Package ‘acc’

October 12, 2022

Type Package
Title Exploring Accelerometer Data
Version 1.3.3
Date 2016-12-15
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Description Processes accelerometer data from uni-axial and tri-axial devices, and generates data summaries. Also includes functions to plot, analyze, and simulate accelerometer data.
Depends R (>= 2.10), mhsmm
Imports zoo, PhysicalActivity, nleqslv, plyr, methods, DBI, RSQLite, circlize, ggplot2, R.utils, iterators, Rcpp
License GPL (>= 2)
LinkingTo Rcpp, RcppArmadillo
RoxygenNote 5.0.1
NeedsCompilation yes
Repository CRAN
Date/Publication 2016-12-16 23:29:38

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acc

Summarizes accelerometer data for multiple types of physical activities

Description

Summarizes accelerometer for multiple types of physical activities

Usage

acc(data, tri, axis, spuriousDef, nonwearDef, minWear,
    patype, pacut, epoch, boutsize, tolerance)

Arguments

data Data which consists of two columns [TimeStamp,counts] (i.e. accelerometer counts file read in by function readCounts)
tri Whether the data is from a tri-axial accelerometer. Default is tri=’FALSE’. If tri=’TRUE’ then option ‘axis’ should be specified.
axis This option is only used for the tri-axial accelerometer. Options are ‘x’, ‘y’, ‘z’, ‘sum’, or ‘vm’. Options ‘x’, ‘y’, or ‘z’ can be specified to summarize data using only data from a single axis. If the option ‘vm’ is used, the square root of the squared sum of counts from three axes is used for the summary. If the option ‘sum’ is used, sum of the counts from three axes are used.
spuriousDef Definition of spurious observation. Defined as minutes of consecutive zeros. For example, if spuriousDef = 20, this means that an observation point will be determined as a spurious observation if there are consecutive counts of at least 20 zeros before and after the single non-zero observation. Default is spuriousDef = 20.
nonwearDef Definition of non-wear time. Defined as minutes of consecutive zeros. For example, if nonwearDef=60, this means that a period will be defined as non-wear time if there are at least 60 consecutive zeros. Default is nonwearDef=60. To consider all observations as wear time specify nonwearDef=’Inf’.
minWear Minimum wear time definition. Defined as minutes of wear time. For example, if minWear = 600, this means that a day will be considered valid only if the wear time is at least 600 minutes. Default is minWear = 600. To return summary for all dates in the data, set minWear = 0.
patype  Types of physical activity for summary. For example, to summarize sedentary
and moderate-vigorous physical activities, user specifies patype=c('Sedentary', 'MVPA').
This labels the summary accordingly.

pacut Cut points to be used for the physical activity type. For example, if the user spec-
ified patype=c('Sedentary', 'MVPA'), pacut can be specified as pacut=c(c(0,99),c(1952,Inf)).
The options requires to have a lower and a upper limit for each activity type (i.e.
c(0,99) for sedentary activity). The specified interval includes its lower and up-
per endpoints (it is a closed interval).

epoch Epoch size. Default is '1 min'. Other epoch size can be specified using this
option (e.g., '1 sec')

boutsize Boutsize to summarize a physical activity. If multiple patype is specified, bout-
size should be specified for each one (e.g., if patype=c('Sedentary', 'MVPA')
then one can use boutsize=c(10,10)).

tolerance Whether two observations outside the physical activity should be permitted in
summarizing a physical activity. If multiple patype is specified, tolerance should
be for each one (e.g. if patype=c('Sedentary', 'MVPA') then one can use toler-
ance=c('FALSE', 'TRUE')).

Value
summary Returns summary for each specified physical activity types (number of bouts
and minutes of the activity), for valid dates.

Author(s)
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References
Hall, K. S., Howe, C. A., Rana, S. R., Martin, C. L., and Morey, M. C. (2013). METs and Ac-
celerometry of Walking in Older Adults: Standard versus Measured Energy Cost. Medicine
and Science in Sports and Medicine, 45(3). 574-82.
(2000). Estimation of energy expenditure using CSA accelerometers at hip and wrist sites. Medicine
and Science in Sports and Exercise, 32: S450-456.

Examples
##
## Example: Loading accelerometer counts data using readCounts function
##
## Not run:
library(acc)
infile <- "CountsDataName.dat"
counts <- readCounts(infile)

## Example: Summarizing accelerometer data for a sedentary individual

# For this example, data is generated using a Hidden Markov model
# First, a sequence of time is generated
randomTime <- seq(ISOdate(2015,4,1),ISOdate(2015,4,3),"min")
# Load the mhsmm package to generate data using a Hidden Markov model
library(mhsmm)
# It is assumed that the counts are generated from a Hidden Markov model
# with three states being non-wear, sedentary, and moderate-vigorous activity
J <- 3; initial <- rep(1/J, J)
# Set up a transition matrix for the Hidden Markov model.
P <- matrix(c(0.95, 0.04, 0.01,
             0.09, 0.9, 0.01,
             0.1, 0.2, 0.7), byrow = TRUE, nrow = J)
# It is assumed that the counts are realized from a mixture of
# two normal distributions (for sedentary activity and mvpa)
# and a constant at zero (for non-wear time).
b <- list(mu = c(0, 30, 2500), sigma = c(0, 30, 1000))
model <- hmmspec(init = initial, trans = P, parms.emission = b,dens.emission = dnorm.hsmm)
# Generate data!
train <- simulate.hmmspec(model, nsim = (60*24*2), seed = 1234, rand.emis = rnorm.hsmm)
# Now set up a dataset that mimicks the accelerometry data
counts <- data.frame(TimeStamp = randomTime[1:length(train$x)], counts = train$x)
library(acc)
# summarize the data using the acc function.
# Sedentary and moderate-vigorous activity is summarized, using Freedson's cut points by default.
summary1 <- acc(data=counts, tri="FALSE", axis=NULL,
                 spuriousDef=20, nonwearDef=60, minWear=600,
                 patype=c("Sedentary","MVPA"),pacut=c(c(0,99),c(1952,Inf)),
                 boutsize=c(10,10), tolerance=c("FALSE","TRUE"))
summary1

## Example: Summarizing accelerometer data for an active individual.

randomTime <- seq(ISOdate(2015,4,1),ISOdate(2015,4,3),"min")
library(mhsmm)
J <- 3; initial <- rep(1/J, J)
P <- matrix(c(0.95, 0.04, 0.01,
             0.05, 0.8, 0.15,
             0.1, 0.1, 0.8), byrow = TRUE, nrow = J)
b <- list(mu = c(0, 30, 2500), sigma = c(0, 30, 1000))
model <- hmmspec(init = initial, trans = P, parms.emission = b,dens.emission = dnorm.hsmm)
train <- simulate.hmmspec(model, nsim = (60*24*2), seed = 1234, rand.emission = rnorm.hsmm)

counts <- data.frame(TimeStamp = randomTime[1:length(train$x)], counts = train$x)
library(acc)
summary2 <- acc(data=counts, tri='FALSE', axis=NULL,
    spuriousDef=20, nonwearDef=60, minWear=600,
    patype=c('Sedentary','MVPA'),pacut=c(c(0,99),c(1952,Inf)),
    boutsize=c(10,10), tolerance=c('FALSE','TRUE'))

summary2

## End(Not run)

\begin{description}
\item[accBatch] Summarizes multiple accelerometer datafiles
\end{description}

\textbf{Description}

Summarizes multiple accelerometer datafiles in a batch mode. Summary can be provided for multiple types of physical activities, by day.

\textbf{Usage}

accBatch(path, tri, axis, spuriousDef, nonwearDef, minWear,
    patype, pacut, epoch, boutsize, tolerance)

\textbf{Arguments}

\begin{itemize}
\item \textbf{path} Path to accelerometer data files read in by function readCounts or readCountsBath. Files in this path can have both uni-axial and tri-axial data. If at least one tri-axial data is present in the path, please specify tri='TRUE' and axis. This information will be used to summarize tri-axial data.
\item \textbf{tri} Is there at least one dataset from a tri-axial accelerometer in the folder? Default is tri='TRUE'. If tri='TRUE' then option 'axis' should be specified. Default axis is axis='vm'.
\item \textbf{axis} If the data is from a tri-axial device, this option is applied. Options are 'x', 'y', 'z', 'sum', or 'vm'. Options 'x', 'y', or 'z' can be specified to summarize data using only data from a single axis. If the option 'vm' is used, the square root of the squared sum of counts from three axes (i.e. $\sqrt{x^2 + y^2 + z^2}$) are used for the summary. If the option 'sum' is used, sum of the counts from three axes are used.
\item \textbf{spuriousDef} Definition of spurious observation. Defined as minutes of consecutive zeros. For example, if spuriousDef = 20, this means that an observation point will be determined as a spurious observation if there are consecutive counts of at least 20 zeros before and after the single non-zero observation. Default is spuriousDef = 20.
\end{itemize}
nonwearDef  Definition of non-wear time. Defined as minutes of consecutive zeros. For example, if nonwearDef=60, this means that a period will be defined as non-wear time if there are at least 60 consecutive zeros. Default is nonwearDef=60. To consider all observations as wear time specify nonwearDef='Inf'.

minWear  Minimum wear time definition. Defined as minutes of wear time. For example, if minWear = 600, this means that a day will be considered valid only if the wear time is at least 600 minutes. Default is minWear = 600. To return summary for all dates in the data, set minWear = 0.

patype  Types of physical activity for summary. For example, to summarize sedentary and moderate-vigorous physical activities, user specifies patype=c('Sedentary','MVPA'). This labels the summary accordingly.

pacut  Cut points to be used for the physical activity type. For example, if the user specified patype=c('Sedentary','MVPA'), pacut can be specified as pacut=c(c(0,99),c(1952,Inf)). The options requires to have a lower and an upper limit for each activity type (i.e. c(0,99) for sedentary activity). The specified interval includes its lower and upper endpoints (it is a closed interval).

boutsize  Boutsize to summarize a physical activity. If multiple patype is specified, boutsize should be for each one (e.g., if patype=c('Sedentary','MVPA') then one can use boutsize=c(10,10)).

epoch  Epoch size. Default is '1 min’. Other epoch size can be specified using this option (e.g., '1 sec’).

tolerance  Whether two observations outside the physical activity should be permitted in summarizing a physical activity. If multiple patype is specified, tolerance should be for each one (e.g., if patype=c('Sedentary','MVPA') then one can use tolerance=c('FALSE','TRUE')).

Value

A folder ‘summaryfiles’ is created within the specified path. In the folder, summary files are saved by the same filenames as in the accelerometer data for valid days which consists of columns [Date, SedentaryMinutes, wearTime, numberOfBoutsSed, mvpaMinutes, numberOfBoutsMVPA]

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

References


Examples

```r
## Example

# Not run:
mypath <- "C:/Accelerometry files/readfiles"
accBatch(path=mypath, tri='TRUE', axis='vm',
  spuriousDef=20, nonwearDef=60, minWear=600,
  patype=c('Sedentary','MVPA'),pacut=c(c(0,99),c(1952,Inf)),
  boutsize=c(10,10), tolerance=c('FALSE','TRUE'))

## End(Not run)
```

### accSummary

Summarizes accelerometer data for a single type of physical activity

**Description**

Summarizes accelerometer data for a single type of physical activity. Functionality is same as function acc, except that this function provides a summary for a single type of physical activity, with more detailed information.

**Usage**

```r
accSummary(data, tri, axis, spuriousDef, nonwearDef, minWear,
  patype, pacut, epoch, boutsize, tolerance, returnbout)
```

**Arguments**

- `data`: Data which consists of two columns [TimeStamp,counts] (i.e. raw accelerometer file read in by function readRaw)
- `tri`: Whether the data is from a tri-axial accelerometer. Default is tri='FALSE'. If tri='TRUE' then option 'axis' should be specified.
- `axis`: This option is only used for the tri-axial accelerometer. Options are ‘x’, ‘y’, ‘z’, ‘sum’, or ‘vm’. Options ‘x’, ‘y’, or ‘z’ can be specified to summarize data using only data from a single axis. If the option ‘vm’ is used, the square root of the squared sum of counts from three axes (i.e. \(\sqrt{x^2 + y^2 + z^2}\)) are used for the summary. If the option ‘sum’ is used, sum of the counts from three axes are used.
accSummary

spuriousDef  Definition of spurious observation. Defined as minutes of consecutive zeros. For example, if spuriousDef = 20, this means that an observation point will be determined as a spurious observation if there are consecutive counts of at least 20 zeros before and after the single non-zero observation. Default is spuriousDef = 20.

nonwearDef Definition of non-wear time. Defined as minutes of consecutive zeros. For example, if nonwearDef=60, this means that a period will be defined as non-wear time if there are at least 60 consecutive zeros. Default is nonwearDef=60. To consider all observations as wear time specify nonwearDef='Inf'.

minWear Minimum wear time definition. Defined as minutes of wear time. For example, if minWear = 600, this means that a day will be considered valid only if the wear time is at least 600 minutes. Default is minWear = 600. To return summary for all dates in the data, set minWear = 0.

patype Type of physical activity for summary. For example, to summarize sedentary activity, use option patype=c('Sedentary'). To summarize moderate-vigorous physical activities, user specifies patype=c('MVPA'). This labels the summary accordingly.

pacut Cut points to be used for the physical activity type. For example, if the user specified patype=c('Sedentary'), pacut can be specified as pacut=c(c(0,99)). The options requires to have a lower and a upper limit for each activity type (i.e. c(0,99) for sedentary activity). The specified interval includes its lower and upper endpoints (it is a closed interval).

boutsize Boutsize to summarize a physical activity. If multiple patype is specified, boutsize should be for each one (e.g., if patype=c('Sedentary') then one can use boutsize=c(10)).

epoch Epoch size. Default is '1 min'. Other epoch size can be specified using this option (e.g., '1 sec').

tolerance Whether two observations outside the physical activity cut point should be permitted in summarizing a physical activity (e.g. if patype=c('Sedentary') then one can use tolerance=c('FALSE')).

returnbout Whether to return data with bout indicators. If returnbout='FALSE' then only a summary of daily physical activity is returned.

Value

If returnbout='FALSE', then a summary for each specified physical activity types (number of bouts and minutes of the activity), for valid dates. Defaults to 'TRUE'.

If returnbout='TRUE', then a list of summary object is returned with:

totalDates Number of unique days available in data.

validDates A summary for each specified physical activity types (number of bouts and minutes of the activity), for valid dates (as defined by minWear).

PA Data supplied by the user is returned with three additional columns [inPA, nonwear, inboutPA], indicating whether the observation was considered to be in the defined cutpoint of the physical activity (inPA), in the defined cutpoint of nonwear time (nonwear), or in bout (inboutPA), respectively.
References


Examples

```r
## Example 1: Loading the activity counts data using readCounts function
## Not run:
library(acc)
infile <- "DataName.dat"
counts <- readCounts(infile)
```

```r
## Example 2: Summarizing accelerometer data for a sedentary individual"
##
# For this example, data is generated using a Hidden Markov model
# First, a sequence of time is generated
randomTime <- seq(ISOdate(2015,4,1),ISOdate(2015,4,3),"min")
# Load the mhsmm package to generate data using a Hidden Markov model
library(mhsmm)
# It is assumed that the counts are generated from a Hidden Markov model
# with three states, being non-wear, sedentary, and moderate-vigorous activity
J <- 3; initial <- rep(1/J, J)
# Set up a transition matrix for the Hidden Markov model.
P <- matrix(c(0.95, 0.04, 0.01,
0.09, 0.9, 0.01,
0.1, 0.2, 0.7), byrow=
"TRUE", nrow = J)
# It is assumed that the counts are realized from a mixture of
# two normal distributions (for sedentary activity and mvpa)
# and a constant at zero (for non-wear time).
b <- list(mu = c(0, 30, 2500), sigma = c(0, 30, 1000))
model <- hmmmspec(init = initial, trans = P, parms.emission = b,dens.emission = dnorm.hsmm)
```
# Generate data!
train <- simulate.hmmspec(model, nsim = (60*24*2), seed = 1234, rand.emis = rnorm.hsmm)
# Now set up a dataset that mimicks the accelerometry data
counts <- data.frame(TimeStamp = randomTime[1:length(train$x)], counts = train$x)
library(acc)
# summarize the data using the acc function.
# Sedentary and moderate-vigorous activity is summarized, using Freedson's cut points by default.
# Option returnbout='TRUE' returns a more detailed information on how the summary was calculated.
summary1 <- accSummary(data=counts, tri='FALSE', axis=NULL,
    spuriousDef=20, nonwearDef=60, minWear=600,
    patype='MVPA', pacut=c(1952, Inf),
    boutsize=10, tolerance='TRUE', returnbout='TRUE')
summary1$validDates # This returns the same summary as when returnbout='FALSE'
# summary1$PA # This returns the activity classification and bout information

## Example 3: Summarizing accelerometer data for an active individual.

###

randomTime <- seq(ISODate(2015,4,1), ISODate(2015,4,3), "min")
library(mhsmm)
J <- 3; initial <- rep(1/J, J)
P <- matrix(c(0.95, 0.04, 0.01,
    0.09, 0.7, 0.21,
    0.1, 0.1, 0.8), byrow='TRUE', nrow = J)
b <- list(mu = c(0, 30, 2500), sigma = c(0, 30, 1000))
model <- hmmspec(init = initial, trans = P, parms.emission = b, dens.emission = dnorm.hsmm)
train <- simulate.hmmspec(model, nsim = (60*24*2), seed = 1234, rand.emission = rnorm.hsmm)
counts <- data.frame(TimeStamp = randomTime[1:length(train$x)], counts = train$x)
library(acc)
# Option returnbout='TRUE' returns a more detailed information on how the summary was calculated.
summary2 <- accSummary(data=counts, tri='FALSE', axis=NULL,
    spuriousDef=20, nonwearDef=60, minWear=600,
    patype='MVPA', pacut=c(1952, Inf),
    boutsize=10, tolerance='TRUE', returnbout='TRUE')
summary2$validDates # This returns the same summary as when returnbout='FALSE'
# summary2$PA # This returns the activity classification and bout information

### End(Not run)

---

**Description**

Creates an aee object for semiparametric regression with augmented estimating equation.
Usage

`aee(ID, time, minutes)`

Arguments

- **ID**: Individual identifier
- **time**: Observation time
- **minutes**: Minutes of physical activity

Value

- **psDF**: A data frame, part of original input data frame with variable "ID", "time" and "count"
- **timeGrid**: Ordered distinct observation times in the set of all observation times
- **panelMatrix**: a matrix representation of panel count data, one row per subject, one column per time point in "timeGrid"

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

References


Examples

```r
## Not run:
# We illustrate the use of function aeexfit
# with the sample data from the National Health and Nutrition Examination Survey (NHANES)
# to examine the association between the cardiorespiratory function (i.e., VO2max)
# and daily minutes of moderate to vigorous physical activity (MVPA).

data(NHANES)
formula <- aee(ID, Day, mvpaMinutes) ~ VO2max
# Standard errors are obtained using sandwich estimation
fitted <- aeexfit(formula = formula, data = NHANES, se = "Sandwich")
summary(fitted)

## End(Not run)
```
Fits semiparametric regression models for irregularly observed physical activity data

Description

Fits semiparametric regression models for irregularly observed physical activity data under conditional independent censoring

Usage

`aeefit(formula, data, weight, se, control=list(), boot)`

Arguments

- `formula`: A formula object as returned by `aee`.
- `data`: A data frame which includes individuals' ID, observation times, and minutes of physical activity since the last observation time.
- `weight`: A vector of sampling weights, for each individual. By default, no sampling weights are applied.
- `se`: The method of estimating standard errors can be chosen by the argument `se`. Two options are available: i) the sandwich estimation (se = 'Sandwich'), or ii) the bootstrap procedure (se = 'Bootstrap').
- `control`: A list of control parameters. See 'Details'.
- `boot`: The number of resamples generated for the bootstrap procedure.

Details

The control argument is a list that can supply any of the following components:

- `betaInit`: Initial value for covariate coefficient, default is 0.
- `interval`: Initial search interval for solving beta. Default is (-5,5).
- `maxIter`: Maximum iterations allowed. Default is 150.
- `absTol`: Absolute tolerance. Default is 1e-6.
- `relTol`: Relative tolerance. Default is 1e-6.
- `a`: A tune parameter. Default is .1. In case of gamma frailty, "a" corresponds to the value of both shape and rate parameters.

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>
References


Examples

## Not run:
data(NHANES)
# Example of analyzing NHANES data
# Example 1: Not adjusted for sampling weights
nhanesToFit <- NHANES[ which(NHANES$mvpaMinutes!=0), ]
formula <- aee(ID, Day, mvpaMinutes) ~ Age+raceBi+VO2max+Gender
fitted1 <- aeeefit(formula=formula, data=nhanesToFit)
summary(fitted1)
## End(Not run)

---

**aeexfit**

Fits semiparametric regression models robust to informative observation times and censoring

---

**Description**

Fits semiparametric regression models robust to informative observation times and censoring

**Usage**

```r
aeexfit(formula, data, weight, se, control=list(), boot)
```

**Arguments**

- **formula**: A formula object as returned by `aee`.
- **data**: A data frame which includes individuals’ ID, observation times, and minutes of physical activity since the last observation time.
- **weight**: A vector of sampling weights, for each individual. By default, no sampling weights are applied.
- **se**: The method of estimating standard errors can be chosen by the argument `se`. Two options are available: i) the sandwich estimation (`se = 'Sandwich'`), or ii) the bootstrap procedure (`se = 'Bootstrap'`).
- **control**: A list of control parameters. See 'Details'.
- **boot**: The number of resamples generated for the bootstrap procedure.
The control argument is a list that can supply any of the following components:

- `betaInit`: Initial value for covariate coefficient, default is 0.
- `interval`: Initial search interval for solving beta. Default is (-5,5).
- `maxIter`: Maximum iterations allowed. Default is 150.
- `absTol`: Absolute tolerance. Default is 1e-6.
- `relTol`: Relative tolerance. Default is 1e-6.
- `a`: A tune parameter. Default is .1. In case of gamma frailty, "a" corresponds to the value of both shape and rate parameters.

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

References


Examples

```r
## Not run:

data(NHANES)
formula <- aee(ID, Day, mvpaMinutes) ~ VO2max
# Standard errors are obtained using sandwich estimation
fitted <- aeexfit(formula = formula, data = NHANES, se = "Sandwich")
summary(fitted)

## End(Not run)
```

Aggregates multiple accelerometer summary files

Aggregates multiple accelerometer summary files (e.g. summary files for multiple individuals) by day. This function can be used in sequence with readRawBatch and accBatch.

Usage

`aggAcc(path)`
NHANES

Description

NHANES 2003 data

Usage

data(NHANES)

Format

A data frame with 19323 rows and 11 variables. This consists physical activity data for 2763 individuals.

Details

- ID: Individual’s ID
- Day: Order of the seven day measurement period 1-7.
- SedentaryMinutes: Sedentary minutes per day in 10 minute bouts.
- numberOfBoutsSed: Number of sedentary bouts per day in 10 minute bouts.
- mvpaMinutes: Minutes of moderate to vigorous physical activity per day in 10 minute bouts.
- numberOfBoutsMVPA: Number of moderate to vigorous physical activity bouts per day in 10 minute bouts.
- wearTime: Wear time per day.
- Gender: Participant’s gender.
- Age: Participant’s age.
- VO2max: Participant’s V02max at baseline.
- raceBI: Participant’s race (white=1, otherwise=0).

---

**plotAcc**

Plots accelerometer data. This function receives summary object from function accsummary.

**Usage**

```r
plotAcc(object, markbouts)
```

**Arguments**

- `object`: An object returned from either the function accsummary.
- `markbouts`: Whether to mark bouts. If `markbouts`='TRUE' a bar along the time axis will indicate whether the epoch was counted as in bout or not. Default is false.

**Value**

A plot is returned.

**Author(s)**

Jaejoon Song <jjsong2@mdanderson.org>

**Examples**

```r
## Not run:

## Example: Simulate a dataset for two days, for an individual with low MVPA level.
##
mvpaLowData <- simAcc(timelength=(60*24*2), paLevel='low')
summary <- accSummary(data=mvpaLowData)
summary$validDates
plotAcc(summary, markbouts='FALSE')

## Example: Simulate a dataset for two days, for an individual with moderate MVPA level.
```
mvpaModData <- simAcc(timelength=(60*24*2),paLevel='moderate')
summary <- accSummary(data=mvpaModData, tri='FALSE', axis=NULL,
spuriousDef=20, nonwearDef=60, minWear=600,
patype='MVPA', pacut=c(1952,Inf), boutsize=10,
tolerance='TRUE', returnbout='TRUE')

summary$validDates
plotAcc(summary, markbouts='FALSE')

mvpaHighData <- simAcc(timelength=(60*24*2), paLevel='high')
summary <- accSummary(data=mvpaHighData, tri='FALSE', axis=NULL,
spuriousDef=20, nonwearDef=60, minWear=600,
patype='MVPA', pacut=c(1952,Inf), boutsize=10,
tolerance='TRUE', returnbout='TRUE')

summary$validDates
plotAcc(summary, markbouts='FALSE')

library(acc)
library(mhsmm)

# Example: Simulate a tri-axial dataset for five days.

J <- 3; initial <- rep(1/J, J)
P <- matrix(rep(NA,9), byrow=TRUE, nrow=J)
P1 <- matrix(c(0.95, 0.04, 0.01,
             0.09, 0.9, 0.01,
             0.1, 0.2, 0.7), byrow=TRUE, nrow=J)

b <- list(mu = c(0, 30, 2500), sigma = c(0, 30, 1000))

model1 <- hmmspec(init = initial, trans = P1, parms.emis = b, dens.emis = dnorm.hsmm)
x <- simulate.hmmspec(model1, nsim = (minutes), seed = seedset, rand.emis = rnorm.hsmm)

seedset=12345
P2 <- matrix(c(0.95, 0.04, 0.01,
             0.09, 0.8, 0.11,
             0.1, 0.1, 0.8), byrow=TRUE, nrow=J)

model2 <- hmmspec(init = initial, trans = P2, parms.emis = b, dens.emis = dnorm.hsmm)
y <- simulate.hmmspec(model2, nsim = (minutes), seed = seedset, rand.emis = rnorm.hsmm)

seedset=123456
P3 <- matrix(c(0.95, 0.04, 0.01,
             0.09, 0.8, 0.11,
             0.1, 0.1, 0.8), byrow=TRUE, nrow=J)

model3 <- hmmspec(init = initial, trans = P3, parms.emis = b, dens.emis = dnorm.hsmm)
z <- simulate.hmmspec(model3, nsim = (minutes), seed = seedset, rand.emis = rnorm.hsmm)
counts <- data.frame(TimeStamp = randomTime[1:minutes], x=x$x, y=y$x, z=z$x)
summary <- accSummary(data=counts, tri='TRUE', axis='vm',
  spuriousDef=20, nonwearDef=60, minWear=600,
  patype='MVPA', pacut=c(1952,Inf), boutsize=10, tolerance='TRUE',
  returnbout='TRUE')
summary$validDates
plotAcc(summary, markbouts='FALSE')

## End(Not run)

racePlot

Race plots of minutes of activity per day

Description

Race plots of minutes of activity per day, for several activity types

Usage

racePlot(summary, title, cex.title, cex.text, cex.center, color)

Arguments

summary An object returned from function acc.
title Title of the plot
cex.title Font size of the title
cex.text Font size of the race track labels
cex.center Font size of the day indicator in the center of the plot
color Color of the race tracks

Value

A plot is returned.

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>
Examples

```r
## Not run:
library(acc)
##
## Example: Simulate a dataset for seven days, for an individual with low MVPA level.
##
mvpaModData <- simAcc(timelength=(60*24*7),paLevel='moderate')

summary1 <- acc(data=mvpaModData, tri='FALSE',
                 axis=NULL, spuriousDef=20, nonwearDef=600, epoch=c('1 min','1 min'),
                 patype=c('Sedentary','MVPA'), pacut=c(c(0,99),c(1952,Inf)),
                 boutsize=c(10,10), tolerance=c('FALSE','TRUE'))

summary1

racePlot(summary1,title="Summary of Physical Activity Per Day",
cex.title=1,cex.text=1.2)

## End(Not run)
```

readCounts

Reads counts data in .dat, .agd, or .csv format for Actigraph GT1M and GT3X devices

Description

Reads counts data in .dat, .agd, or .csv format for Actigraph GT1M and GT3X devices. Device type and epoch is automatically detected and reported in the console.

Usage

readCounts(filename)

Arguments

filename  Spficy full file path and file name. e.g. C:/mydata.dat or C:/mydata.csv

Value

For uni-axial accelerometer (GT1M), two columns are returned, consisting of: [TimeStamp,Counts]
For tri-axial accelerometer (GT3X), four columns are returned, consisting of: [TimeStamp,x,y,z]

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>
Examples

##
## A example to read counts data
##
## Not run:
accData1 <- readCounts("C:/mydata.agd")
accData1 <- readCounts("C:/mydata.dat")
accData2 <- readCounts("C:/mydata.csv")
## End(Not run)

readCountsBatch

Reads multiple accelerometer counts data in a folder

Description

Reads multiple accelerometer counts data in a folder. This is a batch mode of the readCounts function.

Usage

readCountsBatch(path,filetype)

Arguments

path
Path to a folder which contains accelerometer counts data in .dat or .csv format.

filetype
Specify whether the data to read is in dat or csv format. Options are either 'dat' or 'csv'. For example if filetype = 'csv' is specified, all csv data will be read and all other types in the same folder will be ignored. By default, it is assumed that all files in the specified path are either csv or dat files and are intended to be read.

Value

A folder 'readfiles' is created inside the specified 'path'. In the folder, files are saved by the same filenames as in the raw data.

For uni-axial accelerometer (GT1M), two columns are returned, consisting of: [TimeStamp,Counts]
For tri-axial accelerometer (GT3X), four columns are returned, consisting of: [TimeStamp,x,y,z]

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>
Examples

```r
## Example
##
## filepath to locate the activity counts data files
## Not run:
mypath <- "C:/Accelerometry files"
readCountsBatch(mypath,filetype='csv')
## End(Not run)
```

readRaw

Reads raw data in .csv format for GT3X devices

Description

Reads raw data in .csv format for Actigraph GT3X devices. Device type and epoch is automatically
detected and reported in the console. Marks activity intensity based on two existing methods.

Usage

```r
readRaw(filepath,type,resting)
```

Arguments

- **filepath** Specify full file path and file name. (e.g. 'C:/mydata.csv')
- **type** Specify how activity intensity is identified. Options: i) ‘mad’ for Vaha-Ypya
  method, ii) ‘ai’ for Bai et al.’s method, or iii) ‘resting’ to calculate resting state
  intensity level required for Bai’s method.
- **resting** Resting state intensity level, required for Bai et al.’s method.

Value

If the option ‘type’ is ‘mad’ or ‘ai’, five columns are returned, consisting of first four columns
[TimeStamp,x,y,z], and the intensity category/level. If the option ‘type’ is ‘resting’ then a vector of
resting state intensity level is returned.

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>
Examples

## A example to read counts data
## Not run:
# For Vaha-Ypya et al.'s method
accData1 <- readRaw("C:/mydata.csv",type='mad')
# For Bai et al.'s method with known resting state intensities
accData2 <- readRaw("C:/mydata.csv",type='ai',resting=c(.15,.16,.17))
# Calculating resting state intensity for Bai et al.'s method
restingIntensity <- readRaw("C:/mydata.csv",type='resting')
accData3 <- readRaw("C:/mydata.csv",type='ai',resting=restingIntensity)
## End(Not run)

simAcc

Simulates accelerometer data based on a hidden Markov model

Description

Simulates accelerometer data. The simulation function is based on a hidden Markov model, as described in the example for function acc. This function is provided for convenience to generate data from a pre-specified transition probabilities to mimic activity levels of low, moderate and high. To generate data from a specific transition probabilities and distributions, please refer to the example for function acc.

Usage

simAcc(timelength,paLevel,epoch,startDate,endDate,
       mu,sigma,seedset,tpm)

Arguments

timelength Number of observations to be generated.
paLevel Pre-specified levels of physical activity for convenience. User can specify all parameter as preferred, by stating the option as paLevel=NULL. Default is 'moderate'. Options: 1) 'low', 'moderate', or 'high'. Low specifies a hidden markov model with transition probabilities 0.95, 0.04, 0.01, 0.09, 0.9, 0.01, 0.1, 0.2, 0.7, respectively for P11, P12, P13, P21, P22, P23, P31, P32, P33, respectively. Moderate specifies a hidden markov model with transition probabilities 0.95, 0.04, 0.01, 0.09, 0.8, 0.11, 0.1, 0.1, 0.8 respectively for P11, P12, P13, P21, P22, P23, P31, P32, P33, respectively. High specifies a hidden markov model with transition probabilities 0.95, 0.04, 0.01, 0.09, 0.7, 0.21, 0.1, 0.1, 0.8, respectively for P11, P12, P13, P21, P22, P23, P31, P32, P33, respectively. For all levels, it is assumed that the activity intensities are realized from a mixture
of two normal distributions (for sedentary activity and mvpa) and a constant at zero (for non-wear time), with means $\mu = c(0, 30, 2500)$ and variance $\sigma = c(0, 30, 1000)$.

**epoch**  
Epoch size. User can specify desired epoch size in units of time larger than seconds. Defaults to 1 minute epoch.

**startDate**  
Start date in ISOdate format. For example ISOdate(2017,1,1,hour=0,min=0,sec=0,tz="GMT").

**endDate**  
End date in ISOdate format. For example ISOdate(2017,1,1,hour=0,min=0,sec=0,tz="GMT").

**mu**  
Mean levels for each activity type.

**sigma**  
Standard deviations for each activity type.

**seedset**  
Sets seed for random data generation. Defaults to 1234.

**tpm**  
Transition probability matrix that specify probability of change from one activity state to another.

**Value**

A simulated dataset is returned with two columns: [TimeStamp, counts]

**Author(s)**

Jaejoon Song <jjsong2@mdanderson.org>

**Examples**

```r
## Not run:
##
## Example: Simulate a dataset for two days, for an individual with low activity level.
##
mvpaLowData <- simAcc(timelength=(60*24*2), paLevel='low')
summary <- acc(data=mvpaLowData, tri='FALSE', axis=NULL,
               spuriousDef=20, nonwearDef=60, minWear=600,
               patype=c('Sedentary', 'MVPA'), pacut=c(c(0,99),c(1952,Inf)),
               boutsize=c(10,10), tolerance=c('FALSE','TRUE'))
summary

##
## Example: Simulate a dataset for two days, for an individual with moderate activity level.
##
mvpaLowData <- simAcc(timelength=(60*24*2), paLevel='moderate')
summary <- acc(data=mvpaLowData, tri='FALSE', axis=NULL,
               spuriousDef=20, nonwearDef=60, minWear=600,
               patype=c('Sedentary', 'MVPA'), pacut=c(c(0,99),c(1952,Inf)),
               boutsize=c(10,10), tolerance=c('FALSE','TRUE'))
summary

##
## Example: Simulate a dataset for two days, for an individual with high activity level.
##
mvpaLowData <- simAcc(timelength=(60*24*2), paLevel='high')
summary <- acc(data=mvpaLowData, tri='FALSE', axis=NULL,
               spuriousDef=20, nonwearDef=60, minWear=600,
               patype=c('Sedentary', 'MVPA'), pacut=c(c(0,99),c(1952,Inf)),
               boutsize=c(10,10), tolerance=c('FALSE','TRUE'))
summary
```
spuriousDef=20, nonwearDef=60, minWear=600,
pctype=c('Sedentary','MVPA'), pacut=c(c(0.99),c(1952,Inf)),
boutsize=c(10,10), tolerance=c('FALSE','TRUE'))

summary

## End(Not run)

simPA Simulates minutes of physical activity per day

Description
Simulates minutes of physical activity per day with realistic missing data patterns

Usage
simPA(n, type, beta, minday, maxday)

Arguments
n Number of individuals in the simulated data.
type Whether to simulate data from informative/non-informative observation/censoring patterns. Options: i) 'inf', ii) 'noninf'.
beta True coefficient for the binary covariate.
minday Minimum number of observation days.
maxday Maximum number of observation days.

Value
A simulated dataset is returned with four columns: [ID, day, min, x1, z].

Author(s)
Jaejoon Song <jjsong2@mdanderson.org>

Examples
##
## Simulating data for a single individual
## with noninformative observation patterns
##
simdata <- simPA(n=1, beta=1.5, type='noninf', minday=6, maxday=7)
Description

Prints estimated parameters for `aeefit` object

Usage

```r
## S3 method for class 'aeefit'
summary(object, digits = 3, dig.tst = 2, ...)
```

Arguments

- `object`: A `aeefit` object
- `digits`: Minimum number of significant digits to be used for most numbers.
- `dig.tst`: Minimum number of significant digits for the test statistics
- `...`: ...

Value

Estimated parameters for `aeefit` objects

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

Examples

```r
##Will put an example here
```
Arguments

- **object**: A aeexfit object
- **digits**: Minimum number of significant digits to be used for most numbers.
- **dig.tst**: Minimum number of significant digits for the test statistics
- ...

Value

Estimated parameters for aeefit objects

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

Examples

```r
##Will put an example here
```

---

**visGroup**

*Group level plots*

Description

Group level plots of minutes of activity per day

Usage

```r
visGroup(data, ID, activity, type, title, yaxis, xaxis, time, legendTitle, 
          groupBy, groupFun, levels, heatcol)
```

Arguments

- **data**: Summary data by day
- **ID**: Name of column that identifies groups or individuals
- **activity**: Name of column for activity to be plotted
- **type**: Type of plot. Options 'boxplot' or 'heatmap'
- **title**: Title of the plot
- **yaxis**: Axis title for vertical axis
- **xaxis**: Whether to print the x axis label. Options are TRUE or FALSE
- **time**: Name of column that contains time index
- **legendTitle**: Title of legend for 'type=heatmap'
- **groupBy**: Option to plot by group, for 'type=heatmap'
groupFun If groupBy is specified, how are two groups defined? Provide a function to specify a statistic that divides the groups. For example, specify 'median' to divide the two groups by the overall median of the data.

levels Specifies thresholds for heatmap. For example, user can specify 'levels = c(0,300,600,1440)' to plot a heatmap of four levels.

heatcol Specifies colors for the heatmap.

Value

A plot is returned.

Author(s)

Jaejoon Song <jjsong2@mdanderson.org>

Examples

```r
## Example: A box plot
## Not run:
library(acc)
data(NHANES)
NHANES_subset <- NHANES[1:300,]
visGroup(
data = NHANES_subset,
activity = 'wearTime',
ID = 'ID',
type = 'boxplot',
title = "Wear time at baseline",
yaxis = "Wear time (minutes per day)",xaxis=TRUE)

## Example: A heatmap
##
## Not run:
library(acc)
data(NHANES)
NHANES_subset <- NHANES[1:1000,]
visGroup(
data = NHANES_subset,
ID = 'ID',activity = 'wearTime',
type = 'heatmap',title = "Wear time at baseline",
yaxis = "ID",time = 'Day',
legendTitle = "Wear time",
groupBy = 'VO2max',groupFun = 'median',
levels = c(0,300,600,1440),
heatcol = c("white","mistyrose","lightpink","violetred1"))

## End(Not run)
```
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