Package ‘NIRStat’

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Type   Package
Title  Novel Statistical Methods for Studying Near-Infrared Spectroscopy (NIRS) Time Series Data
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Depends R (>= 3.1.0), ggplot2, mgcv, gridExtra
Description Provides transfusion-related differential tests on Near-infrared spectroscopy (NIRS) time series with detection limit, which contains two testing statistics: Mean Area Under the Curve (MAUC) and slope statistic. This package applied a penalized spline method within imputation setting. Testing is conducted by a nested permutation approach within imputation. Refer to Guo et al (2018) <doi:10.1177/0962280218786302> for further details.
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Description

Estimate the Mean Area Under the Curve (MAUC) statistics and conduct a nonparametric test on the MAUC difference before transfusion and after transfusion. If detection limit occurs at 15

Usage

MAUCtest(Yvec,timevec,transfusionvec,fig = T,SD_est=F,num.permu=1000)

Arguments

Yvec
The outcome of NIRS time series $Y(t_i)$ of length N ranging from 15 to 100.

timevec
The time index of NIRS time series $t_i$ of length N.

transfusionvec
The 0/1 indicator of the transfusion status $X(t_i)$. $X(t_i) = 0$ means the current time point is before transfusion and $X(t_i) = 1$ means the current time point is after transfusion.

fig
Whether to plot the NIRS time series. Default value is TRUE.

SD_est
Whether to estimate the SD of the MAUC statistic for pre-transfusion and post-transfusion. Default value is FALSE.

num.permu
Number of permutation for permutation test. Default value is 1000.

Details

This function estimates the Mean Area Under the Curve (MAUC) statistics and conducts a permutation based test on the MAUC difference before transfusion and after transfusion. If detection limit (DL) occurs (15), it will impute the missed data based on a uniform distribution and estimate the MAUC statistics through a standard imputation approach. The statistical testing is conducted through a nested permutation approach across all imputed datasets.

Value

An R vector from MAUCtest containing MAUC statistics and Pvalue in the following order:

MAUC.before
The estimated MAUC statistic before transfusion.

MAUC.after
The estimated MAUC statistic after transfusion.

MAUC.diff
The estimated MAUC statistic difference between before transfusion and after transfusion.

Pvalue
The pvalue of testing the MAUC difference to be zero or not.

SD_pre
SD of the MAUC statistic for pre-transfusion. Optional, only when SD_est = TRUE.

SD_post
SD of the MAUC statistic for post-transfusion. Optional, only when SD_est = TRUE.
Author(s)

Yikai Wang [Emory], Xiao Wang [ICF]
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References


Examples

# Data Simulation
dat = data.frame(Y= rep(0,100),t=1:100,trans = c(rep(0,50),rep(1,50)))
dat$Y = apply(dat,1,function(x){rnorm(1,5*rnorm(1),6*exp(rnorm(1))))}
dat$Y = dat$Y + 15 - quantile(dat$Y,0.3)
dat$Y[dat$Y<=15] = 15

# Estimate the MAUC statistics of the NIRS data and test on the difference.
MAUCtest(dat$Y,dat$t,dat$trans,TRUE,FALSE,100)

plotNIRS NIRS Time Series Visualization

Description

This function visualizes the NIRS time series data and estimates the underlying smoothed trend of the NIRS based on a nonparametric regression approach.

Usage

plotNIRS(Yvec,timevec,transfusionvec)

Arguments

Yvec The outcome of NIRS time series $Y(t_i)$ of length N ranging from 15 to 100.
timevec The time index of NIRS time series $t_i$ of length N.
transfusionvec The 0/1 indicator of the transfusion status $X(t_i)$. $X(t_i) = 0$ means the current time point is before transfusion and $X(t_i) = 1$ means the current time point is after transfusion.

Details

This function visualizes the NIRS time series data before and after transfusion. In order to estimate the underlying smoothed curve, it first imputes the data with detection limit (DL) and utilizes a nonparametric regression approach for the imputed data. The time points with DL is in red and others are in black.
Author(s)

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Examples

# Data Simulation
```r
dat = data.frame(Y= rep(0,200),t=1:200,trans = c(rep(0,100),rep(1,100)))
dat$Y = apply(dat,1,function(x){rnorm(1,5*rnorm(1),6*exp(rnorm(1)))})
dat$Y = dat$Y + 15 - quantile(dat$Y,0.3)
dat$Y[dat$Y<=15] = 15
```

# Visualize the NIRS time series before and after transfusion.
```r
plotNIRS(dat$Y,dat$t,dat$trans)
```

Slopetest  

Slope statistics based Analysis for NIRS data.

Description

Estimate the slope statistics and conduct a nonparametric based test on the slope difference before transfusion and after transfusion. If detection limit occurs at 15

Usage

```r
Slopetest(Yvec,timevec,transfusionvec,SD_est=F,num.permu=1000)
```

Arguments

- **Yvec**: The outcome of NIRS time series \( Y(t_i) \) of length N ranging from 15 to 100.
- **timevec**: The time index of NIRS time series \( t_i \) of length N.
- **transfusionvec**: The 0/1 indicator of the transfusion status \( X(t_i) \). \( X(t_i) = 0 \) means the current time point is before transfusion and \( X(t_i) = 1 \) means the current time point is after transfusion.
- **SD_est**: Whether to estimate the SD of the SLOPE statistic for pre-transfusion and post-transfusion. Default value is FALSE.
- **num.permu**: Number of permutation for permutation test. Default value is 1000.

Details

This function estimates the slope statistics before transfusion and after transfusion based on penalized regression spline method and tests the difference based on a within-band permutation approach. If there is detection limit occurs (15), it will impute the missed data based on a uniform distribution and estimate the slope statistics through a standard imputation approach. The statistical testing is conducted through a nested within-band permutation approach across all imputed datasets.
Value

An R vector from Slopetest containing Slope statistics and Pvalue in the following order:

- **Slope.before**: The estimated Slope statistic before transfusion.
- **Slope.after**: The estimated Slope statistic after transfusion.
- **Slope.diff**: The estimated Slope statistic difference between before transfusion and after transfusion.
- **Pvalue**: The pvalue of testing the Slope difference to be zero or not.
- **SD_pre**: SD of the Slope statistic for pre-transfusion. Optional, only when SD_est = TRUE.
- **SD_post**: SD of the Slope statistic for post-transfusion. Optional, only when SD_est = TRUE.

Author(s)

Yikai Wang [Emory], Xiao Wang [ICF]
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References


Examples

```r
# Data Simulation
dat = data.frame(Y = rep(0,100),t=1:100,trans = c(rep(0,50),rep(1,50)))
dat$Y = apply(dat,1,function(x){rnorm(1,5*rnorm(1),6*exp(rnorm(1)))})
dat$Y = dat$Y + 15 - quantile(dat$Y,0.3)
dat$Y[dat$Y<=15] = 15

# Estimate the Slope statistics of the NIRS data and test on the difference.
Slopetest(dat$Y,dat$t,dat$trans,FALSE,100)
```
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