

Package ‘Actigraphy’

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Actigraphy-package *Functional Actigraphy Data Analysis*

Description

Implements functional linear modeling and analysis for actigraphy data

Details

Please refer to the directory "Actigraphy/doc" for an additional tutorials and a document containing the code for the figures in the referenced paper.

The paper can be downloaded from the Journal of Circadian Rhythms website.

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

References

1. "Measuring the Impact of AHI and Obesity on Circadian Activity Patterns Using Functional Linear Modeling of Actigraphy Data," Jia Wang, Amy Licis, Elena Deych, Jimin Ding, Jennifer McLeland, Cristina Toedebusch, Tao Li, Hong Xian, Stephen Duntley, and William Shannon.

act_29pt *Data Set Containing a One Day Average of Actigraph Data for 29 Subjects*

Description

A data set containing a one day(1440 minutes) of actigraph data for 29 subjects.

Usage

```
data(act_29pt)
```

Format

A data frame that consists of 30 columns; the first column refers to the time indices of one day by minute from midnight to midnight. The following 29 columns contain the actigraph data of 29 subjects with column names being the subject IDs.

act_8pt	<i>Data Set Containing a One Day Average of Actigraph Data for 8 Subjects</i>
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Description

A data set containing a one day(1440 minutes) of actigraph data for 8 subjects.

Usage

```
data(act_8pt)
```

Format

A data frame that consists of nine columns; the first column refers to the time indices of one day by minute from midnight to midnight. The following eight columns contain the actigraph data of eight subjects with column names being the subject IDs.

cat_flm_plot	<i>Plot Functional Linear Model Analysis Results of a Categorical Type</i>
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Description

This function produce either one or two plots: An effect of a categorical (factor) covariate on activity values by time and potentially the F-test for the effect of the categorical covariate.

Usage

```
cat_flm_plot(smoothdata, matchresults, flmresults, ftest,
nperm, lb, xat, varname, col, ylim, L, xlab="Time", ylab="Activity")
```

Arguments

smoothdata	List output from the fda.smoothdata function
matchresults	List output from the matchid function.
flmresults	List output from the flm_cate function.
ftest	A logic value indicating whether to implement F test or not. F test will be implement if ftest is TRUE.
nperm	The number of permutations for the F-test.
lb	X axis labels.
xat	X axis label positions.
varname	Name of categorical covariate.
col	Colors for levels of the predictor.

ylim	Y axis limits for activity plot.
L	The length of the time points.
xlab	The label for the x-axis.
ylab	The label for the y-axis.

Value

One plot of the estimated group means and a possible second plot of the F-test results.

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

Examples

```

data(act_29pt)
data(clinic_29pt_ahi)

colnames(act_29pt) <- sub("X", "", colnames(act_29pt))
data <- as.matrix(act_29pt[,-1])
ahi <- clinic_29pt_ahi

ahi$ahicat <- as.factor(ifelse(ahi$AHI >= 0 & ahi$AHI <= 5, 1,
ifelse(ahi$AHI > 5 & ahi$AHI <= 15, 2,
ifelse(ahi$AHI > 15 & ahi$AHI <= 30, 3,
ifelse(ahi$AHI > 30, 4, 0))))))

matchidb <- fda.matchid(data, ahi[,-2] , "factor",
c("normal", "mild", "moderate", "severe"))
FDcatahi <- fda.smoothdata(matchidb)

L <- nrow(data)
lb <- c("Midnight", "6AM", "Noon", "6PM", "Midnight")
xat <- c(0, L/4, L/2, 3*L/4, L)

geftFDcatahi <- flm_cate(FDcatahi)
predy <- as.vector(geftFDcatahi$freg$yhatfdoobj$y)

xlim <- c(0, L)
ylim <- c(min(predy), max(predy) + 100)

cat.flm.results <- cat_flm_plot(FDcatahi, matchidb, geftFDcatahi,
TRUE, 5, lb, xat, "AHI", 1:4, ylim, L)

```

clinic_29pt_ahi	<i>Data Set Containing AHI(Apnea Hypopnea Index) Information from 29 Subjects</i>
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Description

A data set containing the AHI(Apnea Hypopnea Index) values(continuous) for 29 subjects.

Usage

```
data(clinic_29pt_ahi)
```

Format

A data frame consisting of two columns. The first column contains the numeric IDs and the second column contains the AHI information of the 29 subjects.

clinic_29pt_bmi	<i>Data Set Containing BMI(Body Mass Index) Information from 29 Subjects</i>
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Description

A data set containing the BMI(Body Mass Index) values(continuous) for 29 subjects.

Usage

```
data(clinic_29pt_bmi)
```

Format

A data frame consisting of two columns. The first column contains the numeric IDs and the second column contains the BMI of the 29 subjects.

clinic_8pt	<i>Data Set Containing AHI(Apnea Hypopnea Index) Information from 8 Subjects</i>
------------	--

Description

A data set containing the AHI(Apnea Hypopnea Index) values(categorical) for 8 subjects.

Usage

```
data(clinic_8pt)
```

Format

A data frame that consists of two columns. The first contains the numeric IDs and the second column contains the AHI information for 8 subjects.

cont_flm_plot	<i>Plot Functional Linear Model Analysis Results of a Continuous Type</i>
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Description

This function produces two plots: An effect of a continuous covariate on activity values by time and the F-test for the effect of the continuous covariate.

Usage

```
cont_flm_plot(smoothdata, matchresults, flmresults, xlim, ylim,
fctest, nperm, lb, xat, legendx, legendy, L, xlab="Time", ylab="Activity")
```

Arguments

smoothdata	List output from the <code>fda.smoothdata</code> function.
matchresults	List output from the <code>matchid</code> function.
flmresults	List output from the <code>flm_cate</code> function.
xlim	X axis limits for activity plot.
ylim	Y axis limits for activity plot.
fctest	A logic value indicating whether to implement F test or not. F test will be implement if <code>fctest</code> is TRUE.
nperm	The number of permutations for the F-test.
lb	X-axis labels.
xat	X axis label positions.
legendx	X axis position of the left edge of the legend box.

legendy	Y axis position of the upper edge of the legend box.
L	The length of the time points.
xlab	The label for the x-axis.
ylab	The label for the y-axis.

Value

One plot of the estimated group means and a possible second plot of the F-test results.

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

Examples

```

data(act_29pt)
data(clinic_29pt_ahi)

colnames(act_29pt) <- sub("X", "", colnames(act_29pt))
data <- as.matrix(act_29pt[,-1])

matchid <- fda.matchid(data, clinic_29pt_ahi, "contin")
FDcont <- fda.smoothdata(matchid)

L <- nrow(data)
lb <- c("Midnight", "6AM", "Noon", "6PM", "Midnight")
xat <- c(0, L/4, L/2, 3*L/4, L)

geftFDcont <- flm_cate(FDcont)
predy <- as.vector(geftFDcont$freg$yhatfdbj$y)

xlim <- c(0, L)
ylim <- c(min(predy), max(predy) + 100)

legendx <- 0
legendy <- max(predy) - 100

cont.flm.results <- cont_flm_plot(FDcont, matchid, geftFDcont, xlim,
ylim, TRUE, 10, lb, xat, legendx, legendy, L)

```

fda.matchid

Match IDs from Clinical and Actigraph Data

Description

A function used to match actigraphy data and clinical covariates by subject IDs and return a list of the data combined by IDs. Only the subjects with both actigraphy and covariate data will be returned by this function.

Usage

```
fda.matchid(mat, acov, type, grouplab)
```

Arguments

mat	A data frame with the rows being the time and the columns being the activity, with the column names being the subjects.
acov	A two column data frame that contains only subject IDs and a covariate of interest, respectively.
type	A string specifying either "contin" for continuous and "factor" for categorical covariates.
grouplab	A vector of names of the categories if type is TRUE.

Details

Note: Only the subjects with both actigraphy and covariate data will be returned by this function.

Value

A list consisting of two components as follows:

mat	A matrix where rows represent the time, columns are the samples, and the column names are the subjects.
cov	A two column matrix that contains the actigraphy data and clinical covariates.

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

Examples

```
data(act_29pt)
data(clinic_29pt_ahi)

colnames(act_29pt) <- sub("X", "", colnames(act_29pt))
data <- as.matrix(act_29pt[,-1])

### Example 1: Continuous Covariate
matchida <- fda.matchid(data, clinic_29pt_ahi, "contin")

### Example 2: Categorical Covariate
ahi <- clinic_29pt_ahi

ahi$ahicat <- as.factor(ifelse(ahi$AHI >= 0 & ahi$AHI <= 5, 1,
  ifelse(ahi$AHI > 5 & ahi$AHI <= 15, 2,
    ifelse(ahi$AHI > 15 & ahi$AHI <= 30, 3,
      ifelse(ahi$AHI > 30, 4, 0))))))

matchidb <- fda.matchid(data, ahi[,-2], "factor",
  c("normal", "mild", "moderate", "severe"))
```

fda.smoothdata *Functional Actigraphy Data Smoothing*

Description

This function produces functional actigraphy data from matrix actigraphy data.

Usage

```
fda.smoothdata(data, basistype="fourier", nbasis=9, norder=4)
```

Arguments

data	A list consisting of the following two components: data\$mat A matrix where rows represent the time, columns are the samples, and the column names are the subjects. data\$cov A two column matrix that contains the actigraphy data and clinical covariate.
basistype	A string specifying either "Fourier" and "bspline".
nbasis	The number of basis functions to be used for functional data. Default value is 9.
norder	The order of the bspline basis functions. Default value is 4.

Details

Note: The output of function `fda.matchid` can be directly used as the input for this argument. If the data is a categorical covariate

Value

A list consisting of two components as follows:

fd	A <code>fdSmooth</code> data object containing the functional data (see function <code>smooth.basis</code> in the package <code>fda</code> for details).
cov	An object that is the same as the argument <code>data\$cov</code> .

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

Examples

```
data(act_29pt)
data(clinic_29pt_ahi)

colnames(act_29pt) <- sub("X", "", colnames(act_29pt))
data <- as.matrix(act_29pt[,-1])
```

```

matchid <- fda.matchid(data, clinic_29pt_ahi, "contin")
FDcont <- fda.smoothdata(matchid)

### Smooth the Results
ts.plot(predict(FDcont$fd$fd, c(1:1440)), main="Smoothed Activity Data")

```

flm_cate

Functional Linear Model Analysis

Description

A function that does functional linear model analysis.

Usage

```
flm_cate(FD, basistype="fourier", nbasis=9, norder=4)
```

Arguments

FD	The list from the function <code>fda.smoothdata</code> .
basistype	A string specifying either "fourier" and "bspline".
nbasis	The number of basis functions to be used for functional linear model analysis. Default value is 9.
norder	an integer specifying the order of b-splines, which is one higher than their degree. The default of 4 gives cubic splines.

Value

A list consisting of three components as follows:

freg	A <code>fRegress</code> fit object containing the intercept and coefficient functions (check function <code>fRegress</code> for details)
fregstd	A list containing the standard error functions of the intercept and coefficient functions.

Author(s)

William D. Shannon, Tao Li, Hong Xian, Jia Wang, Elena Deych, Carlos Gonzalez

Examples

```

data(act_29pt)
data(clinic_29pt_ahi)

colnames(act_29pt) <- sub("X", "", colnames(act_29pt))
data <- as.matrix(act_29pt[,-1])

matchid <- fda.matchid(data, clinic_29pt_ahi, "contin")

```

```
FDcont <- fda.smoothdata(matchid)
geftFDcont <- flm_cate(FDcont)
```

weekday

Data Set Containing Five Weekdays of Actigraph Data for One Subject

Description

A data set containing five weekdays of actigraph data for one subject.

Usage

```
data(weekday)
```

Format

A data frame that consists of three columns; the first column is the weekday indices, the second column contains the indices of time in minutes from midnight to midnight, and the third contains the actigraph data.

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