source

<https://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones>

1. Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz. A Public Domain Dataset for Human Activity Recognition Using Smartphones. 21th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning, ESANN 2013. Bruges Belgium 24-26 April 2013.

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wild.binary.segmentation

wild.binary.segmentation

Description

Detects change points in time series data using the wild binary segmentation algorithm from Fryzlewicz (2014).

Usage

```
wild.binary.segmentation(data_M,minsize=15,num_intervals=1250,M_threshold=0.05)
```

Arguments

data_M	An nxp matrix representing a times series of length n with p dimensions.
minsize	The minimum interval length.
num_intervals	The number of random intervals to be generated and tested for change points.
M_threshold	Value used as a threshold to estimate temporal dependence by determining how small of a standardized difference is indistinguishable from zero.

Details

Increasing the minimum interval length will generally reduce type I error while increasing type II error.

Value

The returned value is a list of the estimated change point locations.

Author(s)

Jun Li, Jeffrey Okamoto, and Natasha Stewart

References

Li, J., Li, L., Xu, M., Zhong, P (2018). Change Point Detection in the Mean of High-Dimensional Time Series Data under Dependence. Manuscript. Fryzlewicz, P. (2014). Wild Binary Segmentation for Multiple Change-point Detection. The Annals of Statistics.

Examples

```
library(HDcpDetect)
HAPT2 <- as.matrix(HAPT[1:35,])
wild.binary.segmentation(HAPT2)
```

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